Sovereignty in Defence Industry: from policy to capability

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Acknowledgements

I have been involved in defence and the defence industry my entire working life, initially as an Anti-Submarine Warfare (ASW) officer in the Royal Australian Navy (RAN) and subsequently in a variety of positions across a variety of defence companies. These companies extended from the extremely small, such as working for myself for five years after leaving the Navy in 1994, to a period with a United States multinational that employed over 100,000 persons globally. Whilst these experiences developed an interest in the strategic aspects of defence and defence industry it was a period managing a defence industry association that initiated an interest in sovereignty, and in the application of sovereignty, or rather the perceived lack of sovereignty, in the Australian defence industry. In particular, it was the realisation that very little of Australian defence industry was actually owned, operated, and controlled by Australian interests, that almost miniscule amounts were contracted directly to these companies by the Department of Defence, and therefore that the domestic defence industry existed primarily in a sub-contracting arrangement to overseas interests. It was also somewhat perplexing that nobody seemed to care about the vulnerabilities that could potentially arise from this situation.

Since the commencement of this research, the word *sovereignty* has entered Australian defence commentary on an almost daily basis. Unfortunately, this repeated use, often in conjunction with activities that just occur within Australia's borders, rather than being associated with any ability to control, has diminished the impact and the importance of what sovereignty is, what it means, and what it entails. Hopefully this research will redress that balance and stimulate a wider debate.

I had considered undertaking a PhD some years previously, but in early 2015 I met with Admiral (retired) Chris Barrie at the Australian National University to discuss an idea that I had for a PhD topic. As a young naval Lieutenant, I had worked for Chris, then a Commander, at the RAN Tactical School at HMAS WATSON and valued his insights and his opinions. I remember the 2015 meeting quite clearly. After I had laid out my (somewhat incomplete) thinking he stated "we need that work done. I will speak to some people here at the University about it". And that was that. My foot was on the conveyor belt and events developed thereafter. I have previously jokingly said to Chris that he is responsible for this work, but in large part he is – and I thank him quite sincerely for his input and his ongoing support.

I would also like to thank my supervisors for their insights and their guidance on the development of this research. Professor Stephan Frühling has showed significant patience and support in the formation of the question and in keeping me on track. Dr Andrew Carr and Dr Richard Brabin-Smith have provided extremely valuable feedback through the entire process. As a previous Chief Defence Scientist, Richard's insights into the technological development of complex military systems, both in Australia and overseas, has been particularly illuminating.

Dr Robert Wylie at the University of New Wales Canberra also provided an early sounding-board on the potential topic. His feedback was very useful, and I thank him for his ready and open engagement.

My thanks also go to all the interviewees for this research, in Australia, the United Kingdom, and in Sweden. With only a single exception, persons involved in defence industry, with submarines, and with the development and implementation of defence policy who have been approached for interview have readily agreed. In many cases this has included short notice follow-up questions, and I thank all those involved for their time, their insights, and their support.

I would also like to express my thanks to Mika Ihalainen, the Defence Attache Australia and New Zealand at the Swedish Embassy in Canberra during the period of the development of this research for his repeated support in organising meetings with Swedish military and FMV personnel visiting Australia. These meetings were invaluable, particularly given the later inability to travel to Sweden for interviews due to COVID-19 restrictions and the closure of international borders.

Finally, and far and away most importantly, has been the support and forbearance of my family. This has been long journey, and at many times throughout my mind has been on this topic and not on important family matters. The patience and forbearance of my wife, Ann Marie, in sometimes challenging situations has been ongoing and unwavering, and I thank her, and love her, deeply for this.

Abstract

The development and maintenance of the military force of a state reflects many inputs and constraints. Choices are made regarding whether to develop and manufacture military systems domestically, whether to simply procure such systems and support from a foreign supplier, or whether to adopt a path somewhere between these two extremes.

Decisions taken by governments regarding military capability also involve consideration of the operational advantage with respect to a potential threat that the government may wish the force to have, and for the ability of the state to use its military force as, when, where, and for the period that may be required; that is, freedom of action. These decisions impact on the level of sovereignty that the state seeks to have in the operational utilisation of its military forces and, by extension, in the sovereignty within its domestic defence industry. This thesis has addressed these issues through investigation of the following question: *How well do states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level?*

The thesis has investigated the question through consideration of seven issues that develop from a decomposition of the question, namely sovereignty, policy, capability, sovereignty outcomes, mechanism for translation, measurement of translation, and wellness. Capability has been considered in terms of a major military system, the submarine, with the mechanism for the translation of sovereignty notions to sovereignty outcomes considered as the defence industry that develops and supports that submarine.

The importance of the ability to exercise control over industrial activities, and the components that impact upon the ability to control, is identified, together with the relationships between those components. Frameworks that categorise the ability to exercise control, and which link sovereignty in policy to sovereignty over capability are developed.

Innovative circumplex diagrams, a Sovereignty Diagnostic, are used to depict the ability to control, and the level of operational and defence industry sovereignty that develops from that control. The final issue, wellness, is determined from the comparison of the desired and realised levels of sovereignty from the Sovereignty Diagnostic.

Case studies in Australia, Sweden, and the United Kingdom have been developed to investigate the thesis question. The case studies cover the time leading up to the end of the Cold War to contemporary events. The focus of the case studies is on the policy intent for the state’s submarine

capability over that period, and the ability of the state to control the industrial processes associated with the acquisition and sustainment.

The thesis has shown that the Sovereignty Diagnostic is a valid means through which to consider sovereignty ambition as expressed in defence policy and that manifested at the capability level. The thesis will also show that access to intellectual property, and the capability and capacity within both defence industry and the government client are critical elements in the ability to exercise control, and hence in having operational and defence industry sovereignty.

The research has shown that states largely achieve what they aim to do with respect to translating policy into capability but, in some cases, this can be a result of having relatively low policy ambitions for operational and defence industry sovereignty. The thesis has also highlighted that the ability to design is a key point of difference in both aspirations for operational and defence industry sovereignty, and for the realisation of sovereignty at the capability level. The Swedish and the United Kingdom cases are examples where these factors correlate. The Australian case study, in contrast, where the ability to design does not exist, shows stark differences in policy ambition and in sovereignty at the capability level.

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1 - Introduction

Good ends, as I have frequently to point out, can be achieved only by the employment of appropriate means. The end cannot justify the means, for the simple and obvious reason that the means employed determine the nature of the ends produced.

— **Aldous Huxley**

Introduction

The development and maintenance of the military force structure of a state reflects many inputs and constraints. Inputs include the strategic ambition of the government, and the assessed threats and risks associated with the attainment of that ambition. Constraints develop though the level of the ongoing investment that is required, and the legacy effects of the force-in-being at any point in time. Decisions regarding force structure are therefore a trade-off between the government's strategic ambition and the costs associated with those ambitions.

As most states cannot afford to develop their military forces solely from domestic sources and resources, choices need to be made regarding how these systems are to be acquired, operated, and maintained. These choices are inevitably complex and include whether to develop and manufacture military systems domestically, whether to simply procure such systems and support from a foreign supplier, or whether to adopt a path somewhere between these two extremes.

Decisions taken by governments regarding military capability will also inevitably involve consideration of the operational advantage with respect to a potential threat that the government may wish the force to have, and for the ability of the state to use its military force as, when, where, and for the period that may be required; that is, freedom of action. These decisions impact on the level of sovereignty that the state may seek to have in the operational utilisation of its military forces and, by extension, in the sovereignty within its domestic defence industry. This thesis examines this issue through investigation of the following question: *How well do states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level?*

The thesis question raises seven issues for consideration. These issues are sovereignty, policy, capability, sovereignty outcomes, mechanism for translation, measurement of translation, and wellness. Each of these is covered below, and collectively provide a pathway by which the answer to the question has been obtained.

Sovereignty

The first issue for consideration concerns sovereignty itself. As will be seen in the next chapter, state sovereignty has value. The aspect of value imparts a duality to that sovereignty: able to be used as a commodity to acquire a benefit, but also a liability requiring protection. Decisions associated with protection revolve around the level of investment that the state is willing to make to address that protection. These decisions typically involve considerations of the development and utilisation of a military force, and the level of control that the state has, or wishes to have, over its choices.

The thesis will also examine different forms of sovereignty, principally operational sovereignty and defence industry sovereignty, and how these relate to each other and to state sovereignty. Given that control is a fundamental component of sovereignty (Krasner, 1995, 1997, 1999; Waltz, 2010; Wellings, 2018), consideration of the ability to control will be important in examining the relationship between the different forms of sovereignty, and the aspirations and achievement of these. Frameworks to categorise levels of control will be introduced in the following chapters as the basis for discussion later in the thesis.

Policy

The second issue addresses policy and covers two key questions for this thesis. The first is what, and how, notions of sovereignty are expressed in policy. The second is what factors are important for the implementation of policy.

Given that policy is 'a purposeful synthesis of ends, ways and means' (Wylie, 2007: 54), where 'ends' comprise the choices made by decision makers, 'ways' constitute the institutions and processes available for use in achieving policy ends, and 'means' are the allocated resources, defence policy is constructed with one eye on interests and objectives and the other on whether the pursuit of such objectives is realistic when considering the level of investment required. How closely the two can be aligned depends in turn on the level of risk that the state may be willing to accept. A widely-held view with respect to military capability also holds that some capabilities need to be developed within the state, and supported by government, as these have been recognised as being critical for military success (Defence, 2010a, 2016a, 2018; MOD UK, 2005, 2012; Jenkins, 2013; Kurc, 2017; Jong, 2014; India Indigenisation, 2015; Bitzinger, 2015a, 2011). Conversely, the absence of such domestically-available and domestically-controlled industrial capabilities will raise risks with respect to the ability of military forces to successfully undertake their assigned roles and tasks. The way that the state addresses these risks is often expressed in policy.

The development of policy is a forward-looking activity that seeks to 'influence, change, or frame a problem or issue that has been recognised as being in the political realm' (Hassel, 2015: 569), but is of 'little worth if it is not implemented successfully or properly' (Khan, 2016: 1). Implementation, in turn, has been described as 'a series of activities undertaken … to achieve the goals and objectives articulated in policy statements' (Bullock and Lavis, 2019: 1), and depends upon decisions taken during the life of that policy. As elements of a state's military force structure may remain in service for many decades, decisions regarding the development of a military force may have long term consequences. Moreover, the state will face constraints in the development of defence policy due to the existing force. That is, policy cannot be developed from a clean sheet of paper and will be impacted by previous policies, previous decisions, and previous developments. The thesis has addressed this issue through the consideration of both the extant and earlier policies rather than just though a time-restricted snapshot.

Capability

The third issue is associated with 'capability'. In the United Kingdom (DCDC, 2014) and in New Zealand (HQNZDF, 2017), capability is discussed in terms of fighting power with conceptual, moral and physical components. Australian defence planning addresses capability through the concept of separate Fundamental Inputs to Capability (FICs) that 'combine to achieve capability' (Defence, 2016a: 19), namely personnel, organisation, collective training, major systems, supplies, facilities and training areas, support, command and management, and industry (Defence, 2016a, 2016b). A mapping of the separate Australian, New Zealand and United Kingdom descriptions results in a common descriptive basis, and the Australian approach has therefore been adopted for further discussion.

For simplicity, the nine FIC as described above (Defence, 2014, 2016a, 2016b) can be grouped in a reduced set of four for the consideration of sovereignty. 'Major systems' form the first group. Once acquired, the major system is totally within the ownership of the state and the state has control over its potential use. 'Organisation and command' is the second group. These structures are a manifestation of the manner in which the state seeks to organise, manage and utilise its military forces, and as there are no implications of foreign involvement, there are no broader sovereignty implications. Developments in Europe with the integration of military structures across national borders provide instances where organisation and command do have sovereignty implications, the integration of German and Dutch tank units (Bennhold, 2019) and the integration of elements of the militaries of the Czech Republic and Romania into the Bundeswehr (Braw, 2017) are examples, but these implementations are outside the scope of this thesis and can be ignored. 'Personnel and associated training' comprise the third group. As personnel associated with the military organisation will typically be residents of the state, they can be considered a sovereign asset of the state. The exception for this group is that some training regimes and associated facilities may be provided by, and hence under the control of, other actors, most likely allies or otherwise aligned partners. The termination of such external training arrangements may impact on the effective utilisation of a capability but will not minimise the ability for state control of that capability. Personnel and associated training can therefore be ignored as having any sovereignty impact on the capability.

The fourth group, 'defence industry', is required to develop, deliver, support, and prepare military systems, the organisation, and the personnel at all levels and, given the international nature of the global defence industry, is unlikely to be completely under the control of a single state. Unlike the elements of personnel and associated training that may reside outside the state, elements of defence industry external to the state cannot be easily repatriated. Of the nine FIC defined by the Australian Department of Defence, defence industry is therefore the only one with a material impact on operational sovereignty, with this impact being manifested in the acquisition and use of major systems.

Consideration of capability in this way therefore impacts on the selection of cases through which the question has been examined. A single military system is the selected level of analysis as examining an entire force structure is not viable for the following reasons. First, operational complexities particularly in the area of communications and networking, and the utilisation of both military and civil systems, mitigate against addressing the force structure as a single entity. The typical approach to the analysis and discussion of military force structures is therefore to utilise a force element and class breakdown (CBO, 2021, 2016; Defence, 2016b, 2020b, HM Government, 2010; Sweden MOD, 2015). Second, the configuration of the elements and classes within the force structures of different states differs, and it is therefore difficult to directly compare one force element with another. Third, and pragmatically for this thesis, the task of analysing and comparing the complete force structures, or the elements thereof, of multiple states would be an extremely large and complex task. A single military system therefore provides a better level of analysis.

The submarine has been selected as the single military system for this research as it has defining features that make it a useful focus for the proposed approach. Firstly, the submarine, either the nuclear-powered attack submarine (SSN) or the conventional equivalent (SSK), is a common feature across the force structure of many countries, thereby providing alternatives for the selection of the cases. Second, the employment options for the SSN and SSK are fundamentally similar for all states that operate them: intelligence, surveillance and reconnaissance (ISR), strike, interdiction of shipping, insertion of special forces, anti-submarine warfare (ASW), and minelaying (Bateman, 2011; Hennessy and Jinks, 2015). Third, modern warfare is typically highly networked. Military systems are connected in real time or are reliant on information provided by other systems to an extent that it makes it difficult to neatly bound the capability inherent in most military systems. The need for stealth dictates that attack submarines operate largely outside the communication networks of military forces, thereby providing a simple means through which to bound the investigation. Fourth, the operational effects delivered by the submarine are essentially unique and cannot be delivered or achieved through the utilisation of some other capability. Lastly, and unequivocally, submarines provide governments with operational choices and play a critical role in the mitigation of strategic risk. As a valuable, common and stand-alone capability, the submarine is ideal to explore the thesis question of how well do states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level.

Sovereignty outcomes

The fourth issue centres on what are the 'sovereignty outcomes'. The thesis addresses these as the degree to which the state can independently address 'operational advantage' and 'freedom of action'. In accordance with the descriptions used by the United Kingdom (UK) Ministry of Defence (MOD) (2005), 'operational advantage' addresses operations in the face of an adversary and has a significant technological aspect. 'Freedom of action' addresses the ability to operate as, when, where, and for the period required and is therefore largely associated with the security of supply.

Collectively the two concepts address 'operational sovereignty', with the MOD UK having stated that the aim of operational sovereignty is to contribute to a 'coherent operational effect that is intended to overmatch the adversary and which may be delivered and maintained where and when it is required' (MOD UK, 2016: 1). Chapter 3 will show that operational advantage is associated with operations against a potential adversary and, while manifested through the employment of a military system, exists predominantly at the sub-system level. Freedom of action will be seen to face the supply and support organisations and, although impacted by sub-systems, can only exist at the all-of-system level.

Mechanism for translation from policy to capability

In a general sense, governments in western democracies no longer directly produce the systems upon which their military capability rests. Defence industry, and the industrial activities undertaken by that industry, is therefore critical in the acquisition and sustainment of military systems and is the mechanism through which the translation from policy to capability occurs. The extent to which the state can control the development and employment of its military systems, the level of operational sovereignty that it possesses, is therefore strongly influenced by the extent to which it can control activities within defence industry. Given the central position of industry in addressing the thesis question, the following subsidiary questions are also important. What is defence industry? Is it separate from other industrial activities? Is it possible to consider policy with respect to defence industry separate from other industrial considerations? Is the structure of the defence industry important?

Defence industry as separate from the national industry is evident in that defence forces rely upon military-specific systems, products, and services for which there is no civilian equivalent use. Heidenkamp, Louth and Taylor (2013) have categorised defence industry as those systems and services specifically developed for defence, and have also distinguished defence industry from the broader industry base in the concept of the Defence Industrial Triptych, where the government is simultaneously the customer, the sponsor and the regulator of industrial activity. Watts and Harrison have made similar observations with respect to the United States defence industry, noting that 'one of the most striking differences between the defense industry and the rest of the U.S. economy was that the U.S. government is ultimately a single buyer' (2011: 15). The Australian Defence Industrial Capability Plan (DICP) also recognises the distinction of defence and non-defence industrial activity in the description of the former as those businesses that 'are providing or have the capacity to provide defence specific or dual-use goods and services' (Defence, 2018a: 11).

For this thesis defence industry is considered as being associated with the development and provision of military systems or related military-specific services for defence purposes. Defence industry therefore does not extend to those aspects of industry where the defence force is just another customer and the products or services provided by that company are consumed by multiple clients within the broader economy. This categorisation of the defence industry is supported by the general description of the goods and services included within the defence industry sector provided by the European Commission (2009). As a result, defence industry and any defence industry policy is examined in isolation from broader national industry and industry considerations.

With respect to the importance of defence industry structure[1], in their various treatments of systems thinking, Senge (2006) and Hitchins (2000, 2007, 2009) have highlighted that a key characteristic of systems is that systemic structure influences behaviour. In this sense the relationship of defence industry structure to defence policy and defence industry policy is important as changes in that structure may impact on the attainment of policy goals. Given that governments in contemporary circumstances are unlikely to control how industry reacts to the policy stimuli it receives, the underlying structure of the domestic defence industry will be a factor in how any government intent for the development or sustainment of a military capability will be met. This aspect will be further developed in Chapter 3 and specific examples will be included in the case studies.

Three types of industrial entity relevant to the consideration of defence industry structure and sovereignty can be identified. The first is companies and government entities that both operate and are controlled from within the state: domestically operating, domestically controlled (DO-DC). These entities are characterised by local ownership, local decision-making, and the local retention of intellectual property. The DC-DO categorisation includes entities that are government owned and government operated (GO-GO). At the opposite end of the spectrum are companies that both undertake the relevant industrial activities and are controlled from foreign locations: foreign operating, foreign controlled (FO-FC). FO-FC companies are completely outside the jurisdiction of the state and the state therefore has no control. Between these two situations are entities that are the local manifestation of multi-national companies and conduct operations within the state but are subject to foreign decision-making and control: domestically operating, foreign controlled (DO-FC). Whilst the decision-making of DO-FC entities is ultimately exercised by the foreign parent, the state of residence does exercise a level of influence through local business, taxation, employment, and work-related legislation, through the terms and conditions in contracts, and through the behavioural and moral expectations of the host society (Fisher and Bonn, 2007). The combination of these three separate entities determines the structure of the domestic defence industry and is therefore, potentially, a factor in the way that states undertake the industrial activities to develop and maintain their military systems. The thesis will use these descriptions in the consideration of how defence industry structure has impacted upon the way in which notions of sovereignty in policy have translated into sovereignty outcomes at the capability level.

[1] Defence industry structure describes the ownership and control of the companies that comprise the defence industry.

Measurement of translation from policy to capability

The sixth issue with respect to the thesis question is how the translation from notions of sovereignty in defence policy to sovereignty outcomes in capability might be measured and, given that multiple states and capabilities might be involved, compared. However, the measurement of the operational elements of sovereignty, and defence industrial sovereignty, is not simple. The operational aspects of sovereignty could conceivably be measured through quantitative indicators such as operational days achieved, or dollars invested in particular capabilities, but each of these is linked to other indicators and requires the nature of each and every relationship, and the quanta of the impact of any one measure on the outcome, to be identified and defined. Berg and Kuusk (2010) have developed an approach for categorising sovereignty that assigns numerical measures to different aspects of sovereignty and provides an empirically-derived scale depicting the relativity of sovereignty between states. The model considers factors such as diplomatic relations, the membership of international organisations, the nature of the constitution and the monetary system, but does not cover the elements important for defence industry sovereignty and therefore is not suitable for this thesis.

A purely quantitative measure for sovereignty in defence industry is similarly complex, potentially addressing factors such as overall income for domestic companies, number of patent applications, persons employed, and the average time taken to develop new military systems, as well as the location and impact of skilling and facilities. An example of the extent of this particular problem is provided by the *Strategic Materials* report provided by the Dwight D. Eisenhower School for National Security and Resource Strategy (2016) that highlighted why materials may be strategic, discussed issues associated with security of supply for the ongoing development of defence systems, and was able to quantify the costs and holdings associated with various providers, but did not attempt to combine this single input with all the other inputs required to quantify defence industry sovereignty. The improbability of objectively developing a purely numerical scale for defence industry sovereignty is reinforced by commentators such as Krasner (1997, 1999, 2001, 2004) and Etzioni (2016) who have argued that sovereignty is not absolute. Moreover, as different states may have different classifications for similar aspects of their own capability and industry, issues in comparing one jurisdiction to another may arise under a quantitative approach. This thesis therefore recognises that defence industrial sovereignty is better addressed through qualitative measures that are able to highlight different levels of sovereignty as expressed in defence policy and realised in capability.

Given that, as highlighted earlier in this introduction, control is a fundamental component of sovereignty, translation from policy to capability can be addressed through the ambition for, and the realisation of, the level of control over the industrial activities associated with the acquisition and sustainment of a submarine. This qualitative approach can therefore be used to compare defence policy with capability, for the same capability over time, or between manifestations of the same capability in different jurisdictions.

The degree to which control is sought and achieved will be expressed in frameworks and graphically represented using circumplex diagrams to provide the basis for this comparison. The level of defence industry sovereignty will be determined from the manner in which control is represented in the circumplex diagrams. Whilst the presentation of information will be as the 'circular depiction of the similarities among multiple variables (APA, 2023), the thesis will utilise circumplex diagrams in an atypical, innovative manner. Whereas circumplex diagrams are widely used to depict two-dimensional data, for example Olson, Russell and Spenkle (1989), Posner, Russell and Peterson (2005), Olson (2000), and Jing, Mao and Chen (2019), this thesis will utilise circumplex diagrams to depict three-dimensional data through the application of colour to highlight different levels of control.

The frameworks, and the detailed construction of the circumplex diagrams are provided in Chapters 2 and 3. The circumplex diagram provides a Sovereignty Diagnostic which provides the basis of the universality of the approach, and the ability to compare sovereignty across states, across capabilities, and across time.

Wellness

The final issue is how to assess the "how well" aspect of the thesis question. The thesis addresses this point through a combination of prioritisation and comparison. The prioritisation aspect is developed in Chapter 3 and shows that some aspects of the submarine have more impact on operational success than others. A higher level of sovereignty may therefore be of more value in these aspects if independent industrial activity is sought and operational advantage is to be achieved. Comparison of the policy and capability circumplex diagrams are made to determine the degree of alignment between the two. Given that capability trails policy in time, that is positions announced in policy take time to manifest in capability and may persist long after other policy changes are made, these comparisons are made for capability against both the prevailing and earlier policies. The answer to the "how well" question is therefore illuminated by the alignment of the levels of control, and by extension the defence industry and operational sovereignty, represented in the circumplex diagrams.

Contribution to knowledge

Contribution to knowledge is a key element of any research project, including both in the development of theory and in production of new or refined models that enhance the understanding of an element (Edmondson and McManus, 2007; Timmermans and Travory, 2012; Blaikie, 2010). The current literature regarding defence industry typically focusses on industrial activity to the point of production and acquisition (Watts and Harrison, 2011; Hoff, 2007; Hayward, 2001; Brauer, 2007; Fevolden and Tvetbraten, 2016; Hartley, 2011). Other commentators, such as Bitzinger (2011, 2015a, 2015b, 2015c, 2017), Cheung (2016, 2017), Hartley (2008) and Jones (2006), have focused on the research and development end of the weapon system life cycle and the importance of innovation for the national development of military systems. In addition, both the concept and future development of sovereignty has been extensively discussed (Krasner, 1988, 1995, 1999, 2011; Haass, 2006; 2017; Jensen, 2015; Slaughter, 2005, 2011; Slaughter and Zaring, 2006) but there has been little attention paid to either operational sovereignty or to defence industry sovereignty. This lack of attention is of increasing importance in Australia as the state wrestles with issues associated with the development of its military force, and the costs and practicalities of buying or building submarines and other elements of force structure (Dunk, 2021; Brookes, 2022; Crowe, 2022; Hellyer and Nicholls, 2022; Marles, 2023b; Nicholson, 2022; Ryan, 2022; Shoebridge, 2021; Siegel, 2014).

This thesis contributes to knowledge regarding operational sovereignty and defence industry sovereignty at both the theoretical and the empirical level. At the theory level the research contributes by identifying the elements that impact upon the ability to take independent industrial actions in support of the development and maintenance of military systems, and the way in which they individually and collectively contribute to defence industry sovereignty. This analysis shows that no single element is sufficient for the development of this type of sovereignty, but there are some, associated with independent access to intellectual property (IP), capability and capacity of the defence industry, and the ability of the government client organisation to exercise control, that are necessary. The Sovereignty Diagnostic, comprising an innovative method for depicting sovereignty, has also been developed to assess the level of defence industry sovereignty sought in policy and attained by a state at the defence industry level, and thereby provides the means to address the thesis question. The Sovereignty Diagnostic can be used to assess the level of defence industry sovereignty, and by extension, operational sovereignty, in any jurisdiction, at any time, and for any capability.

At the empirical level, the thesis has undertaken a comparative study of defence industry sovereignty and operational sovereignty within multiple jurisdictions, at different points in time, and across and within different classes of submarine. The Sovereignty Diagnostic, and the separate instances of defence industry sovereignty captured within this thesis for different classes of submarine in different states, provides a basis for direct comparison and investigation. Trends within and between jurisdictions and capabilities can then be determined. Whilst this research is focused on the submarine, the approach developed could be applied in an identical manner to any specific military capability. The knowledge so developed through this research may therefore be useful in the development of defence policy, or in the implementation of that policy with respect to defence industry, and hence for operational sovereignty.

Contribution to policy

The question posed by this thesis, namely how well do states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level, is of increasing interest to policy makers and those charged with the implementation of those policies as governments in western democracies have largely removed themselves from direct involvement in the development, manufacture and support of the systems fielded by the respective military forces. The demand for greater efficiencies within the defence industry sector, and the impact of foreign competition, has seen governments transfer domestic capability development from GO-GO defence enterprises into autonomous, commercially-orientated businesses, or to privatise them completely.

As described by Bitzinger (2015b) and others, local industrial activity in military developments requires ongoing investment into the innovation required to remain at the forefront of technological advancement to develop, or maintain, an operational advantage over an adversary. Hartley (2008), for example, has shown that the amount of funding committed to defence research and development is directly related to the quality of the military equipment that results. The rising costs of military systems, therefore, has seen some states cease production of some elements of defence equipment completely and to simply rely upon foreign suppliers (Bitzinger, 1994, 2003b, 2015a; Caverley and Kapstein, 2012; Hartley, 2007, 2016; Hartley and Sandler, 2003).

States therefore need to decide how much domestic industrial activity they desire, how and in what capability areas is this to be achieved, the investment they are prepared to make in order to achieve it, and what is to be acquired from foreign suppliers (DeVore, 2016, 2017; Wylie, Markowski and Hall, 2006b; Rubin, 2017; Pardesi and Matthews, 2007). Off-the-shelf (OTS) procurement from foreign suppliers, for example, may be economically attractive but may be a high-risk option in that the systems procured may not match the operational requirement of the state or may constrain options for sustainment. Gould (2013) captured this dynamic with respect to the Australian Future Submarine (FSM) in the simple comment that ‘to buy off the shelf is to accept someone else’s requirements’.

The statements above all highlight the issue of sovereignty in defence industry. This thesis assists in the understanding of defence industry sovereignty, and in how the various components that might contribute to the development or maintenance of that sovereignty interact. In particular, this research highlights the impact of time and investment upon sovereignty outcomes at the capability level, and of the importance of having the domestic ability to design the submarine. In this way, the thesis contributes to the understanding of the implications of, and requirements for, the implementation of a policy aimed at addressing defence industry sovereignty, and hence operational sovereignty, and the policy settings that may be appropriate. This contribution is discussed as part of the Conclusions chapter.

Thesis research – case study methodology

The research has been undertaken through a multi-case case study, using a replication design (Yin, 2014). This approach was chosen as the best method to investigate the factors that may contribute to decisions associated with defence industrial sovereignty in multiple jurisdictions, and to compare the separate outcomes to develop an answer to the question how well do states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level. The utilisation of a case study for this research is consistent with Gibbert, Ruigrok and Wicki (2008: 1465) as being ‘most appropriate in the critical, early phases of new management theory, when key variable and their relationships are being explored’, and are ‘typically carried out in close interaction with practitioners’. Dube and Pare (2003: 598) have also described case study research as being useful when ‘a phenomenon is broad and complex, when a holistic, in-depth investigation is needed, and when a phenomenon cannot be studied outside the context in which it occurs’. The approach adopted in this thesis is also consistent with the definition provided by Yin (2014: 16) that a case study is ‘an empirical inquiry that investigates a contemporary element in depth and within its real-world context, especially when the boundaries between the element and context may not be clearly evident’.

The examination of defence industrial sovereignty fits this description in that it is a contemporary element, the real-world context is a mix of strategic, military, economic and political factors, and it is not a simple matter to separate one from the other. Apart from providing the means through which to compare approaches to defence industrial sovereignty from multiple states, a multi-case case study also provides a stronger base for the construction of theory (Yin, 2014; Eisenhardt and Graebner, 2007; Ridder, 2017). Whilst Yin (2014: 37) has noted that 'some theory development as part of the design phase is highly desirable' for case studies, Eisenhardt and Graebner (2007: 25) differ in that 'the theory is emergent in the sense that it is situated in and developed by recognising patterns of relationships among constructs within and across cases and their underlying logical arguments'. This thesis will advance an approach to the consideration of defence industry sovereignty in Chapter 3 that emerges from the examination of the elements associated with defence industry sovereignty in that chapter. The validity of this approach will be tested in the separate case studies and will be utilised in addressing the thesis question.

Case selection

The cases in this research will focus on the treatment of a single major military system, the submarine, with respect to defence industrial sovereignty in three countries, namely Australia, the United Kingdom, and Sweden. As discussed earlier in this chapter, the submarine has been selected as it is common feature in multiple force structures, has similar employment options across these countries, and is typically separate from real time communications networks. The selection of the particular cases against potential alternatives is summarised at Appendix 1, has been made on the basis that they are a representative sample with 'useful variation on the dimensions of theoretical interest' (Seawright and Gerring, 2008: 296), and 'are particularly suitable for illuminating and extending relationships and logic among constructs' (Eisenhardt and Graebner, 2007: 27). The cases have been selected for the following six reasons.

First, the countries are all western democracies, the rule of law prevails, and the relationship of the military to the government decision-making processes is broadly consistent. Western democracies only are considered as these states have governments formed through a "free and fair" democratic process, and the makeup and policy approach of the government can change depending on the outcome of elections. The decisions made by these governments, including those related to investment in military capability, are therefore subject to public scrutiny, comment, and potential rejection, and need to be conveyed and justified to the wider society through official pronouncements and documentation.

Second, the states can be considered as medium or middle powers. Hill (2000: 3) has provided a military-focused description of a medium power as one that 'lies between the small power that must live under guarantee, and the superpower that is effectively impervious to outside threat'. A broader definition has been advanced by Carr (2014: 79) in that middle powers are those states 'that can protect their core interests and initiate or lead a change in a specific aspect of the existing international order'. What is clear from these definitions is that, whilst the middle power is able to independently undertake a range of military actions, these actions are limited in scope, or in location, or in time of commitment. The competing pressures to balance the costs associated with domestic production of military systems and the risks associated with foreign supply are therefore arguably the greatest in middle powers, and these are therefore highly suitable for a study into sovereignty choices and the associated translation from policy to capability.

Third, the military forces of all three states are structured for primarily defensive purposes rather than to extend territorial boundaries, or coerce or subjugate other states. The way that the states therefore seek to utilise their military forces is therefore similar. Fourth, each state has an aim to conduct independent military operations rather than employing a strategy based explicitly and solely on operations as part of an alliance. This criterion has the following ramifications. The first of these is that states that deliberately constrain force development and sustainment within a collaborative agreement, such as the Netherlands and Germany (Kasdorf, 2014; Zandee, Drent and Hendricks, 2016; Zunneberg, 2017), are excluded. The second is that the commitment to independent operations implies that the state has determined the scope, in terms of time, space and capability, of that independence, and that choices have been made regarding the overall cost-benefit of investment in local defence industrial activities when compared to foreign alternatives. The last of these ramifications is that although western democracies since 1945 have typically engaged with each other through alliances (Snyder, 1997; Gaddis, 1998; Campbell, 2004; Gates, 2011), the existence of such an alliance is not a precondition for the inclusion or exclusion of any particular state for this research. That is, it is the state's approach to the conduct of military operations that is the defining factor.

The fifth reason for inclusion is that the states selected for the case studies have all manufactured submarines for their own military forces, either to their own design or to a design provided by foreign sources. States engaged in the production of major military systems will, to varying extent, demonstrate an ability to conduct research and development, to design, to integrate sub-systems, to conduct test and evaluation, and to subsequently maintain and upgrade the system so produced. The ability to manufacture a system as complex as a submarine therefore provides a baseline of industrial capability across the case study states. Sixth, and pragmatically, the states concerned publish their official documentation in English, thereby avoiding the task and associated risks of translation.

The combination of the factors noted above therefore provide the best possible research design to address the thesis question. The selection maximises the utility to the information gained from a small number of samples, whilst being representative of a wider group of similar states that utilise submarines (Seawright and Gerring, 2008; Flyvbjerg, 2006). As a result, the case selection and the replication design used herein will enhance confidence in the validity of the relationships described herein, and the utility of the Sovereignty Diagnostic (Eisenhardt, 1989, 1991; Yin, 2014; Eisenhardt and Graebner, 2007).

Case study boundaries

In the treatment of case study research, Yin (2014: 33), and Lee and Saunders (2017: 21) have noted the importance of bounding case studies, both in terms of defining what is in and what is outside the case study, and the time period over which the research applies. The case studies in this thesis are bounded in four ways: by policy, by capability, by space, and by time. The policy boundary comprises both defence and defence industry policies, pronouncements associated with those policies, and supporting documentation. As discussed earlier, the defence industry can be considered as being separate from other national industry policies, and the boundary does not therefore include other aspects of government business and policies associated with the wider national industry or economic activity.

The capability boundary addresses the nine FICs as described by the Australian Department of Defence (2014, 2016b). As noted previously in this introduction, the nine FIC can be reduced to two that have sovereignty implications, namely the military system and defence industry, and the capability boundary therefore only includes these two aspects.

With respect to the development of military systems, the 2016 *Industry Study into Strategic Materials* by The Dwight D. Eisenhower School for National Security and Resource Strategy noted that:

> (f)inished goods, such as weapons systems, sit at the end of a long “value chain.” Industrial processes such as mining, metallurgical separation, semi-fabrication, fabrication, and assembly add increasing value at each stage of the chain, ultimately transforming raw materials into components of sophisticated military technologies (2016: 14).

A submarine is no different in this regard. These value chains, particularly those that involve international or geographically fragmented elements, have the potential to impact upon defence industry sovereignty, and hence on both operational advantage and freedom of action, through reliance on specific foreign-produced components or the potential placement of counterfeit components into the supply chain (Hellyer, 2020; Haass, 2020; Menz, 2018). This thesis will not directly address the issue of extended international value chains as described above as it would require detailed analysis of individual sub-systems and components and is inconsistent with the methodology adopted herein. The defence industry aspect within the capability boundary will focus on the major system and sub-system level, and therefore on the industrial activities of submarine-related innovation, design, production, upgrade, and update-upkeep, together with system level design, integration and test and evaluation.

The capability boundary excludes non-submarine related research, even where there may be potential for that research to impact upon the submarine into the future, or items such as education and training that may ultimately affect the competence of practitioners within defence industry, and hence the ability to conduct the identified industrial activities. The capability boundary also excludes the disposal of the submarine, even though this is an element within the capability life cycle (Defence, 2016c; INCOSE, 2015; ISO/IEC/IEEE, 2015), as industrial sovereignty can be considered as largely irrelevant at this stage.

The spatial boundary for the case studies is the geographic area of the various states under consideration. Chapter 2 will show that this boundary is consistent with the over-arching concept of sovereignty that is based on territoriality and the ability to control events within the borders of the state. Submarine-related industrial activities that may occur external to this boundary, such as maintenance and ad-hoc repair activity that may be undertaken in foreign ports during the operational deployment, are not considered as these do not impact on the investigation of defence industry sovereignty being considered in this thesis.

The final boundary relates to time. The temporal boundary will vary between the case studies in order to focus on submarine-related events with most relevance to this examination of defence industry sovereignty. Differences in the temporal boundaries for the case studies will not affect the results as the aim is not to compare events at the same points in time, but to utilise comparative events to determine how well states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level. A broad alignment is, however, required to ensure that the technologies being considered are “generationally aligned”, and that the operational utilisation of the capability is therefore broadly consistent. This level of alignment is sufficient for consideration of both operational advantage and freedom of action, and to avoid the potential comparison in an industrial sense of, say, a bi-plane with a jet fighter. Time is also used to segment the cases internally, and hence enable comparisons to be drawn both within and across cases. In this sense the temporal segmentation can be considered as a form of regime analysis (Byrd, 1991) in that regimes have discernible features that are useful in distinguishing one period from another. The selected segmentation is also consistent with Dogan and Higley (2012: 269) in that the transition from one regime to another can involve 'sharp confrontations among political elites' and that these inflection points are therefore potentially major turning points in politics and in policy. Each case study will also have an introductory section to baseline both the policy and the capability, and thereby provide a historical reference point for the evaluation of developments over the period under review (Ureta, Lekan and von Hardenberg, 2020; Redeker, Wardle, Wilder and Miles, 2009; Foster and Franz, 1995).

Assuring the case study

Research methods authors, including Yin (2014: 45), Gibbert, Ruigrok and Wicki (2008: 1466), and Lee and Saunders (2017: 30), have noted that the case study approach to research can be assured through a structured application of techniques that include construct validity, internal validity, external validity and reliability. Construct validity has been assured through the use of multiple sources of evidence, including interviews with personnel with responsibility for the development or implementation of policy-related aspects, both within government circles and within industry. A total of 45 interviews and correspondence exchanges have been conducted in support of this thesis as shown at Appendix 2. The transcripts of interviews have been passed back to interviewees to ensure that notes taken comprise a faithful summary of the discussion, and that the interviewee has not been misquoted or misrepresented. In some cases, key personnel have reviewed a draft of a relevant section of the thesis.

Internal validity is addressed through the establishment of frameworks for the categorisation of sovereignty at the policy and capability levels, and through ensuring that the levels of sovereignty described within these frameworks are consistent and comparable. The development of a consistent method for describing different levels of sovereignty in policy and in capability has therefore provided the basis for depicting and comparing results through the utilisation of directly comparable circumplex diagrams. Within this research, external validity is addressed through the use of replication logic across the case studies. This replication is based on the use of a common military system across the states under review, a general commonality in the period under review, the assessment of levels of sovereignty through the application of consistent frameworks for policy and for capability, and presentation of results using a commonly-applied circumplex diagram. In addition, the selection of cases has been made on a general set of conditions as described previously in this introduction.

The application of a common set of tools to address external validity also serves to address reliability. As noted previously, interviews have been summarised and the notes of these interviews have been passed back to the interviewees for comment and amendment as necessary. Assessments made with respect to policy and the intent for sovereignty within policy can be traced back to the relevant policy document. Assessments made with respect to levels of sovereignty pertaining to a particular class of submarine at a particular time, and as represented in the circumplex diagrams, have been validated though documentary evidence such as reports regarding system suppliers and, where necessary, with personnel directly involved with the particular submarine at that time.

Theory development

The development of theory is an important element of the case study methodology (Yin, 2014; Eisenhardt and Graebner, 2007). In Chapters 2 and 3, this thesis will identify a series of elements related to defence industry sovereignty and will abductively develop an approach, culminating in the Sovereignty Diagnostic, to describe how these elements collectively contribute to sovereignty outcomes at the capability level. Such an approach is consistent with description for theoretical development from abductive reasoning provided by Timmermans and Tavory (2012: 174) that:

> (t)he theories developed in abductive analysis denote an attempt to generalize causal links and descriptions of the world out of particular empirical instances. Such theories depend on the fit with observations and their plausibility in light of alternative theoretical accounts. Pragmatically speaking, better theories allow for understanding of more and a broader variety of elements. As a form of generalization, theory allows us to move between instances within the same study and between studies as well as to expect certain things to happen and explain how and why certain events have happened.

The validity of the Sovereignty Diagnostic proposed in Chapter 3 will then be tested, both separately and collectively, in the various case studies. The frameworks developed in support of the Sovereignty Diagnostic will be based on elements and activities associated with the development and maintenance of military capability. In this sense the elements can be considered as analogous to the Ward, Clark and Haig (2016: 214) description of phenomena that comprise 'a varied ontological (basic components of people and the world) bag that include objects, states, processes, events, and other features that are difficult to classify'.

One important issue to note regarding the translation of sovereignty concepts from policy to capability is time, and that the two develop on significantly different temporal scales. Policy can change quickly with changes of government or with changed strategic circumstances. Both force structure capabilities and defence industry capabilities take time to develop, and in the case of the force structure can be in operation for many decades. As an example, it takes many years to develop the capability to design and manufacture a system as complex as a submarine, and if the requisite domestic industrial capability does not exist domestic activity cannot follow until that industrial capability has been established. Policy-related decisions taken by governments may therefore take many years to show results, or may linger for an extensive period after the decision was taken or after the policy has been changed. This temporal aspect will be addressed in the case studies and in the conclusions.

A word about words

Some words in this thesis are used in varying ways, describe different aspects of an element, or have completely different meanings depending upon the context. This section is designed to provide the reader with clarity regarding the use of particular terms throughout the thesis. Chapter 2 describes 'sovereignty' in depth, so it is not included here.

'Autarky', 'self-sufficiency', and 'self-reliance'

Commentary on defence and defence industry is replete with words that describe the approach adopted by a state for the development and support of its military force. The definition and utilisation of these words is sometimes unclear and at times they are used interchangeably. In addition, Bitzinger (2015c: 2) has also utilised the term 'limited autarky'. This short section is designed to provide clarity in how 'autarky', 'self-sufficiency' and 'self-reliance' will be used in this thesis.

First, 'autarky' is a condition typically associated with economics whereby the state is independent of all others (Helleiner, 2021). The concept of autarky has been utilised with respect to defence industry and the development of military systems in that the state is independent of all others for the entirety of its military systems requirements. Autarky has also been described as 'self-sufficiency', and it is at this point where important nuances emerge. Moravcsik (1991) and Bitzinger (2015a, 2015b, 2015c, 2017) use the terms interchangeably. Wylie, Markowski and Hall (2006b) discuss degrees of autarky and also use the term in parallel with self-sufficiency. Fruehling (2014a) has linked self-sufficiency with independence and has suggested that a self-sufficient state is independent of all others, including in equipment supply, in logistic support and in intelligence gathering. In this way Fruehling equates 'self-sufficiency' with 'autarky'.

But are these terms interchangeable? The concept of being ‘independent of all others’ suggests that the autarkic state has complete control over each and every process involved in weapons development, from mining and refining ore, through to the manufacture of semi-conductors and other specialised components, and on to design and manufacture of sub-systems and systems. The contexts within which ‘self-sufficiency’ is used by the commentators above suggests something less than this extreme, where, for example, raw materials or basic electronic components are sourced from foreign suppliers and then integrated into systems of domestic design and manufacture. This is the situation that largely existed in Swedish defence industry during the Cold War. In that sense, Sweden was self-sufficient but not autarkic.

‘Self-sufficiency’ is therefore designed to ensure that the state has a reliable source of the key military systems that it requires, when required. Under this strategy the state seeks to remove the need to acquire systems from foreign suppliers, to avoid any potential withholding of technologies or embargoes, to ensure that the systems required are available, and to ensure that systems that have previously been acquired can be updated and enhanced in the face of unanticipated challenges (Bitzinger, 2015c; Rubin, 2017, 2018a, 2018b; DeVore, 2017; Kuah, 2005). ‘Limited self-sufficiency’, in the Bitzinger parlance, may apply to one or more key sub-systems. A limited-self-sufficient state may therefore be self-sufficient in submarine sensor systems, for example, but not in weapons or communication systems.

‘Self-reliance’ can be considered as an incomplete form of ‘self-sufficiency’ and exists within a spectrum of capabilities that ranges between total dependence upon another party to being self-sufficient. That is, degrees of ‘self-reliance’ exist. Self-reliance therefore provides the military force with the ability to operate independently of others rather than explicitly with the ability to develop in a completely independent manner. This assessment is supported by Fruehling (2014a), by Pardesi and Matthews (2007: xx) who have suggested that ‘unlike self-sufficiency, self-reliance permits technology acquisition from foreign suppliers’, and in a psychological relationship sense by Van Schoyck (2018) who has highlighted that self-reliance, unlike self-sufficiency, does not exclude the need to connect to others. Beazley (2009: 62) has explicitly raised the concept of self-reliance as a spectrum and mix of capability, and ‘being self-reliant enough so that judgement … can be exercised’. Multiple states of self-reliance can therefore exist simultaneously. A nation may, for example, be dependent upon a partner for the supply of guided weapons, be able to maintain and support, but not design or produce, sonar systems, be able to produce but not design submarines, and be able to research, design and construct advanced electronic systems.

This thesis will therefore adopt the convention that 'autarky' is complete independence from all others, while 'self-sufficiency' accepts the supply of raw materials or basic components from foreign suppliers. 'Limited self-sufficiency' is a focused form of self-sufficiency, and applies to discrete sub-systems operated by the national force structure. 'Self-reliance' is a variable concept that fills the gap between being self-sufficient and being dependent and therefore aims to ensure that the force, however acquired, can operate in an independent manner in specific conditions and for a specific length of time.

Capability

The word 'capability' appears repeatedly throughout this thesis, including within the thesis question. The Oxford Dictionary (2021) includes two relevant definitions as 'the power or ability to do something' and 'forces or resources giving a country the ability to undertake a particular kind of military action'. In most cases the meaning of the word will be evident from the context within which it is used, but the following paragraphs provides descriptions to minimise the potential for ambiguity.

'Military capability' has been variously defined. Fordham (2004), for example, has focused on numbers, of platforms, weapon systems, and personnel, and has simply equated capability to military spending. Dunn (2014) has provided a broader consideration in the assertion that military capability is comprised of force structure, modernization, unit readiness, and sustainability. This description is most directly applicable to states that seek self-sufficiency and, as for Fordham, has implied that the factors listed will provide an operational outcome. In both of these descriptions capability is considered to be the totality of the military forces of the state. Australian defence planning documentation (2014: 1) provides a more nuanced definition in the statement that capability is 'the capacity or ability to achieve an operational effect', and that an operational effect is further defined 'in terms of the nature of the effect and of how, when, where and for how long it is produced'. Under this description, military capability can exist in discrete elements, such as a class of submarine, and this is the interpretation that will be adopted for this thesis.

'Industrial capability' is the ability of industry to deliver a product or service to an acceptable level of proficiency (Nagarajan and Prabhu, 2015). Defence industrial capability has also been previously defined by the US Department of Defense as 'a skill, facility, process or technology needed to design, develop, produce, repair or maintain products used by the Department of Defense' (US DOD, 1996: 3).

System

'System' is another term that is used in a variety of ways within the thesis. The following convention will be adopted for those circumstances where the context for the usage of the term may be unclear. A 'military system', also known as a 'major system' in the FIC terminology of Australian Defence Department documentation, is a 'core component of capability, and often comprise systems of principal items in their own right' (Defence, 2014: 2). Military systems can be decomposed into a platform system and a combat system. The 'platform system' is comprised of the elements that allow it function within the natural environment, to 'float and move' as per a common naval description, together with those elements that allow humans to exist within the platform. The 'combat system' comprises the elements necessary to 'fight'. In this thesis the combat system is taken to include those subsidiary elements that have a role in the sensing, decision-making, and subsequent actions associated with the submarine undertaking its operational roles. Those elements of the combat system that enable the plethora of data to be processed, managed, displayed, and utilised will be referred to as the 'combat management system'. As stated by Kumar, George, and Jagathyraj (2014: 366):

> a centralized command centre is the heart of combat management in any naval warship. Typically known as combat management system (CMS), it is a complex system that involves multiple elements that integrates different types of sensors, weapons, decoys, machines, communication, operational commanders, operators and also real-time tactical intelligence.

Where the thesis commentary includes a system within a system, or a sub-system, the discussion will provide explicit description of that subsidiary system to avoid confusion.

Thesis limits

This thesis addresses the question how well states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level. Some constraints to the overall consideration are necessary to allow the author to answer this question. The thesis will not examine the mechanics by which governments develop policy, nor the methods or processes through which defence-related organisations address strategic imperatives and risks, consider competing priorities for investment, and develop and sustain force structures. The thesis will therefore not consider why a submarine may be funded at the expense of other possible capability options, the detailed arguments that may support a decision regarding the combat system or platform system capabilities of any submarine acquisition, or the operational utilisation of that submarine. The research will also not consider the political implications of the selection or rejection of alternatives in the decision-making process, either in the context of “guns or butter” or when considering other options for the satisfaction of a particular operational effect. Similarly, the thesis will not cover corporate decision-making associated with investment in submarine-related industrial capability.

This research is conducted at a level that aggregates submarine sub-systems into broad categories associated with either the platform system or the combat system. The author recognises that this analysis may not highlight the sovereignty implications of individual components, supply chain arrangements, or specialised industrial processes, for example, the availability of a specific electronic component or the welding of a novel material. Determinations at this increased level of detail may illuminate what is important for sovereignty over a particular capability but will not contribute in a material way to determining an answer to the thesis question.

Whilst Chapter 3 will address the aspect of capacity in defence industry, the thesis will not consider industrial aspects associated with the rate of production for military systems, nor whether a surge in production can be achieved should it be required. The focus of the thesis is on the translation of notions of sovereignty in policy to outcomes at the capability level, that is the ambition to control the industrial process associated with the development, acquisition, and sustainment of a system, and not on whether ambitions for force structure requires, for example, the production of one submarine or two submarines per year.

The thesis will not examine the “adequacy” of the defence budget for the countries under consideration, nor whether the funds made available for defence purposes would be better spent on other national activities. Hall, Markowski and Wylie (2010: 153), in their consideration of the economic aspects of defence procurement, have noted that the social value of defence cannot be determined in circumstances other than conflict, and hence that the ‘resulting ambiguity exacerbates the difficulty of knowing whether scarce resources are being optimally allocated both among competing defence capabilities and between defence and other social priorities’. The research will not cover the potential benefit across the wider society to be derived from defence-related employment or research and development, or the contribution of defence industry to national economic security. Finally, the thesis will also not extend to consideration of the impacts of the broader economy on the defence effort, such as the provision of fuel, utilities and financial services, or other ancillary issues such education, skills development, and training, upon which successful defence-related industry activities are based.

Thesis structure

This thesis is structured into separate chapters to investigate how well states translate notions of sovereignty as expressed in policy into sovereignty outcomes at the capability level. Following this introduction, the chapters will address the research question as described hereafter.

Chapter 2 addresses states and state sovereignty, and how operational sovereignty and defence industry sovereignty relate to state sovereignty. The discussion will show that state sovereignty has value, able to be used for benefit but requiring protection. This protection is typically achieved through the development and maintenance of military capability. Chapter 2 will develop a sovereignty-policy framework to categorise states according to the policy intent for sovereignty and will introduce policy-related elements that have relevance to the overall consideration of sovereignty.

Chapter 3 will focus on the capability, the defence industry and the submarine, and will identify and discuss industry-related elements relevant to the discussion of control, and hence for sovereignty. A framework to link industrial elements to the potential for control will be abductively proposed, together with a capability-control framework and a circumplex diagram as the means to graphically depict where, and to what extent, control can be exercised across the various industrial activities impacting upon the submarine; that is, a Sovereignty Diagnostic. The level of defence industry sovereignty will then be determined from the circumplex diagram and the manner in which control is exercised. The combination of the frameworks in Chapter 2 and Chapter 3, coupled with the graphical representation via the circumplex diagram, will be the basis upon which the thesis question is addressed in the case studies.

Chapters 4, 5 and 6 will present the case studies. The Australian case study in Chapter 4 will focus on the life of the *Collins* class submarine between 1987 and the 2018 Defence Industrial Capability Plan (DICP), a subsidiary document to the 2016 Defence White Paper (DWP). The transition from the *Oberon* submarine to the *Collins* will provide a baseline for consideration of sovereignty and its evolution over the period under review. The Swedish case study in Chapter 5 will cover the period from the end of the Cold War in 1991 to 2020, will include multiple classes of submarine and the sale of the Swedish indigenous design and manufacture capability, as represented by Kockums, to Germany in 1999 and its reacquisition in 2014 as tensions grew over the Russian annexation of Crimea. The United Kingdom case study in Chapter 6 will commence with the election of the Thatcher Government in 1979 and conclude with the vote to leave the European Union (EU) in 2016. The focus will be on the industrial capability and support for the UK submarines from the *Oberon* class conventional submarine through to the *Astute* class SSN. The relationship of the Navy (RN) SSNs and the nuclear deterrent housed within the *Vanguard* class ballistic missile nuclear submarines (SSBNs) will also be briefly examined to establish strategic context. Circumplex diagrams of the form outlined in Chapter 3 will be used extensively to provide snapshot comparisons of policy and capability in each of the case studies.

Chapter 7 will draw conclusions and provide an answer to the thesis question. A summary of the case studies to provide conclusions against the "how well" aspect of the thesis question will also be provided. The thesis will highlight that there are no elements that are 'sufficient' and inevitably result in defence industry sovereignty, but that there are some that are 'necessary', and that these add in a Boolean sense. The conclusions will highlight that the ability to design is a key point of difference in both aspirations for operational and defence industry sovereignty, and for the realisation of sovereignty at the capability level. Chapter 7 will also make comment on the application of this research to both literature and to policy, and will suggest areas for further research. In addition, the chapter will apply the frameworks developed in the thesis to a contemporary situation, the Australian decision to acquire nuclear powered submarines, to determine the operational and defence industry sovereignty implications of that decision.

2 - Sovereignty and policy

National sovereignty is an obligation as well as an entitlement.

Richard Perle

There is no ‘perfect’ strategic decision. One always has to pay a price. One always has to balance conflicting objectives, conflicting opinions and conflicting priorities. The best strategic decision is only an approximation—and a risk.

Peter Drucker

Introduction

The question for this thesis posits a dynamic that commences in policy and concludes at the capability level. The introductory chapter highlighted seven issues for consideration with respect to the thesis question, three of which, namely sovereignty, sovereignty outcomes, and sovereignty in policy, are addressed herein. The first part of this chapter will introduce concepts concerning sovereignty and the state. The second part will discuss how sovereignty is presented and discussed in defence policy and defence industry policy. A framework for the categorisation of sovereignty within policy will be presented. The following chapter will then address sovereignty at the capability level. The two chapters collectively will therefore provide the basis upon which the thesis question can be addressed.

Sovereignty concepts

On 24 October 1648, at Munster in Westphalia, a treaty was signed between the Holy Roman Emperor Ferdinand II and King Louis XIII of France that ended the Thirty Years War. The Peace of Westphalia has since become intimately associated with the concepts of sovereignty and the state. Whilst the concept of *state* develops from that of *sovereignty*, and the two are inherently linked, often in the colloquial form of the “sovereign state”, or “state sovereignty”, the concepts are not synonymous and need to be understood in how they connect and in how they differ.

Sovereignty and the state

The concept of sovereignty developed from consideration of the position of the sovereign in European politics in the late Renaissance. At this time geographical areas were, in the main, ruled by singular persons holding a hereditary, or otherwise long term, political position. Whilst the size and nature of the geographical areas varied widely, the position of the ruler, the sovereign, as the pre-eminent political authority within the defined territory, was a common feature. The sovereign was therefore, by consent of the populace of the territory, or at least by the consent of the ruling class, placed in a position of authority over that populace. In order to survive challenges to their position, the sovereign required an accepted basis for the authority upon which their edicts within the territory could be based, and the power to enforce edicts and laws in the event that such laws and edicts were refused or transgressed. In an internal sense therefore, the sovereign required territory, authority, and the ability to exert control within their territorial boundaries. Given that other territories with other sovereigns also existed, including those with contiguous territories, the stability of a sovereign's realm depended, in part, upon the nature of interactions with these other sovereigns. This interaction was affected by each sovereign's view of the legitimacy of the other, and an understanding of the consequences of attempting to interfere in activities within another's territory. From an external perspective therefore, the ability of the sovereign to rule within his/her defined territory was affected by the recognition afforded by other sovereigns of the right to rule, and the tacit acceptance of the norms of non-intervention inside each other's territory. That is, each sovereign was afforded autonomy with respect to their own territory.

The modern concept of sovereignty has developed from this beginning. Krasner (1997), for example, has noted that the major elements in the contemporary consideration of sovereignty are control, authority, non-intervention, recognition and territoriality.

The modern concept of the 'state' has therefore developed from sovereignty. Skinner (2010) has outlined links to the status of the sovereign, and increasingly from the late sixteenth century to the association of the word 'sovereignty' with a specific type of union of humans living under a sovereign or some other ruling group. States, however, whilst broadly consistent with respect to origin, have developed on markedly different trajectories, with concomitant markedly different impacts on the position, the power, and the prestige of the sovereign. These different trajectories have resulted in outcomes such as the replacement of sovereigns with alternative forms of political process, or the dilution of their discretionary powers. Whilst this has resulted in the development of different political and judicial institutions within the respective geographically defined areas, the importance of territory has remained a key characteristic of the state. States can, therefore, be considered as comprising a populace, governed and controlled by a political structure that is endowed with the authority to govern and control, enclosed within a geographically defined territory. Moreover, states gain legitimacy in the international system by the act of recognition from other states. In this sense sovereignty and the state can be seen to be inherently linked. The concepts differ however in that a state has physical representation insofar as it can be identified on a map and includes real humans and real institutions organised within a political process.

Whilst a state can be readily described and defined, this is not the case for sovereignty. Krasner (1995: 121) has stated that there 'is no single definition of sovereignty because the meaning of the term depends on the theoretical context within which it is being used.' Sovereignty does not exist of itself. Unlike a state it has no intrinsic form. MacCormick (2016: 153) has posited that the 'sovereignty of a sovereign state may … be conceived as comprising the aggregate of the state's powers, however they are exercised and by whomever.' This definition implies that sovereignty is not bounded by geographic area, is relative to the power of a particular state, and emanates from that state. A state with sufficient power can therefore, under this definition, be considered to have sovereignty over a weaker actor by being able to impose its will on that weaker actor. Such a definition would therefore seem to be inconsistent with the fundamental foundation of sovereignty from its historical beginnings; that of the territorial integrity and non-intervention of each actor.

Waltz (2010: 96) has suggested that sovereignty means that a state 'decides for itself how it will cope with its internal and external problems, including whether or not to seek assistance from others and in doing so limits its freedom by making commitments to them'. This definition emphasises a state's control over its decision-making and the importance of interstate connectivity and relationships but omits any mention of the territorial nature of sovereignty as generally accepted from the Peace of Westphalia. Importantly, however, Waltz raises the prospect that sovereignty is not absolute, and that whilst bestowed on states by the international system, is a commodity that each state can utilise in its dealings with other states to obtain a benefit, executing a Free Trade Agreement for example. In effect therefore, states can consign aspects of their sovereignty to other actors. In order for such delegation to be both accepted by and acceptable to other states, the legitimacy of states to utilise aspects of their sovereignty in such a way must be a requirement of sovereignty itself. That is, whilst sovereignty may be bestowed through the act of recognition by actors within the international system, once bestowed there are no inherent restrictions as to what a state may do with its sovereignty providing that any such actions do not impact on another state's sovereignty without their consent.

The multi-faceted nature of sovereignty

As noted in the previous section, sovereignty can be considered as a commodity and therefore has value. As sovereignty has value, and as states exist in an anarchic international environment where power is unevenly distributed and where each state is individually responsible for its own security, sovereignty needs to be protected if it is to be retained. Given a system where the intentions of the actors are largely opaque, states will naturally assess their strengths and weaknesses with respect to other states, and some will determine that the power and intentions of another actor pose a threat. The existence of threats gives rise to strategic risks: risks that the threats, real or perceived, may eventuate. As states are responsible for their own security they therefore need to invest in protective measures if the risks are to be mitigated and sovereignty is to be retained. Sovereignty is therefore also a liability.

One way to address protective action is to exploit sovereignty as a commodity and to enter into a military alliance. Under an alliance a state commits to certain future actions, usually under defined scenarios, and in return receives a security benefit (Waltz, 2010; Snyder, 1997), typically in the form of increased deterrence and a reduced risk of coercion or imposition (Krasner, 1999). The cost, or the potential cost, increases with the level of formality of the agreement, as '(a)lliance treaties create both expectations and obligations of support for all signatories' (Fruehling, 2016: 13).

The more direct means to protect state sovereignty is through the development and maintenance of military forces. Fruehling (2014b: 1) has provided a clear link between strategic risks and military capabilities, in the statement that:

> uncertainty and threat are integral components of the concept of risk, and it is the reaction to strategic risks – risks that arise from, or could be reduced by, the use of armed force – that most countries maintain a defence force.

The protection afforded the state from its military force is a function of the force structure, its viability in the face of the expected threat, and its capability to undertake operations as, when, where, and for the period required. The ability of a state to develop, support, maintain, repair, and replace a military force, or part thereof, unimpeded by factors not within its control can be described as 'operational sovereignty'. Operational sovereignty therefore encompasses technological development, acquisition and sustainment, and comprises, as described by the UK MOD in 2005, the separate elements of 'operational advantage' and 'freedom of action'. Operational sovereignty therefore also has a dual nature in that operational advantage is focused on a potential adversary, while freedom of action is linked to suppliers and recognises that dependency on foreign suppliers creates vulnerabilities that can be avoided through local production (Bitzinger, 2015a).

The starting point for operational sovereignty is that there is none. Whereas states start with a “glass full” of the sovereignty that provides legitimacy within the international system, and which can be retained, utilised, or lost, states also start with a “glass empty” of the sovereignty necessary for protection of the state, and this aspect needs to be developed. As the means through which the state addresses its desired ends will be a function of the investment that the state chooses to make, the scale of such investment is a balance between cost and risk. Operational sovereignty, therefore, costs. Furthermore, as resources are finite, choices must be made regarding where to invest, and which capabilities represent the potential greater return on that investment. The implication is therefore that the importance of having operational sovereignty is greater for some capabilities than for others, and hence operational sovereignty is a relative concept with the importance of any one capability varying with the strategic circumstances.

As modern military forces rely upon industry, operational sovereignty is dependent upon sovereignty in defence industry. Moreover, as the importance of having operational sovereignty is relative to the capability under consideration, the corollary is that the imperative for defence industrial sovereignty, or the ability of the state to control activities within its defence industry, is also relative (Dunk, 2017).

Sovereignty and policy

Public policy is ‘a set of decisions made by governments and other political actors to influence, change, or frame a problem or issue that has been recognized as being in the political realm’ (Hassel, 2015: 569). Policy is therefore a guide, or a potential driver, of behaviour across a wide range of government concerns and activities (Abramowicz and Stepniewska, 2020; Dib *et al*, 2020; Francelino *et al*, 2019; Mignon and Bergek, 2016; Porter, Rutkow and McGinty, 2018; Veugelers, 2012; White, Lunnan, Nybakk and Kulisic, 2013). Two important points with respect to policy need to be emphasised at this point. The first is that, as highlighted by Hassel (2015), public policy can also take the form of a nondecision or a deliberate neglect. The second is that the desired policy outcomes are not guaranteed and consequently policies can fail. Such non-attainment of intended outcomes can be as a result of, for example, the selection of the wrong drivers or the introduction of a replacement policy (Fullan, 2011; Vince, 2015; Walsh, 2006).

Defence policy

As introduced in the previous section, states raise and sustain military forces to address perceived threats to their sovereignty, and to provide a means through which to mitigate strategic risks. Many states also develop public statements or defence policies to frame these considerations and through which to provide citizens, and other states, with visibility regarding these assessments and the concomitant structure and perceived utilisation of the military forces at its disposal. The broad settings evident at the defence policy level are often further developed in other, often classified, documents that deal with more detailed considerations of the threat, of the justification for force structure development, and of the operational use of that force.

Policy, as stated by Wylie (2007: 54), is ‘a purposeful synthesis of ends, ways and means’. Defence policy is no different. The Geneva Centre for Security Sector Governance has also stated that defence policy ‘covers everything from ends to ways and means of achieving national defence objectives’ and ‘is a series of guidelines, principles and frameworks that link theory …to action’ (ISSAT, 2021). As noted in the introduction, defence policy is a trade-off between interests and objectives on the one hand and whether the pursuit of such objectives is realistic from a national investment perspective on the other. Therefore, defence policy is fundamentally focused on the management of strategic risks (Dean, 2020; Dibb and Brabin-Smith, 2017; Dibb, 2019; White, 2017, 2008; Monk, 2012; Thomson, 2012), or as stated by Cornish and Dorman (2015: 356):

> when strategic concerns are many and varied, and when resources are too constrained to meet all conceivable obligations and choices, it is only rational that national strategy should be a matter of risk management, seeking to achieve the most agile strategic prioritization and re-prioritization as circumstances change.

Given that, in the military space, the minimisation of strategic risk is typically associated with the development, maintenance and deployment of military systems and forces of sufficient size and structure to deter or defeat an adversary, the policy approaches to addressing risk are also a measure of the amount of independence that the state desires with respect to those capabilities. Consideration of risk is therefore linked to the desire for operational sovereignty and for sovereignty in defence industry. As clearly stated by a previous Australian Chief of the Defence Force (CDF), Admiral Chris Barrie, in an interview with the author in 2018, ‘the determination of sovereignty is concerned with determining the limits to the risk that we are willing to accept’.

States therefore have choices in how to address the assessed risks. In one circumstance, given a largely undefined threat, low levels of strategic risk, and an indeterminate period within which a specific threat might develop, the state may use concepts such as 'warning time' or 'expansion time' as policy parameters. The state may therefore make a definite decision not to develop and maintain a substantial military force, or to develop and maintain a 'core force', on the assumption that time is available to build the required force as the threat develops and the risk increases (Brabin-Smith, 2012, 2013). States may also, for example, choose to stockpile munitions and spares, and therefore take the risk that the stockpile will be sufficient for future operations and, in doing so, avoid the domestic investment associated with the development of weapons and other systems. Other states may choose to address strategic risks by trading their sovereignty for an envisaged benefit through an alliance, with the expectation that partners will provide sufficient support when required. Some states may adopt a position of neutrality and hence deliberately choose a risk mitigation strategy based on the trust that their declaration of neutrality will be respected. Switzerland, for example, adopted such a course of action. The decisions taken by states with respect to risk therefore reflect political positioning and aspirations.

Whilst military forces are developed and maintained to address strategic risks (Fruehling, 2014b), there are also operational risks associated with the deployment and application of that force. As highlighted previously in this chapter, these risks can be considered as being Janusian in nature, with one aspect facing the potential threat and the other facing the supply chain. Operational sovereignty addresses these risks in the concepts of operational advantage and freedom of action, and is also typically included in defence policy.

'Operational advantage' is associated with risks that develop from the threat, and has been defined as 'the ability to find and maintain an edge over potential adversaries, both to increase the chances of success in hostile situations and to increase the protection of the assets involved' (MOD UK, 2012: 26). 'Operational advantage' can therefore include aspects such as training, command and control capability, the size of the military force available, the readiness of that force, and the possession of systems with a technological advantage over a perceived threat. Whilst technological advantage can be sought through allies and provided by foreign suppliers, the receiving state may not be able to influence the direction and pace of the research and development necessary to maintain the technological advantage. A state may therefore be dependent upon others though an inability or unwillingness to make the necessary investment. As military capabilities and technologies are of varying importance for the mitigation of strategic risks, policy choices will typically be required as to which capabilities and technologies are critical and may therefore need ongoing domestic investment, and which can be satisfied by other means. It is important to recognise that a policy for the development and maintenance of operational advantage does not necessarily result in that operational advantage being achieved or maintained, only that the potential exists for it to be achieved or maintained.

The second half of this duality, ‘freedom of action’, is also included in defence policy and has been described by the MOD UK (2012: 26) as:

> for national security capabilities in general, freedom of action rests on the assurance of being able to use them – or continue to use them – whenever needed; and that when used they will perform as required. … freedom of action includes being able to conduct combat operations at a time and place of choosing… We must be able to operate, maintain, and refresh certain capabilities effectively, without being dependent on others.

‘Freedom of action’ addresses the risks associated with the ability to use force as required, including in the face of an evolving adversary. Freedom of action is therefore a critical part of self-reliance and recognises the risks associated with dependence on overseas supply and support; risks that have come to fruition for a range of countries. As examples, Australia initially had Carl Gustav ammunition withheld by Sweden during the Vietnam War (Feldman, 2013; Soderlind, 1988; Tramoundanis, 1995) and spare parts for the *Oberon* submarine retained by the UK during the Falklands War to meet RN requirements (Briggs, 2015a; ASC, 2018). The Soviet Union imposed decision-making conditions on Egypt in exchange for equipment resupply during the Six-Day War (CIA, 1970), and the French embargo on Israel during the same conflict led to the development of the Israeli defence industry (Rubin, 2017). France withheld the resupply of Exocet missiles to Argentina during the Falklands War (Puche, 1988), and during both the First and Second Iraq Wars Belgium and Switzerland respectively refused to provide small arms ammunition resupply to the United Kingdom (UK Anon #1, 2018; Commons, 1998, Salzmann, 2018). Freedom of action may also be impacted if the facilities, manpower and skills necessary to undertake maintenance and upgrade activities are constrained in their availability when required. As for the case of operational advantage, there may be systems and technologies for which a foreign source of supply is acceptable, and there may be some for which it may not.

At first glance there is a direct relationship between the level of the assessed threat and the level of investment that is represented in defence policy. As stated by Gray (2008: 330):

> Defense planning is controlled by money. And the money made available depends upon how frightened we are, and whether or not we believe that we can purchase useful protection.

At one end of the spectrum, where the threat and risks are high, the state may tend toward self-sufficiency and attendant high levels of investment. At the other end, where risks are low, the level of investment may be commensurately low and there may be no sought-after sovereign defence industry activity. In between lies the reality for most developed states; that is finding a balance between the need to manage risks and the availability of funding. The way that this issue is addressed by governments, whether for example to trade-off operational advantage for freedom of action, or to seek integration with a partner, is often in the development and release of defence industry policy.

Defence industry policy

As noted at the introduction, governments of states in the western world typically no longer manufacture and directly support the military equipment upon which their defence forces rely (Heidenkamp, Louth and Taylor, 2011; Hartley, 2007, 2008, 2011). The military forces of these states are therefore reliant upon industry, and the domestic defence industry is therefore a critical aspect of any national aspiration for operational sovereignty. Defence industry policy can therefore be seen as being dependent on, and subordinate to, the defence policy. Hall, Markowski and Wylie (2010) have gone further and suggested that procurement policy sits as the immediate subordinate to defence policy, and that defence industry policy is in turn the strategic subset of that procurement policy. This observation may be correct from a narrow economic procurement perspective, but the core aspects of government procurement such as achieving value for money, and the efficient, effective, ethical and economic utilisation of public money (Finance, 2019) are not relevant for this research, and hence the distinction is immaterial. As this thesis is focused on the translation of intentions, not the common pitfalls all policy implementations in defence face (Dupont, 2015; Lorell, Lowell and Younossi, 2006; De Spiegeleire *et al*, 2019; Walsh, 2006; Nair and Howlett, 2017), a direct link between defence policy and defence industry policy will be assumed. In this link, defence industry policy is also intentionally associated with the management of strategic risk.

While governments in the western world may direct research into military systems through GO-GO research institutions, may continue to own and operate some elements within the defence supply chain, and have the power to direct work to individual enterprises if required, they do not control all activities or all operating entities within that industry. Governments, therefore, can only influence the behaviour and corporate decisions of private companies, and defence industry policies are often used to convey government ambitions and expectations with respect to the industrial contribution to overall military capability. The importance of having a policy directed towards defence industry and the development of domestic industrial capabilities has been clearly stated by Dibb (2006: 11) in that:

> (i)f Defence does not make clear which industrial capabilities Australia needs, then industry will make independent decisions and those local capabilities that are required to maintain our national security may disappear. This may constrain the choices about how we use the Australian Defence Force (ADF) in the future.

Sovereignty, as noted by multiple commentators, is fundamentally about the ability to control (Krasner, 1999, 2001; Jensen, 2015; Wellings, 2018). As noted earlier in this chapter, states acquire and sustain military forces to support how they address their security and other strategic risks. The military capabilities so developed aim to achieve an operational effect (Defence, 2014). This operational effect 'is intended to overmatch the adversary and …be delivered and maintained where and when it is required' (MOD UK, 2016: 1). Control in this sense is therefore to have the ability to independently address the development of the systems designed to achieve overmatch, and to have the mechanisms to enable the capability to be utilised as, when, where and for the period required. It is important to reiterate that having such control does not imply that overmatching systems will necessarily be developed or that mechanisms for the independent use of those systems will be available, only that the state has independent action over how these tasks are addressed. That is, the state seeks to avoid being controlled in either of these aspects by another party.

A corollary to the point above is that, as most states do not seek self-sufficiency, and as funding is finite, there will be a need to prioritise capabilities for the operational impact that they provide and hence for the industrial support that these capabilities require. That is, independence may be sought over the ability to develop some military systems but not all. Defence industry planning in the United Kingdom has repeatedly acknowledged the need for this prioritisation in statements such as 'we need to consider carefully which industrial capabilities we need to retain in the UK' (MOD UK, 2005: 2) and through a consideration of the 'operational advantages and freedom of action (that) we need to protect' (MOD UK, 2012). Similar approaches towards defence industry have been described for Canada (Jenkins, 2013) and in the United States context Watts and Harrison (2011: xiii) have stated that:

> (t)he United States' defense industrial base strategy should ensure the preservation of those few sectors that are currently critical to American national security, adding over time any emerging sectors that become critical, and ruthlessly underfunding or jettisoning any sectors that cease to be critical.

The Australian approach has attempted to link operational capability to the industrial capabilities that are needed to be retained in-country through the successive concepts of Priority Local Industry Capabilities (PLICs) (Nelson, 2007), Priority Industry Capabilities (PICs) (Defence, 2010a) and latterly as Sovereign Industrial Capability Priorities (SICPs) (Defence, 2018a). Some capabilities are therefore of sufficient importance that there is a government-recognised need for an ability to independently 'access, or (have) control over, the essential skills, technology, intellectual property … and infrastructure as and when required' (Defence, 2018a: 17).

One further point develops from the considerations above, namely that control is not possible without an independent ability to undertake the associated industrial activities. As the global defence market has progressively consolidated into a small number of multi-national companies that control the development of most of the advanced defence systems in western democracies (Hartley, 2007, 2011; Brauer, 2007; Heidenkamp, Louth and Taylor, 2011), and as these companies are often established within states as a domestic subsidiary under the control of the foreign parent and the regulations of the foreign government (Sageder and Feldbauer-Durstmuller, 2019; Greer and Singh, 2019; Amao, 2011), it follows that the ownership structure of the defence industry is an important contributory factor in the ability to control, and hence the attainment of sovereignty. Defence industry policy therefore aims to provide the impetus, and the support, for the development of the level of independence deemed appropriate for the capability in question. The manner in which industry is able to respond to policy ambitions is addressed in the following chapter.

Sovereignty-policy framework

The above discussion has highlighted that an independent ability to undertake industrial activities is key to having sovereignty in defence industry. The degree of independence sought in these activities reflects the level of operational sovereignty that the government desires to possess. Given that autarky is unrealistic in the modern world, and that the importance of sovereignty varies according to the military system under consideration, the framework at Table 1 is based on the policy aspirations of the state over six levels of sovereignty, ranging from full sovereignty to having none at all, for an individual major system such as a submarine. The categorisation of sovereignty in this way is considered appropriate given the differentiation of sovereignty concepts such as 'self-sufficiency', 'limited self-sufficiency' and 'self-reliance' in common use, and as discussed in the introduction (Bitzinger, 2015c: Rubin, 2017, 2018a, 2018b; DeVore, 2017; Kuah, 2005; Fruehling, 2014a; Pardesi and Matthews, 2007).

The highest level in Table 1 is described within the framework as *full sovereignty*; when the state seeks the independent ability to develop, support and utilise all aspects of a specific major system. A state with full sovereignty is therefore self-sufficient with respect to that major system. *Focused sovereignty* is akin to the Bitzinger (2015b) description of 'limited self-sufficiency'. States that seek focused sovereignty seek the ability to independently develop and maintain certain sub-systems associated with a major system. The focused sovereignty sought may, for example, be in a particular sensing technology, or in command and control systems, or in certain types of weapons, and may not extend to the platform into which these sub-systems are integrated. Full sovereignty results when the state has focused sovereignty over all the sub-systems within the major system.

Limited sovereignty develops where the state wishes to have the ability to address capability domestically, but not to do so completely independently due to fiscal or other constraints. Limited sovereignty, therefore, typically develops where the entity providing the industrial activity is the domestic subsidiary of a foreign company. Restrictions on independent activity may also develop where a DO-DC entity constrains the access to key intellectual property[2]. *Rudimentary sovereignty* describes the situation where a state only seeks the independent ability to address the sustainment of a system within the force structure. *Limited rudimentary sovereignty* develops when the state is content with sustainment of a major system being provided domestically, but when independence in the conduct of that sustainment is not sought. Limited rudimentary sovereignty would typically be provided through the DO-FC subsidiary of a multi-national company.

Table 1 – Sovereignty-policy framework

Full sovereignty	The state seeks the ability to independently address all industrial activities associated with the acquisition and sustainment of an entire major system.
Focused sovereignty	The state seeks the ability to independently address all industrial activities associated with the acquisition and sustainment of one or more sub-systems associated with a major system.
Limited sovereignty	The state seeks the domestic capability to address the industrial activities associated with the acquisition and sustainment of a major system, or associated sub-systems, but does not seek independence in these activities.
Rudimentary sovereignty	The state seeks the ability to independently address the industrial activities associated with the sustainment of a major system.
Limited rudimentary sovereignty	The state seeks the domestic capability to address the industrial activities associated with the sustainment of a major system but does not seek independence in these activities.
No sovereignty	The state does not seek the ability to address the industrial activities associated with a major system or associated sub-systems.

[2] Whilst the scenario described might be somewhat problematic, a specific example involving BAE Systems and its refusal to provide Hawk trainer software to MOD UK was provided to the author in an interview with a retired senior British military person in 2018 (UK Anon #1, 2018).

No sovereignty results when states do not seek the ability to address capability domestically and are content for related activities to be provided by FO-FC entities. The risks associated with reliance on foreign suppliers are accepted or mitigated through close involvement with allies and other partners, or through strategies such as stockpiling.

An important point develops from the framework at Table 1, namely that it is possible for a policy to simultaneously seek multiple levels of sovereignty for different aspects of a capability. For example, the state may seek focused sovereignty for platform aspects of submarines such as stealth-related technologies and limited sovereignty for sensors and weapons. The corollary to this point is that, if the state seeks sovereignty in some form over a particular capability, it is important to understand which systems and sub-systems within that capability are the most critical for mission success as there is greater operational benefit associated with those. Prioritisation is therefore important. This aspect will be further developed in the following chapter.

Conclusions

This chapter has covered a broad range of sovereignty considerations, commencing with the nature of state sovereignty, defining sovereignty concepts, and establishing the foundations upon which the thesis question *how well do states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level* can be addressed. The differences between state sovereignty, operational sovereignty and defence industrial sovereignty have been discussed. With respect to operational sovereignty, the chapter has highlighted that this is manifested through two distinct components; 'operational advantage' that faces the threat and 'freedom of action' that focuses on how, when, where, and for the period required that the capability may be deployed, and hence considers supply side risks.

The manner in which sovereignty concepts are expressed in defence policy and the subsidiary defence industry policy has been explored. A framework for the consideration of sovereignty in defence policy that raises six levels of sovereignty has been developed. The chapter has also highlighted that sovereignty in defence industry is related to risk assessment, and the importance of independence in how a state might address operational advantage and freedom of action. The following chapter will explore the capability aspects of operational and defence industry sovereignty to establish priority areas for consideration, to develop frameworks to enable the comparison of policy with capability, and to explore the relationship between the industrial elements considered relevant to the determination of sovereignty outcomes.

3 – Sovereignty and capability

One cannot always rely on someone else's sword. One must be prepared to fight for one's own cause. And to be ready for this, one must have the means.

Niccolò Machiavelli

I must confess that my imagination refuses to see any sort of submarine doing anything but suffocating its crew and floundering at sea.

H.G. Wells

Introduction

The previous chapter has addressed sovereignty at the policy level and has determined that states may have differing ambitions with respect to being able to independently handle its major systems and sub-systems for operational advantage and for freedom of action. That is, sovereignty ambitions may lead to differences in the extent to which the domestic defence industry is involved in the acquisition and sustainment of elements of force structure, and the control that the state has over associated industrial activities. This chapter will address the final four issues raised in the introduction about the thesis question, namely those associated with the submarine capability, with the mechanism for translating sovereignty notions from policy to capability, with the measurement of that translation, and with the concept of wellness. In doing so, the chapter will provide an analytical framework, a Sovereignty Diagnostic, that can be applied in the case studies to directly address the thesis question.

The link between defence industry and major systems has been established in the introduction. The previous chapter has also established that the ability to control is a fundamental aspect of sovereignty. Chapter 2 has also highlighted that sovereignty with respect to major military systems is often set at the sub-system level. These three relationships will form the basis of the approach to the taken in this chapter to explore sovereignty at the capability level.

The first part will focus on defence industry and the activities conducted within industry. This part will also investigate the elements of defence industry required if control is to be exercised, and how they relate to the level of control that can be obtained. A capability-control framework based on these industrial activities will be developed. The second part will discuss the submarine capability, its constituent elements and prioritisation of these elements according to their importance for operational success. The third part will introduce a novel means to graphically display the outcomes of the frameworks, and to determine the level of defence industry sovereignty that the state possesses. Chapters 2 and 3 will therefore provide the theoretical basis for the investigation of sovereignty in the case studies and for the thesis question *how well do states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level* to be answered.

Defence industry

As highlighted in Chapter 1, defence industry, and its associated activities, are critical in the acquisition and sustainment of military systems. The extent to which the state can control the development and employment of its military systems, and the level of operational sovereignty that it possesses, is therefore strongly influenced by the extent to which it can control activities within its defence industry. This section provides a discussion on defence industry and the activities that comprise the undertakings necessary for, or associated with, the development, production and sustainment of military systems. The description of industrial activities will be consistent with that provided by the US Department of Defense Dictionary (2017: 64) definition of the defence industrial base (DIB) as the 'capabilities to perform research and development, design, produce, and maintain military weapon systems, subsystems, components, or parts to meet military requirements'.

Defence industrial activity

Industrial activity does not occur in isolation of other events. Government policy establishes a capability need and the capability is brought into existence and managed through a common set of linked, although not necessarily linear, life cycle stages that conceive, develop, produce, use, support and retire the capability (INCOSE, 2015; ISO/IEC/IEEE, 2015). The international standard on system life cycle processes also includes an integration process and a verification process (ISO/IEC/IEEE, 2015). The United Kingdom Defence Industry White Paper has described the activities necessary for a sovereign defence industry capability in similar terms as the ability to 'design, develop, integrate, evaluate, support and maintain key systems and sub-systems, together with the conduct of test, evaluation, support and upgrade for those systems' (MOD UK, 2012: 28). As this section is to highlight those industrial activities that may be important in the context of sovereignty, these three descriptions will be combined to cover innovation, design at both the complete system and subsidiary levels, systems integration, system level test and evaluation (T&E), production, upgrade, and update-upkeep, and will be detailed hereafter.

As the conduct of the 'design process' is the result of an earlier innovative research and development activity, innovation can be considered as the starting point for defence industrial activities and for the consideration of sovereignty therein. This statement is supported by the description of innovation provided by O'Sullivan and Dooley (2009: 5) that innovation is:

> the process of making changes, large and small, radical and incremental, to products, processes, and services that results in the introduction of something new for the organization that adds value to customers and contributes to the knowledge store of the organization.

Under this description innovation is both the process that leads to the design and that which provides variation and augmentation of that design once developed.

One additional factor to consider in this regard is that systems are invariably comprised of subsidiary systems (Hitchins, 2007; Watt and Willey, 2005; Matthews *et al*, 2001), and that innovation that is manifested at the system level has typically occurred within a subsidiary system or by integrating a new system with a pre-existing one: the integration of a helicopter with a frigate for example. That is, system level innovation is an emergent property of developments in lower-level systems. As an illustration of this dynamic, consider developments in the anti-submarine warfare capability of a ship that results in the ship being more likely to detect a submarine in its vicinity. In this case the innovation may be in the sonar system that provides more reliable detections, or in the combat management system through improved deconfliction and presentation of objects detected by the sonar, or through quietening of the propulsion system and hence a reduction in vessel self-noise that enables an improved detection capability. Whilst the increase in capability may be attributed to the ship, the improvement has occurred within a subsidiary system, and for this reason innovation can be considered in this thesis as occurring only at a sub-system level. This distinction will become important in the presentation of the capability-control framework.

Innovation results in *design*, which, according to von Stamm (2008: 17), is 'the conscious decision-making process by which information (an Idea) is transformed into an outcome, be it tangible (product) or intangible (service)'. For a complex system, the design exists at multiple levels from components through sub-systems and on to the full *system design*. For a submarine, the complete system design needs to bring all components and sub-systems together in a way that fits them all within a confined space and enables the overall functionality of the entire system to be achieved. The result of the design process is a body of intellectual property that is frequently called 'the design' that is used as the basis of *production*, or the process of turning the design into reality.

Given the withdrawal of Western governments from the direct production of military systems and the globalisation of the defence industry, at the level of the major system the outcome from the production activity will almost inevitably be the result of the integration of subsystems and components sourced from many suppliers across a supply chain (National Research Council, 2008; Menz, 2018). The critical role fulfilled by *systems integration* has been commented upon by Davies and Mackenzie (2014: 775) in that:

> the systems integrator coordinates the network of organizations involved in the phases of design, construction, integration, testing, commissioning and handover of a fully operational system. It comprehends how components and subsystems interact when joined together in a complete system, manages the uncertainty caused by their integration and balances the need for stability and flexibility when plans have to be adjusted and conditions change.

Systems integration is therefore a fundamental industrial activity in making a design into a product, as reinforced by the statement from Gholz, James and Speller (2018: 1479) that:

> systems integrators must know more than they themselves manufacture. Their breadth of knowledge about the range of technologies that comprise the complex system allows them to make decisions on what to source, from whom to source, and how to effectively integrate those technologies into the system.

Test and evaluation is conducted repeatedly throughout the development of a military system as components and assemblies are progressively integrated into increasingly more complex sub-systems and then into the final major system to provide 'objective evidence that a system or system element fulfils it specified requirements and characteristics' (INCOSE, 2015: 83). Fox *et al* (2004: xv) have also described T&E as 'the primary means of ensuring that the system will actually perform its intended functions in its intended environment'. The ability to conduct T&E depends, therefore, on having sufficient access to design data to allow representative testing to be undertaken. In some cases, for example the purchase of a system from a FO-FC entity, design data may not be made available and the ability of the state to undertake detailed T&E may be inhibited. In an interview with the author, a retired UK Chief of Defence Materiel emphasised it is necessary to know how a system works, not just if it works, to have a complete understanding of the performance implications of the system (UK Anon #1, 2018). In another interview, Gould (2018) has also highlighted the human implications of T&E in that understanding that submarines will perform as expected is important in appreciating the risks associated with putting people in harm's way in the operation of that system. As this thesis is focused on the submarine as a system, the consideration of T&E will only be undertaken at the system level, and will be assumed as part of the design and production processes for sub-systems.

Update-upkeep is the undertaking of general maintenance to keep major systems operating in accordance with the original design concept. Whilst update-upkeep may implement minor improvements, for example the replacement of a circuit board with an updated equivalent, the original design and related operational employment of the capability are not significantly altered. Access to design information is required for this activity, but only to the extent that it enables such maintenance to be undertaken.

Upgrade is the process by which the original design is varied or augmented through innovation to provide improvements. The need to upgrade may be driven by a desire to apply improved or newly developed technologies, or a need to react to observed improvements in the capability fielded by an adversary. Whilst the effect of an upgrade may be important to the maintenance of operational advantage, the ability to upgrade as required is also associated with freedom of action. The ability to augment a design is therefore dependent upon having access to that design, and the necessary industrial skills to develop and implement the changes (MOD UK, 2012; AUS Anon #4, 2019).

Refit and battle damage repair (BDM) are two other activities that are likely to be required for major military systems. The former can be considered as an amalgam of systems integration, upgrade, and update-upkeep in that sub-systems may be removed and replaced with improved variants. The latter is likely to involve some production related activities in addition to those required for refit to repair or replace damaged sub-systems or sections of the platform. As the industrial activities that comprise both refit and BDM are comprised of other activities described herein, neither need to be separately considered.

The design is therefore a common requirement for all activities described above. None of the industrial activities involved in the development or maintenance of operational advantage, or for freedom of action, can be undertaken without access to the design. Innovation is a pre-requisite for upgrade, although the ability to implement the outcome of an innovation process also depends on access to the design (AUS Anon #4, 2019; Briggs, 2019). The ability to conduct systems integration and T&E are required to ensure that all the elements of the major system design are properly combined, and that the realised system will achieve its intended use (INCOSE, 2015; ISO/IEC/IEEE, 2015). The design is therefore a fundamental determinant of defence industrial sovereignty.

Defence industry sovereignty elements

The section above has discussed industrial activities associated with the development and maintenance of military systems, and therefore with both operational advantage and with freedom of action. As is evident from the earlier discussion in this section, defence industrial sovereignty is fundamentally impacted by access to design information; to intellectual property (IP). This section will identify and discuss this and the other domestic elements required to bring the notions of sovereignty expressed in policy to fruition in a military system, or in related sub-systems.

Intellectual property

Intellectual property relationships

As stated by the World Intellectual Property Organization (WIPO) (2020), IP refers to creations of the mind and will be generated by activities such as early-stage innovation, by the process of design, and by the post-design innovation that leads to the upgrade of military systems. In addition to the IP that is captured in design and other formal documentation (the 'know-what'), Garud (1997) also highlighted the importance of the 'know-how', or the factual but less tangible knowledge required to achieve the practical end associated with the formal intellectual property, and the 'know-why' that addresses why specific design choices were made. An example of know-why, specifically the impact of environmental conditions on the indiscretion ratio[3] of a submerged conventional submarine and hence on factors impacting on submarine design, was provided to the author in a 2019 interview (AUS Anon #3, 2019). The importance of the know-how and the know-why was also emphasised in an interview conducted by the author with a previous Chief Executive Officer of ASC Pty Ltd, the company responsible for the production and maintenance of the *Collins* class submarines, that:

> sovereignty is being able to solve problems domestically. This requires know-how and know-why, not just IP (Ludlam, 2019).

In the 2019 interview, Ludlam also cited the difficulties encountered with the construction of the Royal Australian Navy's Air Warfare Destroyers at ASC that arose as the Australian Department of Defence had procured the design drawings for these ships, but not the additional know-how or know-why that made the drawings work. This example has also been highlighted by Ferguson (2011: 216) who stated:

[3] A description of indiscretion ratio is provided in the Acronyms and Glossary.

> Navantia is delivering some 10,000 drawings that are essentially identical to those used by Navantia themselves. While Navantia’s design and engineering processes are excellent, like many industrial processes shipbuilding relies on human knowledge and experience and the drawings haven’t always conveyed the subtle expertise and ‘tricks of the trade’ that Navantia’s workforce has developed building the F-100 family at its Ferrol yard.

The information represented in the design is therefore only an incomplete part of the IP necessary for defence industrial sovereignty. The less tangible aspects are also required if the state is to independently undertake the related processes, and hence be able to independently address both operational advantage and freedom of action. Of these two aspects, operational advantage is more technologically challenging as it aims to develop systems that are superior to those fielded by an adversary (MOD UK, 2005). Innovation is therefore a pre-requisite if operational advantage is to be developed domestically. Gilli and Gilli (2018: 152), however, have highlighted that, for the development of military systems, ‘innovation has progressively been the result of scientific and engineering research, as well as of accumulated experience in design, development, and manufacturing’. This observation raises a dilemma for the makers and implementers of defence industry policy, namely that while innovation generates know-why, both know-how and know-why influence the ability to innovate.

Figure 1 depicts the relationships between the various industrial activities as discussed in the previous section, and highlights the key role played by the intellectual property components. The diagram is similar in concept to that of the value chain introduced by Michael Porter (2001) to examine how consecutive steps are used to develop a finished product, and competitive advantage. Value chains have been developed previously to address the acquisition of defence capability (Markowski, Hall and Wylie, 2010; Wylie and Markowski, 2010b), and the concept is used here to highlight the importance of the separate components of intellectual property.

In the diagram, the industrial activities as previously discussed are shown in white boxes. The outcomes of these activities, whether tangible or intangible, are shown in green, culminating in the manifestation of the major system. Blue connectors depict an additive relationship; that is, where the output of an activity impacts on another activity or an outcome but that secondary activity is not dependent upon the first. Red connectors depict a dependent relationship; that is, where an industrial process or an outcome is dependent upon another entity within the chain.

The design, the know-how and the know-why are shown collectively in Figure 1 as intellectual property, and clearly demonstrates the critical role that these elements have in bringing a military system into existence, and in upgrading and maintaining it throughout its life. The treatment of the

IP associated with a major military system, and the extent to which that IP can be independently accessed for military purposes, is therefore expected to be critically important in determining the extent of the defence industrial sovereignty held by the state with respect to that system.[4]

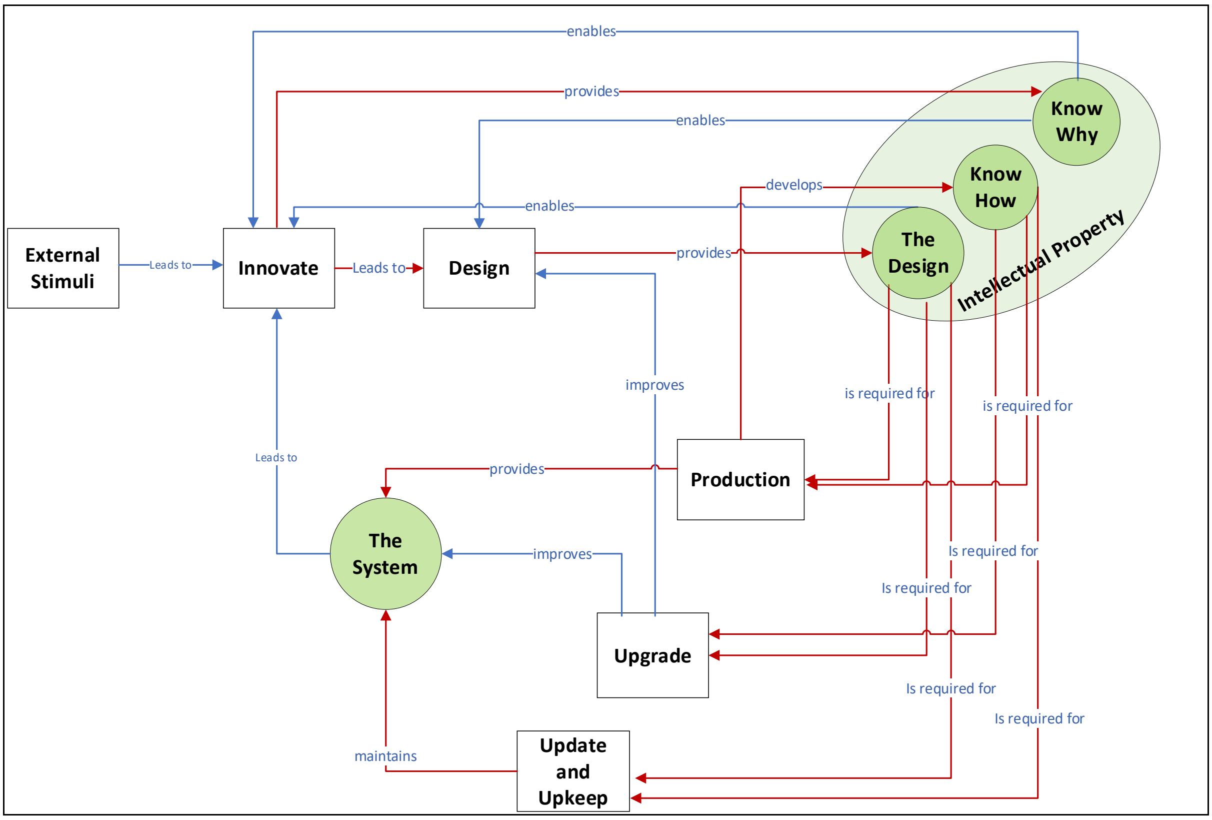


Figure 1 – Relationship between intellectual property and defence industry activities

Access to intellectual property

Whilst the access to IP is of fundamental importance, it is also often associated with the desire of states to maintain a security advantage (Bellais and Guichard, 2006). Thomson (2006) and Brabin-Smith (2006) have both highlighted the limitations for the exploitation of acquired technologies that result from the lack of access to design information. Dibb (2006: 18) has also commented on the need for Australia to 'negotiate firmly with the US over its non-disclosure policies and get access to the source codes that will enable us to modify or alter the performance characteristics of US platforms, missiles and sensors', whilst the UK *National Security Through Technology* document

[4] The assumption here is that the treatment of intellectual property is handled legally, and the state does not engage in activities such as reverse engineering to obtain the design information outside of a contractual arrangement.

(MOD, 2012: 28) has stated that a key element in obtaining operational sovereignty and associated freedom of action is:

> appropriate freedoms from potential legal constraints on the use of technology (including intellectual property rights) to enable the UK and its suppliers to maintain, upgrade, and operate key systems and sub-systems.

In an interview with the author in 2019, Harry Dunstall, previously Deputy Chief Executive Officer and General Manager Commercial of the Australian Defence Materiel Organisation (DMO), noted that ‘Defence will seek sufficient IP rights to allow the Government to sustain in-country with the party of Defence’s choosing’ and that ‘access to IP from foreign Original Equipment Manufacturers (OEMs) typically does not include an ability to upgrade’ (Dunstall, 2019). In a 2018 interview with the author, a retired senior British military officer was more forceful in the statement that, ‘the government needs the IP otherwise it can’t do anything’ (UK Anon #1, 2018).

There are three possibilities for industrial access to the IP associated with the detailed design of a major system. First, the intellectual property has been generated within the state, or independent access has been provided to the state from a foreign source, and the IP is available for independent use for military-related purposes. Second, the information is generated within, or transferred into, the state, but not made available to the state for independent use. In this circumstance the state may hold a copy of the IP and may be able to utilise the IP in limited circumstances, but has no authority to independently make changes. This will most likely involve a DO-FC subsidiary of a multinational company. The combat system software for the *Collins* class submarine is an example, with Australian Defence holding a copy of the software domestically, but suggestions for variation need to be passed back to the US for consideration, agreement and implementation (AUS Anon #4, 2019). Lastly, the information is generated by a FO-FC entity and not made available to the state. The distinguishing feature in this circumstance is that the state has no access to anything related to the intellectual property except through the offshore owner.

Capability and capacity

Capability and capacity within both industry and the government client organisation are required if a state seeks the ability to pursue operational advantage and freedom of action. In a defence industrial context, *capability* can be considered as ‘a skill, facility, process or technology needed to design, develop, produce, repair or maintain products used by the Department of Defense’ (US DOD, 1996: 3), and delivered at an acceptable level of proficiency (Nagarajan and Prabhu, 2015). *Capacity* is about quantity, and whether there “is enough”. That is, whether the products and services that are needed can be delivered in the quantity and in the timeframe that is needed (Vincent, 2008). Capability without capacity will therefore leave the defence force wanting. Capacity is an irrelevant consideration if the capability does not exist. Both are therefore required.

Capability and capacity in industry

As discussed in the introductory chapter, capability in defence industry is required to develop, deliver, support, and prepare military systems, the defence organisation, and associated personnel at all levels. Adequate capacity is also a necessary element of the ability to control industrial activities associated with both operational advantage and freedom of action. With regard to capacity, multiple authors (Bitzinger, 2003a, 2003b, 2016; Gholz and Sapolsky, 1999a, 1999b; Sapolsky and Gholz, 1997, 2001; Hall and Markowski, 1994) have highlighted that excess capacity is a cost on defence budgets through the maintenance of unused or inefficiently utilised facilities and workforce. Excess capacity may be appropriate if there were an expected requirement to surge defence industrial production or support an increased operational tempo, but such considerations are outside the scope of this thesis and the assumption is therefore made that capacity is adequate, or it is not.

Whilst capabilities are developed through training, learning and experience (Rockart and Dutt, 2015; Smallwood and Ulrich, 2004), such development requires time and investment and, once developed, needs to be maintained through repeated doing. That is, projects of sufficient scope and scale need to be regularly initiated in order for skills to be exercised (Drezner *et al*, 1992; Schank *et al*, 2011b; Clegg, 2012). Capability can therefore be lost if not sufficiently exercised, and if lost will need time to recover. Fausset *et al* (2017), Svensson, Angelborg-Thanderz, Borgvall and Castor (2013), and Wang *et al* (2013) have all highlighted the decay in skills that occurs with non-use, and that the extent of the decay is a function of the extent of the non-use. The time taken to rebuild skills is therefore also impacted by the extent of the decay. Whilst such a conclusion may be somewhat self-evident, the impact can be significant, with the UK Secretary of State for Defence noting in the 1980 Defence Estimates that:

> Defence capability takes a long time to build. It cannot be acquired or re-built suddenly if, after it has been allowed to run down, the international scene darkens (Secretary Defence, 1980: 2).

The implications of decay in industrial capability and capacity, and the challenges in rebuilding, are also demonstrated in the UK *Astute* program as the gap between the *Vanguard* and *Astute* submarine projects:

> led to a situation in which submarine design and build skills atrophied …, resulting in a costlier and lengthier Astute procurement effort. The issue is not that the gap should have been avoided, but that the MOD neither anticipated the impact of the gap nor factored into the cost and schedule estimates the need to rebuild industrial base capability (Schank *et al,* 2011b: xii).

One other aspect of industrial capability that needs consideration is how capability relates to the industrial activities of innovation, design, production, upgrade, and update-upkeep. A former Commander of British forces in Iraq has alluded to the difference in requirements across these activities in a statement to a House of Commons Defence Committee (HCDC) inquiry into the development of defence equipment that:

> just doing support availability contracts on a support basis does not necessarily preserve the highly skilled aspects of systems engineering, of design engineering and of development engineering (Commons, 2010: 49).

Simply put, the level of the defence industrial capability required for update-upkeep is less than that required for upstream tasks in the capability life cycle. Three additional observations arise from this statement. First, training, learning and experiential factors will differ across the activities. The development and maintenance of appropriate capability and capacity will therefore differ. Second, time and investment are required to move from one activity into an upstream one (from update-upkeep to production, for example), as new capabilities and appropriate capacity will need to be developed. Third, given that operational advantage is focused on being able to address innovation and design, the ability to control defence industry activity associated with operational advantage is more challenging that those associated with freedom of action.

Capability and capacity in the government client organisation

In the government client organisation, typically a combination of a public service and an operating Navy when considering submarines, capability and capacity are required to fulfil three separate, but inter-related functions. The first is the Design Authority (DA), described in an Australian National Audit Office (ANAO) report as ‘the organisation responsible for the initial design, design review and internal design approval of materiel systems; and for the design of modifications or changes to a materiel system’ (ANAO, 2009: 12). The UK Maritime Regulator has a similar description as being 'the authority vested in an individual or organisation to systematically ensure the fitness for purpose of a design through life and to make design decisions, or approve changes to the design intent, or material state’ (Regulator, 2013: v). The Submarine Institute of Australia (SIA) has been more descriptive in that:

> the Submarine Design Authority has a crucial role every stage in the life of a submarine: from concept, detailed design, production, through life support to disposal. Having managed the production of the detailed design it oversees the construction, much as an architect does in a large construction project. Prior to the submarine going into service and throughout its life a named individual within the design authority certifies that the vessel (1) meets the customer's requirements, (2) is fit for its intended purpose, (3) is safe to operate, and (4) complies with relevant legislation and regulations.

The second function is that of acceptance, with specific client-side positions typically delegated the authority for conduct of this activity (Defence, 2020b; Regulator, 2013). The Australian Defence Test and Evaluation Strategy (Defence, 2021a) and a report from the ANAO (2015) both make specific reference to the need for a skilled workforce, together with the appropriate test facilities, for the conduct of T&E associated with the acquisition of major systems. The third function is the ongoing responsibility as the ‘parent navy’, described by the ANAO as encompassing:

> the extensive knowledge, engineering services, configuration control, supply support, training, intellectual property, and technical comprehension of design concepts, principles and systems which affect the through-life support of a naval platform that is vested in, and managed by, the Navy of origin. It also requires development of an industry capacity that includes an understanding of the design philosophy to the extent necessary to design and implement modifications and undertake major repairs safely and effectively (ANAO, 2009: 12).

Suitable technical and managerial skills are therefore required to ensure that all aspects of design, development and sustainment can be properly managed, and decisions impacting on operational advantage and/or freedom of action can be made.

In a study into the development of defence capabilities formed by complex systems-of-systems, Kordova and Fridkin (2021) have found that the greatest risks to project success are inadequate human and other resources. Sufficient capacity across all the above functions is therefore a necessary component of being able to control the industrial processes associated with the development and the sustainment of a submarine.

Defence industry structure and corporate control

The global defence industry has changed substantially since the end of the Cold War, with corporate amalgamations resulting in the creation of a smaller number of very large companies that operate globally, often with subsidiaries established in other locations (Hartley, 2007; Hayward, 2009; Hartley and Sandler, 2003; Heidenkamp, Louth and Taylor, 2011). These subsidiaries are under the management control of the headquarters (Sageder and Feldbauer-Dusrtmuller, 2019), typically in the United States, the United Kingdom or Europe for global defence companies (Beraud -Sudreau *et al,* 2020; Marksteiner *et al*, 2021). The structure of the local DIB, and the extent to which control is exercised from foreign locations, will therefore be a feature of defence industry sovereignty. One aspect of this control, namely the potential impact of industrial structure on access to IP, was summarised in the Australian 2010 Defence Industry Policy Statement as:

> Technology transfer and intellectual property (IP) restrictions pose another significant challenge. Multinational defence industry primes and suppliers are highly protective of their IP as a major source of competitive edge. Domestic legislation, such as export control laws, can also prohibit them from transferring their proprietary technologies, even to wholly-owned subsidiaries in closely allied countries (Defence, 2010a: 22).

As noted by a range of commentators (Clark, 2020; UK Anon #1, 2018; Blackham, 2018; Fruehling, 2017; Defence, 2010a; Besch, 2019; Brabin-Smith, 2006; Barrie, 2006; Thomson, 2006; MOD UK, 2005, 2012), the structure of the domestic defence industry has an impact on access to intellectual property as the state will be able to acquire greater IP rights for developments funded and conducted internally. In turn, government policy towards the domestic defence industry plays a key part in the structuring of that industry. The approach taken by the US, where the Department of Defense cannot 'contract a programme related to national security with companies 'controlled' by foreign governments' (Beraud-Sudreau *et al*, 2020: 19) and where the defence industry is tightly regulated and controlled (Heidenkamp, Louth and Taylor, 2013) is one example. In India, the recent relaxation of policy regarding the amount of Foreign Direct Investment that is automatically allowed in companies that manufacture defence products is likely to lead to greater foreign involvement in the defence industry (Ministry of Commerce and Industry, 2020; Kumar, 2020). The Australian experience, with a policy that advanced the primacy of market forces for defence industrial activities, saw the diminution of the DO-DC element of industrial activity (Dunk, 2015, 2016a, 2016b; Beraud-Sudreau *et al*, 2020). Whilst Dibb (2006: 10) has suggested that 'the fact that defence is a monopsony means that it effectively determines the future shape and size of the defence industry', the structure of the defence industry also influences the realistic sovereignty goals in policy.

The discussion above has highlighted the difference between the ability to pursue activities domestically and the ability to do this independently. A domestic capability has been seen to include both DO-DC and DO-FC entities, and may therefore involve a limited ability to control. An ‘independent’ capability therefore develops when the state is not constrained by foreign ownership, or other factors, and is therefore in the position to exercise control over the manner in which operational advantage and freedom of action are addressed. The additional point that develops from this discussion is that, to have independence, the local defence industry needs to have been involved in similar activities in order to evolve design, development, and manufacturing capability and capacity. Time, and investment, are therefore required.

Industry capability-control framework

In Chapter 2, this thesis proposed a framework for sovereignty ambition in defence policy, extending from full sovereignty to having none at all. The levels in that framework have been based on the extent to which the state seeks to address the handling of its critical major systems or sub-systems. That is, the extent to which the state seeks to control the industrial processes and activities associated with operational advantage and freedom of action. This chapter has examined these activities, namely innovation, design, production, upgrade and update-upkeep, and the elements associated with the exercise of control. The elements impacting upon control have been proposed as access to, and utilisation of, intellectual property, together with having adequate capability and capacity in both the domestic industry and the government client organisation, all influenced by the structure of the domestic defence industry.

Further examination of the thesis question, how well do states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level, now requires a framework through which the extent of the translation from ambition to reality can be assessed. The first stage of this process is to examine how differing levels of IP access, together with adequacy of capability and capacity, impact upon the ability of the government to exercise control.

Figure 2 presents a diagrammatic of representation of the ways in which the elements combine to provide three levels of control. The level of control is shown in three shades of colour, with darker colours corresponding to an increased ability to control. Independent access to design IP, coupled with having adequate capability and capacity in both industry and the government client organisation, results in the ability to exercise control. That is, the elements necessary for control add in a Boolean manner. Having no access to design IP, or having inadequate capability or inadequate capacity in either industry or the government client, results in no ability to control. In the example where the state has access to the IP but lacks either the capability or capacity to utilise that IP, it is somewhat self-evident that there would be no ability to control the outcome. The situation whereby the state has access, but not independent access to IP, probably through the involvement of a DO-FC entity, together with adequate capability and capacity, results in a limited ability to control.

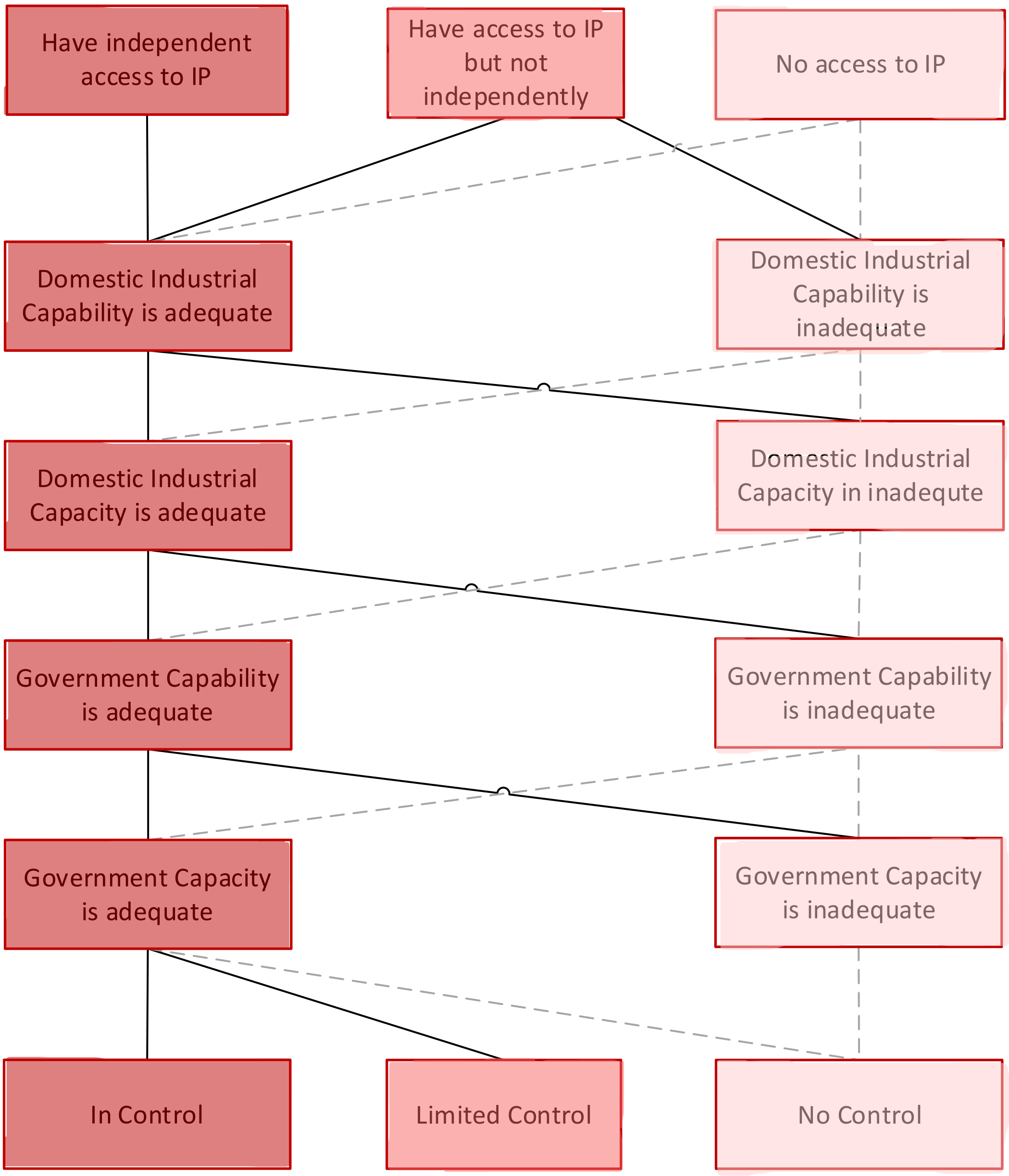


Figure 2. Control, no control traceability framework

The three-level control structure can therefore be applied to the various industrial activities, at both the all-of-system and sub-system levels, to develop the capability-control framework at Table 2. As discussed in the previous section, although T&E is an activity associated with the development and production of any system or sub-system, it is only considered within this framework at the system level as this is the activity that proves that the entire system will operate as designed. All other industrial activities are included at only the sub-system level as the system level sovereignty effects will be evident through the aggregation and presentation of sub-system results.

Figure 2 has posited a binary choice regarding both capability and capacity. This is an obvious simplification of an industrial reality where capacity, for example, may be able to produce major systems, but not at the rate desired by the government. As noted in Chapter 1, the issue of rate of production for force structure purposes is outside the scope of the thesis. The simplification at Figure 2 is therefore considered to be a suitable representation of the impact of both capability and capacity in the translation of sovereignty notions in defence policy to sovereignty outcomes at the capability level.

Table 2 – Capability-control framework

Control	**Limited Control**	**No Control**
System-Level Activities		
System Design (SD) / Systems Integration (SI) / System Test and Evaluation (T&E)		
Able to domestically control the application of system-level activity.	Able to domestically undertake the system-level activity but not to control all aspects of that activity.	Not able to undertake the system-level activity domestically.
Sub-system Level Activities		
Innovation / Design / Production / Upgrade / Update-Upkeep		
Able to domestically control the various sub-system activity.	Able to domestically undertake the sub-system activity but not control all aspects of that activity.	Not able to undertake the sub-system activity domestically.

Whilst Figure 2 and Table 2 apply at both the system and the sub-system level, it is important to recognise that the manifestation of the ability to control differs for systems and sub-systems. At the system level, control means that the government client organisation has the ability to determine requirements, set system specifications, approve the design and any design changes, and accept the final product. At the sub-system level, the ability to control can be considered as the ability, in theory, of the government to determine requirements, set specifications for the sub-system, engage directly with a local entity for the production and acceptance of that sub-system, and then to provide that sub-system to the Prime Contractor as Government Furnished Equipment (GFE) for integration into the system. Whilst sub-system activities are mostly likely to be undertaken as a sub-contract from the Prime Contractor, the government as the system client does retain the ability to engage directly with a sub-system producer, and control sub-system development and production, if the various control elements are in place.

The capability-control framework at Table 2 is an important feature of the Sovereignty Diagnostic, and in how this thesis addresses the thesis question. However, in order to address the thesis question, it is necessary to relate the framework to the submarine capability under consideration, and from this to ascertain the levels of defence industry sovereignty that arise from the control. This is the focus for the remainder of this chapter.

The submarine

The submarine has been selected as the major system focus for this research as it has defining features that make it a useful focus for the proposed approach. The function of a submarine is to remain unseen, and to undertake missions where remaining unseen provides an operational advantage. Stealth is therefore the predominant concern of the submarine and it has previously been argued that 'without stealth the conventional submarine is nothing more than a slow, incompletely armed and equipped submersible corvette with poor endurance' (Dunk, 2001a). A submarine has also been variously described as 'a highly complex, expensive, safety-critical asset central to Defence's capability' (Economics References Committee, 2014: para 2.31), 'among the most complex systems that countries produce' (Schank *et al,* 2011: ix), and 'the most complex military platforms in existence' (Insight Economics, 2017: 8). Moreover, submarines require a significant commitment to research and development in order to maintain operational advantage (Briggs, 2012), particularly with regard to the signature management aspects of the platform and the maintenance of stealth advantages (Yule and Woolner, 2008; Patrick, 2014). In addition, from a general maintenance perspective, submarines have been described as being challenging to keep operational (Andersson, 2015) and 'maintenance heavy' (Coles, Greenfield and Fisher, 2012: i). Therefore, not only is the submarine technologically challenging in design and production, but also expensive and industrially intensive throughout its operational life.

The submarine is a complex system comprised of multiple sub-systems and myriad components, typically sourced from multiple suppliers, and a functional breakdown of the system is therefore required to guide the discussion of defence industrial sovereignty. Examination solely at the total system level will be too broad to provide any useful insight into the translation of notions of sovereignty in defence policy into sovereignty outcomes at the capability level. Conversely, an examination of the system at the component level will highlight differences between individual submarines of the same class due to variations in configuration. Moreover, given the number of components involved in complex systems, a decomposition at the component level will be excessively time-consuming to develop and overly complicated for analysis purposes.

The functional breakdown of the submarine system therefore needs to be of sufficient fidelity to identify those elements of the system that are critical for operational success, and hence links to the consideration of development or maintenance of sovereignty in defence industry (Defence, 2010a, 2013, 2016a, 2016b, 2018; MOD UK, 2005, 2012; Commons, 2006a, 2006b; Conroy, 2018; Jenkins, 2013; Rubin, 2017, 2018b). The breakdown adopted for this thesis is consistent with the approach advanced in submissions to an Australian Senate inquiry into shipbuilding by the industry association Australian Business Defence Industry (ABDI)[5] (2014, 2017) that proposed that any major system can be considered as comprising five platform categories (enclosure, mobility, services, habitability and platform management), and four combat system categories (combat management, sensors, effectors, and communications). This description is broadly aligned with other system functional descriptions as advanced by Olivier and Balestrini-Robinson (2014), by Hause and Hallett (2016), with the SCMILE framework (Lowe *et al*, 2006; Lowe and Flahive, 2017) developed by the Australian Defence Science and Technology Organisation (DSTO), and with the Swedish LOVENTP service structure proposed for network based defence (Gustavsson *et al*, 2004). The general characteristics associated with the platform system and the combat system will be examined in the following sections.

Submarine platform system

As considered above, the submarine platform system comprises the sub-systems in the enclosure, mobility, services, habitability, and platform management system categories. Whilst all categories in the platform system are necessary for the functioning of the submarine, they are not of equal importance when considering the operational advantage that the submarine might possess. As the defining feature for a submarine is stealth, and as the stealth and associated vulnerability of a submerged submarine are fundamentally determined by its signature (Dunk, 1999, 2001a; McIntosh and Prescott, 1999, Patrick, 2014; Moore, 2019; Fusil, 2007; Briggs, 2015b; Goldrick, 2016), the categories closely associated with the generation and characterisation of both the passive and the active signatures are of greater importance for operational advantage than those that are not.

[5] The author of this thesis was also the author the referenced Senate Inquiry submissions in a role as Executive Manager of Australian Business Defence Industry.

The passive signature of the submarine is largely derived from its movement through the ocean and through the earth's magnetic field, and is influenced by the shape of the hull, from the propeller and associated machinery to drive this movement, and from other rotating machinery within the submarine hull (Howard, 2011; Joubert, 2006). Mobility, and the associated propulsion arrangement, are therefore closely related to submarine stealth. The submarine also has a reflected signature when impacted by an acoustic pulse from an active sonar. In this circumstance, the shape and construction of the hull are the determining factors and reflection-reducing coatings, also known as anechoic tiles, are often used to minimise sonar reflections. The submarine hull and external fittings, the enclosure in the above functional breakdown, and to a lesser extent the internal machinery to drive the submarine through the water, are therefore critical elements in the achievement and preservation of submarine stealth.

Submarine combat system

The combat system is critical to the ability of the submarine to fight and provides the interface for the submarine to the outside world. This interface includes the operation of sensors and the detection, classification, identification and tracking of contacts, the receipt of externally-provided intelligence and other information via communication channels, and the deployment of devices such as decoys and weapons (Lockheed Martin, 2021; Shackleton, 2016; Becker *et al*, 2011). The combat system also provides for the manipulation and presentation of incoming data, and thereby allows the crew to make sense of the situation within which the submarine exists at any point in time and to plan subsequent actions. The combat system therefore provides the basis upon which decisions can be made to move, to observe, to track, to avoid, to defend, or to attack (Kumar, George and Jagathyraj, 2014; Becker *et al*, 2011).

The submarine system functional categories presented in this thesis each comprise a variety of sub-systems that, for convenience, have been aggregated to a level conducive for the discussion of sovereignty in defence industry. In the sensor domain, these components will include active and passive sonar systems, together with electro-magnetic and visual systems. Given that the submarine's strength is in remaining submerged and undetected, whilst simultaneously detecting other bodies, the predominant sensor will be acoustic. The communications category is similarly comprised of multiple communications channels; specialised data and radio links covering wide frequency bands, and a low band-width acoustic communication channel. The combat system also comprises multiple effectors, including weapons such as torpedoes and missiles, and self-defence measures such as noisemakers and other decoys.

The functional categories and sub-systems outlined above, namely those associated with sensing, communicating, and reacting, provide the input to, and receive output from, the combat management system (CMS) which manages and aggregates incoming and stored information, and presents this information in a form to optimise decision-making. The CMS also incorporates the utilisation of specialised decision aids such as environmental models, signature-related information, and the presentation and visualisation of tactical options to assist in the understanding of a developing tactical situation. Such decision aids may be specific to the class of submarine, to the local operating environment, to tactics developed and employed by the state, or to a specific threat. Therefore, whilst the combat system in total is fundamental to the management of the combat aspects of a submarine, the CMS is the element that welds the separate components into a coherent whole and is unequivocally associated with decision-making and the utilisation of the submarine as an effective unit (Kumar, George and Jagathyraj, 2014; Becker *et al*, 2011).

Prioritisation of submarine categories

Chapter 1 noted that an examination of the prioritisation of certain categories of the submarine would be used as means through which to assess the "how well" element of the thesis question. This approach has been adopted on the premise that some categories of submarine capability have greater impact for operational success and hence, should a state wish to have independence with respect to the development and maintenance of operational advantage, a higher level of sovereignty may therefore be of more value in these categories. Given that the submarine needs to survive and fight in a difficult and threatening environment, the categories of most importance for operational success are those that enable stealth to be maintained, for the safety of the platform and the crew to be upheld, and for situational awareness to be developed and exploited (Briggs, 2015b, 2015c; Goldrick, 2016; Lockheed Martin, 2021; Shackleton, 2016; Becker *et al*, 2011; Howard, 2011; Joubert, 2006; Kumar, George and Jagathyraj, 2014). The possession of an operational advantage in the enclosure, mobility, CMS, and sensors categories is therefore of greater benefit in these categories. The early planning for the *Astute* class SSN also supports this premise in the reported statement by the then British Assistant Chief of the Naval Staff (Operations) that:

> (a) submarine that will encounter its Soviet opponent at an inherent disadvantage must be of questionable value… Therefore, if we are to keep an SSN force at all, its members must be designed to out-detect and out-fight the Soviets. Whether they need also to out-run, out-dive and out-communicate is perhaps open to argument (Hennessy and Jinks, 2015: 543).

A focus on prioritisation therefore can provide a view into how well policy aims are being realised. Table 3 shows the priority order for sovereignty of the submarine categories where priority 1 (P1) reflects importance for survival through stealth, and the development and utilisation of situational awareness for decision-making, and priority 2 (P2) comprises all other categories.

Table 3. Prioritisation of submarine categories for operational advantage

Priority	Category	Rationale for prioritisation
P1	Combat management	Required for situational awareness and navigation, and hence for survival.
	Enclosure	Critical impact upon stealth and on survival.
	Sensors	Required to provide the external information that forms the basis of environmental understanding and tactical manoeuvring.
	Mobility	Critical impact upon stealth and hence on survival.
P2	Effectors	Necessary for operational success, but priority 1 categories ensure that the effectors can first be put in the right place.
	Services	Has an impact upon stealth through rotating machinery and radiated noise, but these have a lesser effect than either the enclosure or mobility.
	Communications	The SS/SSN is not networked in real time to other military assets but requires communications for tasking, reporting, and receiving operational intelligence and other information. The SSBN requires ongoing connection to the outside world.
	Habitability	An enabling and support function
	Platform management	An enabling and support function

An additional point that develops is that, whilst utilisation of prioritisation in this way is a useful device for the consideration of operational advantage, the same does not apply for freedom of action. Whilst the former is associated with operational success, the latter is required to allow the submarine to deploy and to manoeuvre to a fighting position: float in order to move in order to fight in the Navy parlance. That prioritisation as described does not apply to freedom of action can be seen in the impact on the operational availability of the Australian *Oberon* submarine from a withholding of spares by the RN during the Falklands War (Senate, 2014; Briggs, 2015a) and on limitations on the operational availability of the *Collins* submarine due to inadequate planning and investment for maintenance activities (Coles, Greenfield and Fisher, 2012; Coles, Greenfield, Fisher and Davies, 2014; Coles, Greenfield, Spark and Savage, 2016). In addition, the cannibalisation of *Astute* submarines in the UK to ensure operational availability, where some cannibalised parts were of inconsequential value (NAO, 2017), also highlights that freedom of action requires all aspects of the submarine to be available, and not just prioritised elements.

Depicting and comparing levels of control

Graphics are a well-known method through which to display complex data for ease of interpretation and hence to gain information, often through the identification of patterns (Unwin, 2020; Albers, 2015). In this thesis, levels of control have been represented at Figure 2, and Table 2 has applied those levels across the submarine capability. This section provides a description of how the levels of control are represented through the novel use of a circumplex diagram to depict the submarine categories, the various industrial activities that relate to those categories, and the level of control that is able to be exercised over the industrial activities.

The circumplex diagram at Figure 3 is an atypical, innovative use of this type of diagram to depict three-dimensional data, rather that the two-dimensional data that is usually displayed in circumplex diagrams (Olson, Russell and Spenkle, 1989; Posner, Russell and Peterson, 2005; Olson, 2000; Jing, Mao and Chen, 2019). The third dimension, the level of control that is able to be exercised over industrial processes associated with the submarine, is added to the diagram through the application of colour.

The diagram is split both vertically and horizontally into hemispheres. The vertical split is made to delineate the combat system and platform system categories. The horizontal split shows P1 functional categories in the top half and P2 categories at the bottom. The right side of the diagram shows the combat system categories in the order combat management, sensors, effectors, and communications extending clockwise from the top. The left side shows platform system categories in the anti-clockwise order enclosure, mobility, services, habitability, and platform management.

The three inner-most rings of the diagram represent the all-of-system activities of system design, systems integration, and test and evaluation respectively from the centre. A break is shown in the diagram to signify a distinction between systems-level and sub-system considerations. The five concentric rings extending progressively outward from the break represent industrial processes in the order innovate, design, production, upgrade, and update-upkeep. The level of control is shown in three shades of colour, with darker colours corresponding to higher levels of control as developed from Figure 2 and Table 2. As will be evident in the following section, this approach can be used to identify levels of sovereignty in defence industry that result from that control. Figure 2 and Table 2 therefore feed into the circumplex representation as shown at Figure 3, a Sovereignty Diagnostic that can be used to depict sovereignty over a submarine at any time.

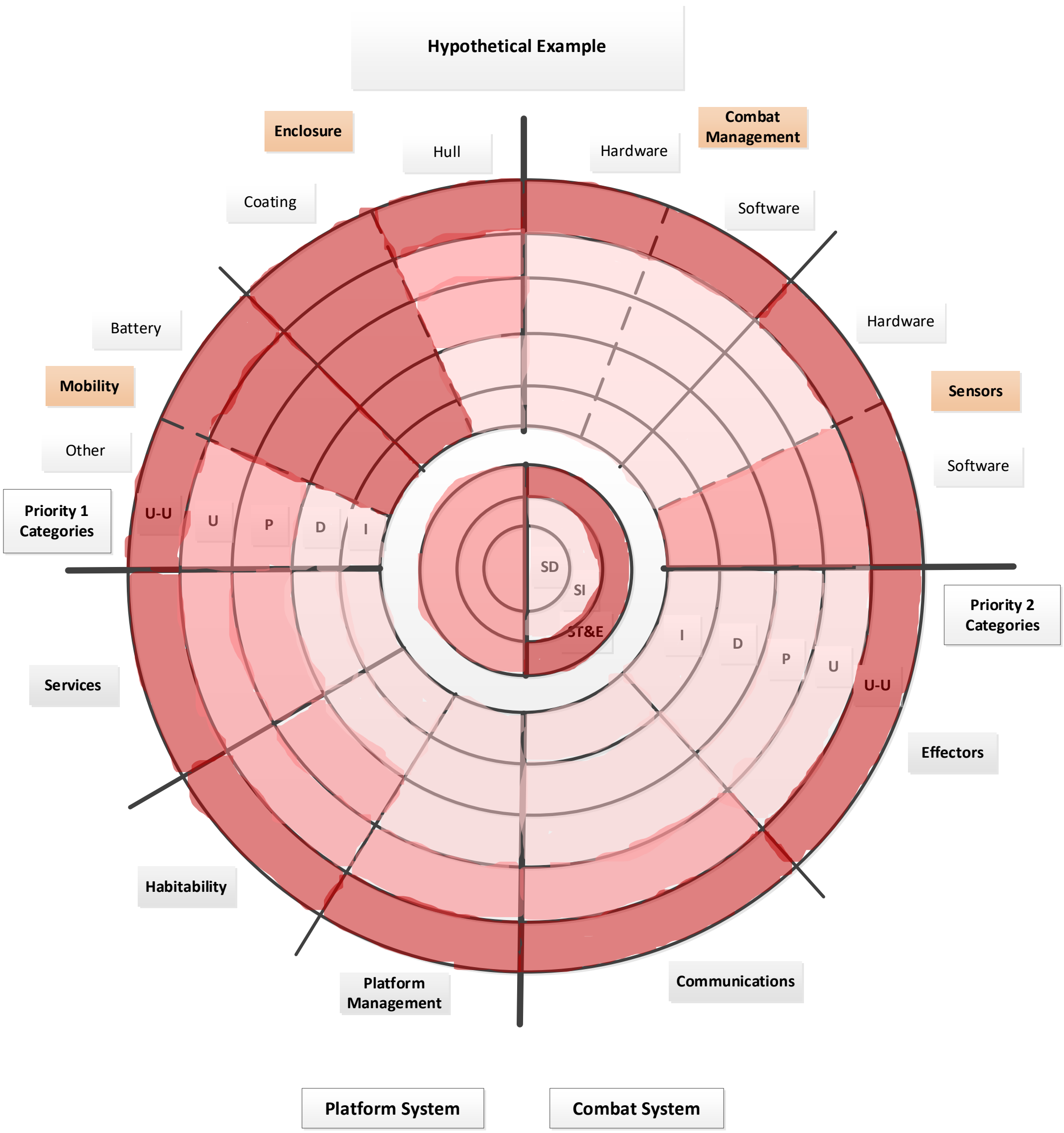


Figure 3. Presentation of level of defence industrial control over a hypothetical submarine

Both policy and capability diagrams will be presented in the format shown at Figure 3. The convention adopted for this thesis is that planned level of control from defence industry policy is presented on the left, and that realised in capability is on the right. In the event that only policy is shown in a diagram, the circumplex will occupy the left side position as if a capability diagram were also present. For ease of comparison, the circumplex diagrams associated with the Australian case study are red, Sweden orange, and UK green with all following the approach to shading as described above where greater levels of control are in darker shades.

The Sovereignty Diagnostic achieves four objectives associated with obtaining an answer to the thesis question. The first is to provide a means to depict the level of control implied by the government policy ambition for sovereignty. The second is to provide a similar depiction for the achieved ability to exercise control, thereby allowing the two to be compared and to determine how closely the achieved reality has met the intent. This is examined in further detail in the following section. The third is to provide a window into whether the control sought for a military system is in the categories determined as being priorities for the successful operation of that system. This is a factor in the assessment of wellness. The fourth objective is to provide a mechanism that will allow comparison between submarines in different jurisdictions, between different classes of submarine in the same jurisdiction, or between the same class of submarine at different points in time to investigate trends associated with defence industry sovereignty, and by extension in operational sovereignty, that may exist.

The circumplex diagrams can therefore be used to provide a snapshot comparison of policy intent for control and that achieved in capability at selected temporal points. Given that there is typically a temporal lag between the statement of intent in policy and its manifestation in the submarine, it is somewhat unrealistic to simply compare policy and capability at the same point in time. Such a comparison would merely highlight the difference between the as-stated policy as applied to the submarine, rather than how well the sought-after control has been realised. For this reason, it is important to also include the depiction of sovereignty sought as expressed in an earlier policy. To highlight that one combination is the period under consideration, and one represents the position at an earlier time, the diagrams in the case studies will be shown in a vertical configuration where diagrams from earlier periods will be shown above those representing a later time. Movements in the ability to control, and therefore in defence industry sovereignty, across time will therefore be evident.

Defence industry sovereignty and patterns

This thesis has proposed a Sovereignty Diagnostic as a means to consider and visualise the levels of control over a submarine. The visualisation may therefore show a pattern, a ‘noticeable regularity … that repeats … in a predictable manner (Jancy, 2018), that can be used for ‘characterising their common properties and classifying them with respect to these properties into classes’ (Volf and Novak, 2018: 1). For this thesis, that characterisation is the level of sovereignty that arises from the way in which the state is able to exercise control over industrial activities associated with the submarine. This section therefore completes the translation from sovereignty in policy to sovereignty in capability by linking patterns of control in the circumplex diagrams to levels of defence industry sovereignty. As introduced in Chapter 2, these levels are full, focused, limited, rudimentary, limited rudimentary, and none, and are described and depicted below.

Given that the ability to control is a fundamental aspect of sovereignty, an inability to exercise control signifies no defence industry sovereignty. States with *no sovereignty* will therefore have a circumplex diagram that displays no coherent patterns across the submarine categories or the industrial activities.

Rudimentary sovereignty is an increase from having no sovereignty, as illustrated in Figure 4. Rudimentary sovereignty develops when the state has the ability to independently address the industrial activities associated with the update-upkeep of a major system. Rudimentary sovereign would allow the state to undertake general maintenance activities, but not to independently upgrade or otherwise improve the system or sub-system under consideration. A state would need to have rudimentary defence industry sovereignty over all submarine categories to avoid the possibility of being operationally constrained in the employment of that system.

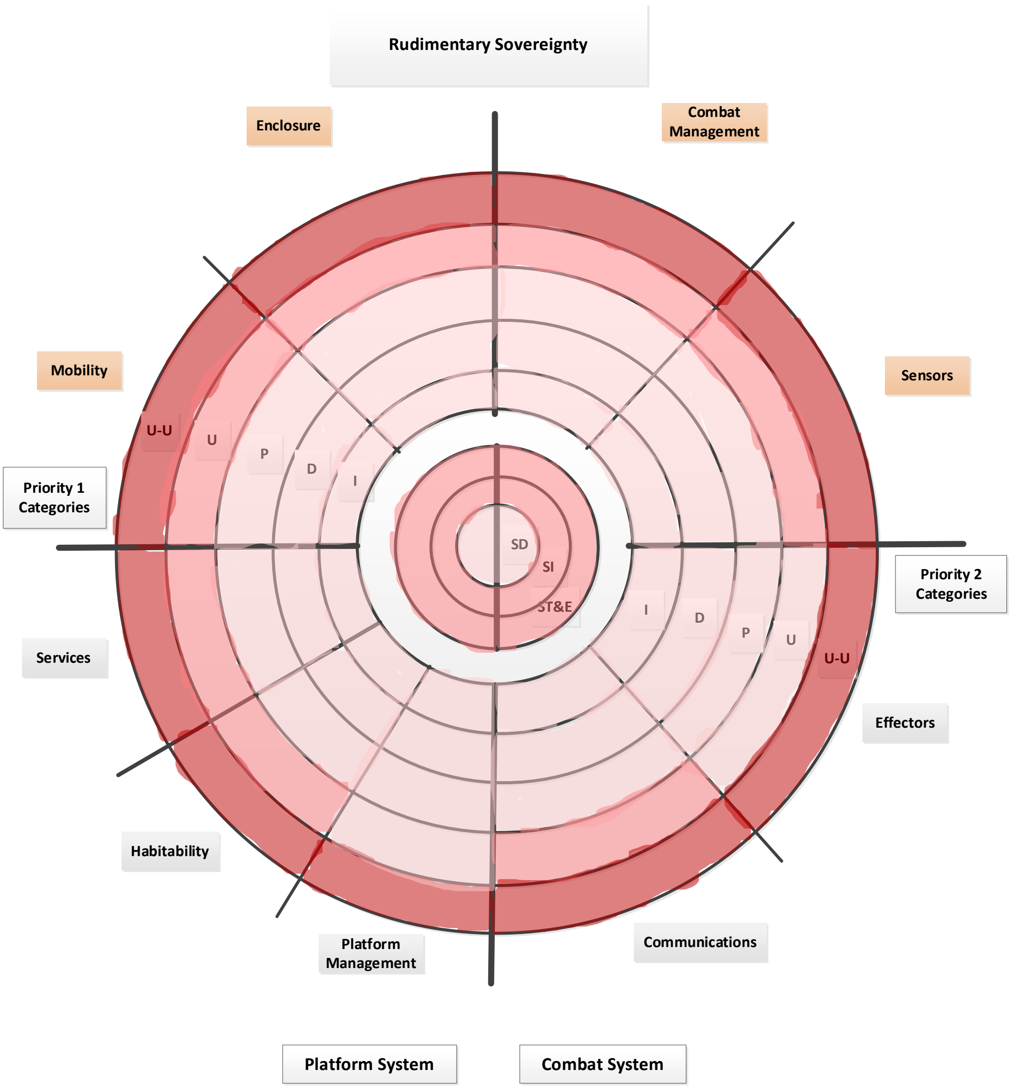


Figure 4. Example of Rudimentary Sovereignty

As demonstrated through examples with Australian *Oberon* and *Collins* submarines, and the *Astute* SSN, the ability to control the deployment of a submarine as, when, where and for the period required, freedom of action, is dependent upon having all aspects of the submarine maintained and supported. A break in the update-upkeep ring of the circumplex diagram therefore signifies that rudimentary sovereignty does not exist and, consequently, the state is dependent upon an external provider for the maintenance of that component. Figure 5 depicts the situation where *limited rudimentary sovereignty* exists as the state does not have independence in the way that it addresses update-upkeep over the entire submarine. In the example below, in the mobility category, the state is only able to exercise limited control over the update-upkeep. Whilst the associated intellectual property in this example would be held within the state, independent access to that IP would not be available, and, while the update-upkeep could therefore be conducted domestically, the state would be dependent upon a DO-FC entity for the provision of support.

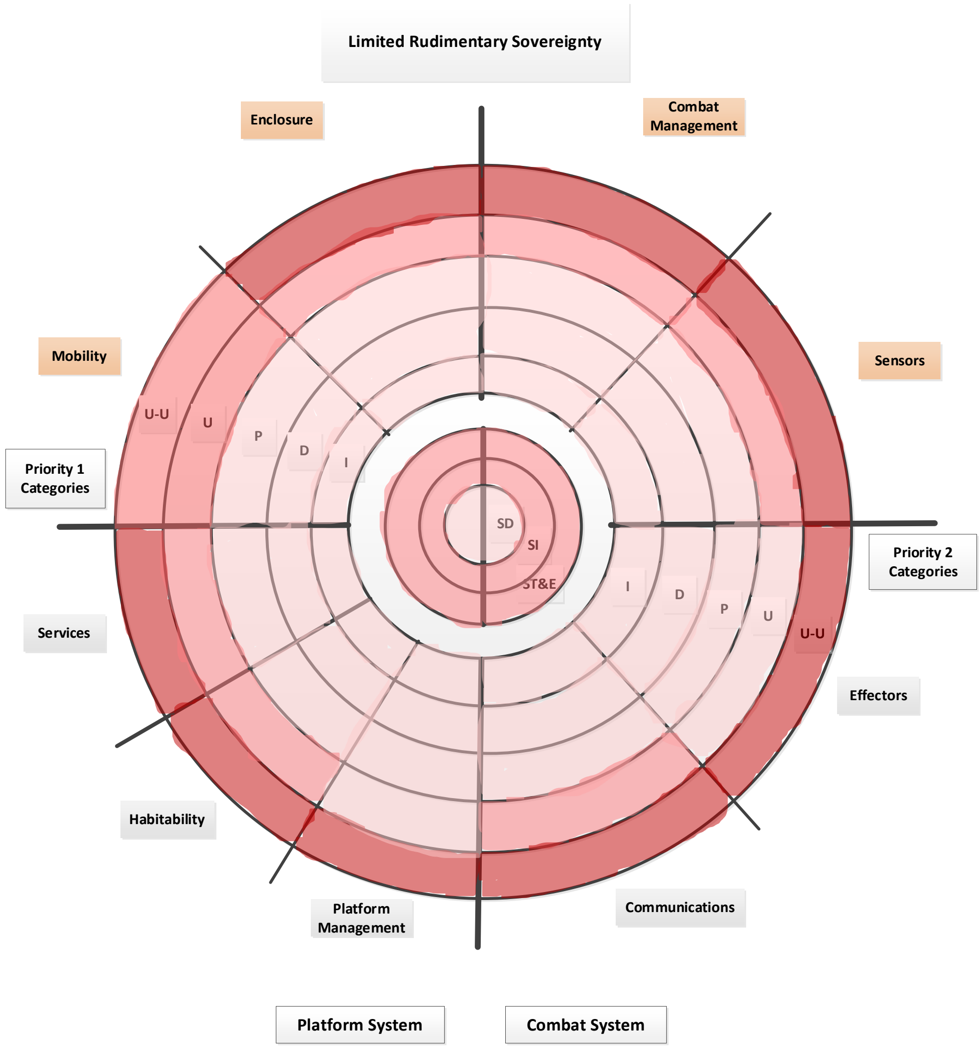


Figure 5. Example of Limited Rudimentary Sovereignty

A further restriction to rudimentary sovereignty develops where the intellectual property associated with the update-upkeep of one or more categories is not available in-country. In the example at Figure 6, the state has no access to IP associated with effectors and is therefore dependent upon a FO-FC entity for the provision of all associated industrial activities, including update-upkeep, and has no ability to exercise control. As described earlier in this chapter, withholding or non-availability risks are associated with this situation and, consequently, the state therefore has no sovereignty.

Figure 6. Example of No Sovereignty due to break in Rudimentary Sovereignty

The next level in the state's ability to control industrial processes develops when the state can exercise limited control over one or more submarine categories. Figure 7 provides an example of *limited sovereignty* over the combat management and sensors categories together with rudimentary sovereignty. In this example, the state would be able to undertake industrial activities associated with the combat management and sensors categories, but would not be able to do this independently, and would therefore be reliant upon DO-FC entities for these activities. It is important to note that limited sovereignty in every category, coupled with limited sovereignty in the all-of-system activities, only results in limited defence industry sovereignty, and operational sovereignty, for the submarine.

Figure 7. Representation of Limited Sovereignty for Combat Management and Sensors

Focused sovereignty arises when the state has control over one or more of the functional categories of the submarine, or key sub-systems associated with those categories. A state could have focused defence industry sovereignty in some areas, with limited sovereignty in other categories. Multiple levels of sovereignty exist simultaneously in the example at Figure 8. Focused sovereignty in the combat management category means that the state could independently develop and utilise IP in this priority category. Limited sovereignty is also shown in the sensors category, with the implications of this as discussed for Figure 7. In addition, rudimentary sovereignty exists for the submarine.

Figure 8. Example of Focused Sovereignty for Combat Management and Limited Sovereignty for Sensors

The final level of sovereignty is *full sovereignty*, which results from the state being able to exercise control over all the industrial processes across all submarine categories. This includes the all-of-system design, systems integration, and T&E. A circumplex diagram associated with full sovereignty is therefore uniformly dark red as shown at Figure 9.

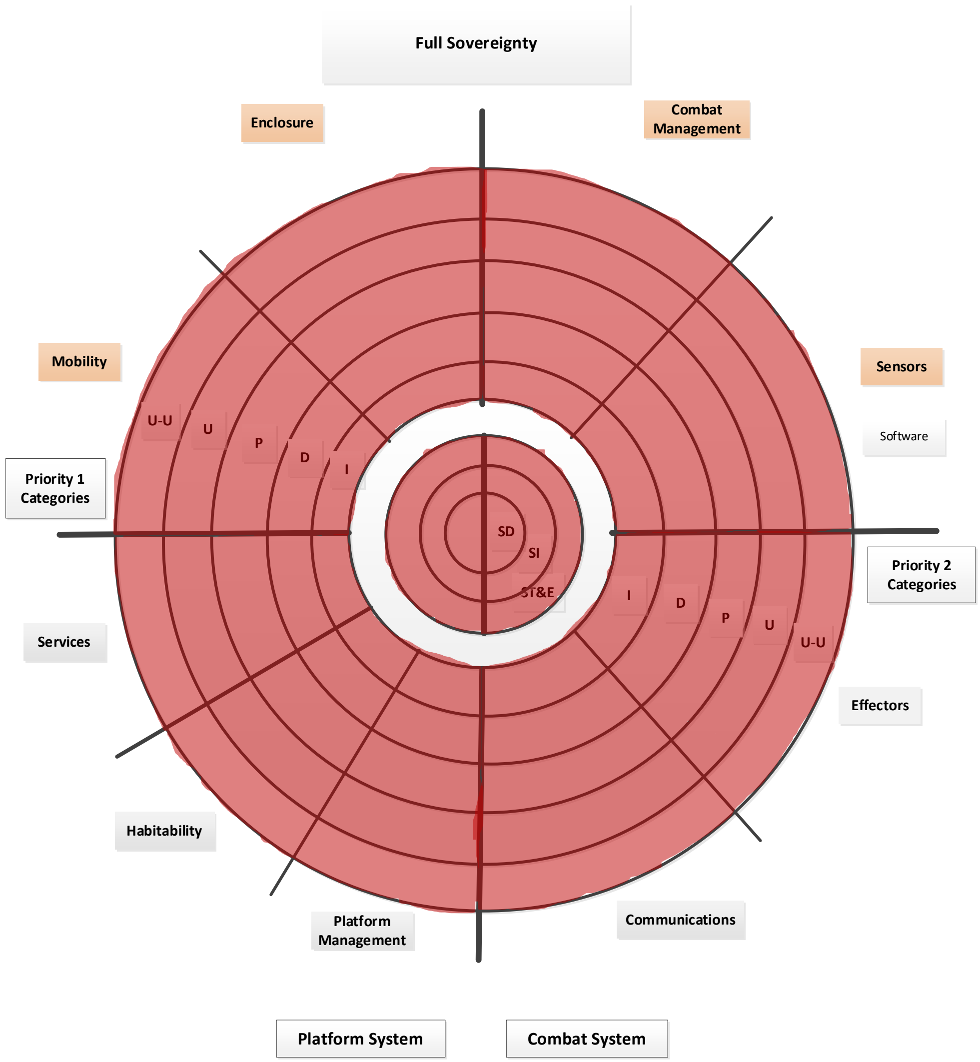


Figure 9. Example of Full Sovereignty

Conclusions

This chapter has considered the development of sovereignty at the capability level, by addressing the ability to control defence industry activities across the submarine. A description of control, based on access to IP, and the adequacy of capability and capacity in both the domestic defence industry and in the government client organisation, has been advanced. The submarine capability has also been categorised into a combat system and a platform system, and the categories that comprise each have been prioritised for their importance to operational success. This categorisation is an important factor in the determination of wellness.

The submarine capability, the industrial activities that are applied across the submarine, and the level of control over these activities have been combined in a novel and innovation utilisation of a circumplex diagram to graphically depict where control is exercised. The level of defence industry sovereignty that the state possesses over the submarine can therefore be discerned from each circumplex diagram. The form of the circumplex diagram at Figure 3 is critical in allowing a visual comparison of the pattern of control in different combinations of policy and capability. Graphical representation in this way also allows comparisons between the same submarine at different points in time, and for different classes of submarine in the same and different jurisdictions. This graphical representation, together with the framework that describes the various levels of industrial control, has been advanced as a Sovereignty Diagnostic.

Collectively, Chapter 2 and Chapter 3 provide the foundation upon which to answer the thesis question how well do states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level. **Error! Reference source not found.**The wellness aspect of the t hesis question is directly addressed in the Australian, Swedish and United Kingdom case studies in the following chapters.

4 – Case Study – Australia

God and the soldier we both adore

when at the brink of ruin, not before.

The danger over, both are like requited,

God is forgotten, and the soldier slighted.

– **Rudyard Kipling**

Introduction

Australia is an open, multi-cultural, democratic society with a political and legislative structure based on the United Kingdom Westminster system. Australia is also a western-orientated state in an Asian setting. This translocation of identity and attitudes, coupled with long-standing ties to a parent culture far-removed in the northern hemisphere, initially resulted in a general feeling of strategic anxiety in the Australian psyche (Lantis and Charlton, 2011; Burns and Eltham, 2014). The result has seen Australia consistently seek security support from “great and powerful friends”, initially the United Kingdom and subsequently the United States.

Historically, at least until the advent of long-range missile systems, Australia’s geography has also provided a degree of natural security, with extensive maritime approaches to the west, east and south. Australia’s defence outlook has therefore predominantly been focused north, with an emphasis on the maritime approaches. Australia’s security concerns have reflected its small population, primarily located in the southeast and southwest corners, and with comparatively sparsely populated areas in the north where neighbouring countries are closest. Although there have been threats to Australian interests, and Australia has engaged in conflicts in protection of those interests, since 1945 the direct threat to continental Australia has been low. The rise of China, and developing geostrategic competition between China and the United States in East Asia and the Western Pacific, has seen the epicentre of global major power tension move closer to Australia’s areas of interest than has been the case for many decades.

Australia shares a similar strategic outlook with many other western countries through promotion of a global rules-based order and adherence to a set of international norms and behaviours (Rudd , 2008; Defence, 2016b; Bisley, 2018; Smith, 2017; DFAT, 2017). In the recent past Australia has maintained a small but technologically advanced defence force with a supporting civilian administrative organisation. The military is raised, trained, and sustained by a budgetary commitment as depicted in Figure 10. The defence force is focused on a variety of tasks including the defence of Australia, on making contributions to regional security and stability, and the provision of humanitarian assistance.

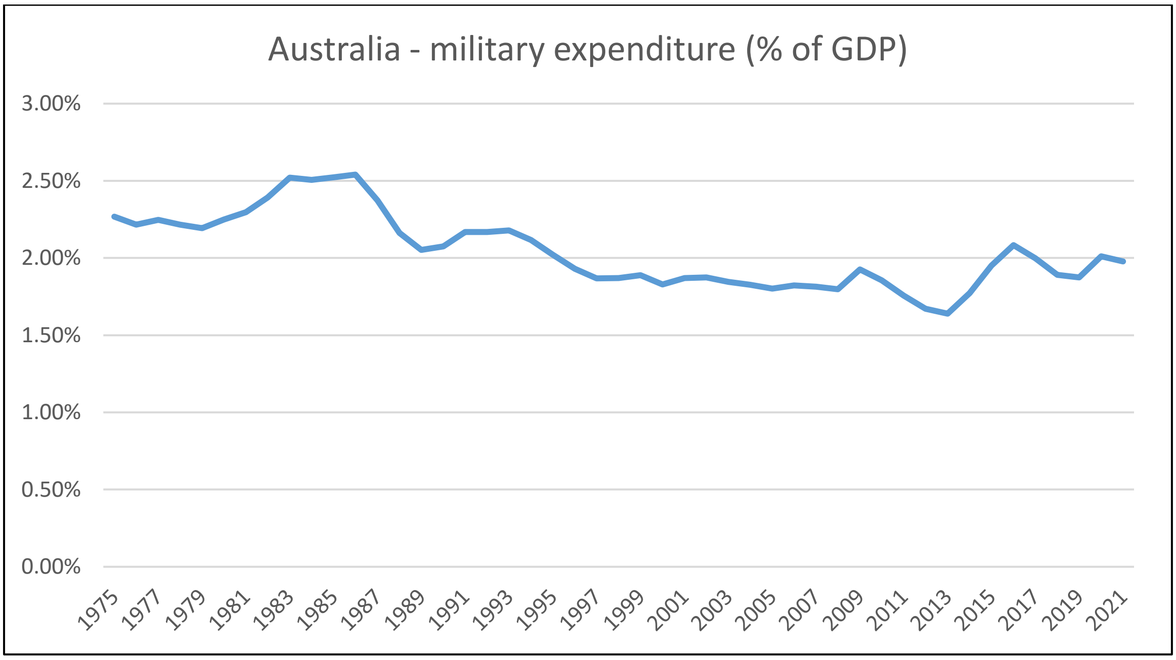


Figure 10. Australia military expenditure as percentage of GDP (SIPRI, 2022)

Australia meets the definition of Hill (2000) as a medium power as it is not a superpower, and does not need to rely upon external support for all aspects of its security. It also meets the Carr (2014) definition as it arguably has the ability to protect its core interests. That is, Australia is capable of addressing some, but not all, of its potential security challenges. A recognition of the need to conduct independent military operations is a recurring theme in defence policy (Defence, 1972, 1976, 1987, 2000, 2016a, 2020a; Beazley, 2009). The contribution of defence industry to national security has long been recognised by Australian governments, in parallel with an acceptance of a general need to rely upon external sources of supply for technologically advanced systems due to the small domestic market and the associated costs of developing military systems.

This case study into sovereignty in Australian defence industry covers a period of significant change in the structure and capability of that industry sector. At the time that the operational requirements for the *Collins* submarine were developed in the early 1980s, a large proportion of defence industry activity was conducted through GO-GO factories and dockyards. This included the Williamstown

Naval Dockyard (WND) in Victoria, and the Garden Island Dockyard (GID) and Cockatoo Island Dockyard in New South Wales (NSW). These government owned and operated enterprises were increasingly seen as inefficient (Howe, 1983), and the establishment of the *Collins* submarine production capability in the late 1980s and early 1990s coincided with successive waves of restructuring, commercialisation and privatisation of the government-owned industrial capabilities (Rawlinson, 1989; Wylie, 2010a). In the intervening years between the planning for *Collins* and the planning for its successor, the defence industry landscape in Australia changed substantially and the majority of Australian defence industry is now owned by, and ultimately controlled from, foreign locations. This case study will examine operational and defence industrial sovereignty within this environment.

Bounding the Australian case study

The Australian case study will be bounded in accordance with the principles outlined in the introduction; that is, by military system, by capability, by space, and by time. The military system boundary is the submarine, primarily the *Collins* class but with a lead-in through the *Oberon* class. The temporal boundary commences in the latter stages of the *Oberon* submarine and extends across the life of the *Collins* class submarine to the publication of the 2018 DICP (Defence, 2018). The rationale for the selection of this boundary is that the period, whilst extensive, contains key events important for the study of sovereignty in defence industry. The first is the transition from the *Oberon* class to *Collins*, and the government's ambition regarding operational and defence industrial sovereignty at that time. This transition has been recognised as being of fundamental importance in both a strategic and industrial sense with McIntosh and Prescott (1999: 1) having stated that:

> (t)he *Collins* class submarines constitute, on the one hand, probably Australia's most important strategic asset for the decades starting 2000, and on the other, Australia's most ambitious and technically advanced defence industrial project ever.

The second key event covers a series of problems experienced with the *Collins* including, but not limited to, the critical areas of submarine noise and the combat system. How these problems were addressed, and the resultant impacts on industrial activity, are illustrative of wider issues associated with sovereignty. The life of the *Collins* class therefore provides a means through which to compare the level of defence industrial sovereignty for a single military system over time, and to correlate this with both stated government intent as expressed in policy and in developments in the wider defence industry landscape.

Structuring the Australian case study

Policy considerations in Australia with respect to operational and defence industrial sovereignty in the context of the *Collins* class submarine can be categorised into four broad periods. The initial period concludes in 1983 and covers the latter part of the life of the *Oberon* submarine. This period includes some important developments within the Australian defence industry and serves as a baseline for the later discussion. The second covers the time of increasing emphasis on defence self-reliance during the Hawke and Keating Governments from 1983 to 1996, and also covers the planning for, and introduction of, the *Collins* class submarine. The third period extends across the entire life of the Howard Government from 1996 to 2007 and includes a focus on the primacy of market forces in the industry space and on industrial rationalisation. This period also includes the coming to light of, and the determination of solutions to, a multiplicity of problems associated with the production of the *Collins* in Australia. The final period commences with the election of the first Rudd Government in 2007 and continues to the release of the DICP by the Turnbull Government in 2018. The latter two periods encapsulate the majority of the operational life of the *Collins* submarine to date and have also seen significant restructuring within the Australian defence industry.

Policy and industry baseline (prior to 1983)

Defence policy

The *1972 Australian Defence Review* (Defence, 1972), followed by the *1976 Australian Strategic Analysis and Defence Policy Objectives* paper and the initial *Defence White Paper* (DWP) (Defence, 1976) highlighted a number of concepts that have become enduring policy positions for Australia. Whilst the emphasis given to these various concepts has varied over time, this combination of documents, together with Cabinet consideration and reaffirmation in the following years (Minister for Defence, 1979, 1980) established that (1) whilst the existential threat was low there was a need for Australia to be able to undertake some operations independently; (2) as a country with a small population and a correspondingly small military force there was a need to maintain an ongoing technological edge over the militaries of regional countries; (3) alliances, and particularly the ANZUS alliance with the United States, were important for Australian security; and (4) a capable local defence industry was necessary to support the force-in-being.

These pillars of defence policy also give rise to corollary positions that have also become enduring features of Australia's defence policy. The low level of threat resulted in the use of warning time and force expansion as Australia's chosen policy. The former is encapsulated in the DWP statement that 'major threats … are unlikely to develop without preceding and perceptible indicators' (Defence, 1976: 10) and that the period of deteriorating strategic circumstances would be sufficiently long to enable the defence force to be expanded to meet the expected contingency. Warning time has therefore allowed defence planners in Australia to balance between the maintenance of a credible force and making commitments to defence that might ultimately not be required (Brabin-Smith, 2012, 2013). The concept of warning time presupposes a sufficiently versatile core force capable of timely expansion to meet a developing threat, and of a defence industry capable of responding to increased demand (Brabin-Smith, 2023).

A need to have the ability to conduct independent operations also gave rise to a need for self-reliance. This was recognised in that, while the existential threat to Australia was low, there were credible scenarios that Australia might be required to address independently and, as a consequence, 'self-reliance in situations of less than global or major international concern will lay claim to being a central feature in the future development of Australia's defence policy' (Defence, 1972: 11). As considered in Chapter 2, self-reliance also brought a need for operational sovereignty and consideration of both operational advantage and freedom of action. Operational advantage was implicit in the desire to maintain a technological edge over the military forces of regional countries to offset the limitations of a small population, but was made possible through the relationships with, primarily, the United States and the United Kingdom. This situation was succinctly stated in the 1976 DWP as:

> being small, but having enduring close relationships with large and advanced countries, Australia is able to avoid the crippling cost of developing most of its own military equipment. However, we must be in a position to select and employ equipment with skill, and we need to sustain its efficiency once in service with minimum dependence on overseas sources (Defence, 1976: 48).

The latter part of the above statement refers directly to freedom of action, and the memory of having had ammunition resupply withheld by Sweden during the Vietnam War (Feldman, 2013) was still evident. The potential impact from a lack of sovereignty, and the inherent risks associated with reliance on supply from overseas, had also been identified in the *Strategic Basis of Australian Defence Policy 1975* in the statement that:

> (t)he minimum requirement for our defence industry is that it should have, after making a judgement of the continuing availability of overseas sources, the capability to support the relevant Service capabilities in independent combat operations of limited intensity, possibly

> involving protracted operational deployments. This necessitates the availability of industrial support for such modification, servicing and repairing as might need to be undertaken locally of Service equipment likely to be needed, together with a suitable technological base that can be expanded to meet increased development and production requirements envisaged in these circumstances (as repeated in Fruehling, 2009: 540).

A report by the Joint Committee on Foreign Affairs and Defence (JCFAD) (1977: 6) into defence industry reiterated this potential vulnerability with respect to freedom of action as the committee was:

> concerned … that (during low-level conflict) … some overseas countries from whom we obtain military supplies might, perhaps because of a possible clash in the issues involved in the conflict, decide to cut off supply of equipment and spares despite stringent contractual or treaty arrangements.

The policy intent for a degree of self-reliance therefore implicitly advocated a corresponding importance in the need for, at the minimum, *rudimentary defence industrial sovereignty*. Such a position involved a balance between the need for ongoing access to high technology weapon systems through alliance partners offset against the risks associated with being dependent upon external actors. The importance of domestic industrial capability was recognised in the 1976 DWP statement that:

> where there are specialised segments of private industry which are of major importance to the support or production of Service equipment, or the maintenance of essential capabilities to support Service activities, the Department of Defence continues to be prepared to consider selective assistance to keep the capacity alive in industry (Defence, 1976: 52).

Australian defence industry

Australian defence industry has always had the significant disadvantage of a small domestic military market for systems and services. Moreover, the geographic location of Australia as a first world, Western-orientated society in an Asian setting, far removed from states with similar economic standing and cultural outlook, has inhibited the ability of Australia to overcome aspects of this market weakness through the collaborative development of military systems with close neighbours. The industrial options for Australian governments have therefore been largely restricted to building its own or buying foreign-designed systems, with the choice depending on the costs and benefits that each approach provided.

In the early period of this case study, the Australian defence industry largely comprised GO-GO factories and dockyards. The 1968 *Strategic Basis* noted that the local industry had 'the capability in its complex of Government factories and private industry to equip and support our defence forces to a considerable degree', and furthermore that:

> (m)ajor weapons systems will still need to be purchased from overseas sources as the small numbers required and the complexity of the equipment tend to make the economics of complete local production unattractive. From the operational and logistic viewpoint, there are advantages in the establishment of maintenance, repair and test facilities and of capacity, both in Government factories and in private industry, for production of items of defence equipment which are required for our forces (as repeated in Fruehling, 2009: 389).

The initial Defence White Paper in 1976 also recognised that, in some circumstances, foreign-sourced military systems might be unsuitable and that locally developed solutions could be required. Moreover, the White Paper also noted the need to reduce the dependence on overseas support for equipment fielded locally and to 'ensure that the Defence Forces can be supported and maintained in Australia' (Defence, 1976: 51). Early defence policy, and DWP 76 implicitly, therefore accepted the link between the ability to conduct independent operations and the defence industrial sovereignty necessary to support both operational advantage and freedom of action. Moreover, the challenges in resourcing such operational sovereignty, and the corresponding need to prioritise spending, is evident in a statement given to the Parliament by Defence Minister Killen in 1978 that:

> (n)o subject so readily attracts oversimplified solutions as the dilemma as to how much added cost we should accept in order to divert money to Australian industry to help raise its production in high technology, as against importing it at lower prices because of the advantage of largescale production in major allied countries (Killen, 1978: 2196).

Resources were limited and choices therefore needed to be made as to where that funding would go. That is, choices were required into which operational and industrial capabilities would be sovereign, and which would be supported by foreign suppliers. One of these capabilities was the Australian *Oberon* class submarines.

Submarines

Australia has an extended, although not continuous, history as an operator of submarines, commencing with two *E-class* boats in World War One, the transfer to Australia of six *J-class* submarines from the United Kingdom in 1919, and the commissioning of two *O-class* submarines in

1928. During World War Two an obsolete Dutch *K-class* submarine was commissioned into the Australian Navy and was used for ASW training. A continuous commitment to a submarine force has been in place since the introduction of the *Oberon* class in 1964.

The importance of submarines to the overall defence effort was recognised in the 1976 Defence White Paper statement that:

> (s)ubmarines are a potent deterrent with important functions in anti-shipping and anti-submarine warfare, covert reconnaissance/ surveillance and patrol, clandestine operations, and mine warfare. They provide the only means of sustained interdiction in areas where local air superiority cannot be established (Defence, 1976: 20).

The period of the *Oberon* submarine demonstrates the inherent tension between defence policy, the required level of investment, and operational and industrial sovereignty. The advantages of having the Australian defence industry provide local support for Australian military capabilities acquired from foreign sources was noted in the 1968 *Strategic Basis* (Fruehling, 2009) and the 1972 *Australian Defence Review* (Defence, 1972: 51) in the statement that the main aim of Defence industrial policy was:

> to ensure that the Defence Force can be supported and maintained in Australia, utilising for the provision of equipment and materiel, a combination of local industry, selective stockholding and reliable overseas sources of supply.

With respect to the submarine capability, Woolner (2001b) has highlighted that, at the time, the RAN 'was dependent on overseas suppliers for some 85 to 90 per cent of the support for the *Oberons'* and that local maintenance could be problematic as the complete documentation for the boats was not available. Australia, therefore, had limited or no access to *Oberon* platform design IP with the exception of that required for update-upkeep. In addition, Schank *et al* (2011a) have noted that the RN, not the RAN, remained the "parent Navy" for the *Oberon* submarines; that is the 'Navy of the nation that designed, built, and employed the mission system(s)' (Navy, 2016).

Figure 11 compares the level of defence industrial sovereignty sought in principle for Australian military capabilities in the 1976 DWP to that realised for the *Oberon* submarine at a similar time. The circumplex diagram highlights the following aspects of government intent with respect to defence industry and associated operational sovereignty. First, as the White Paper noted that 'Australia will continue to rely on overseas sources for the design and construction of most of the larger and more complex weapons systems' (Defence, 1976: 51), both the system design and the functional category design activities, and the production activities, are shaded light pink for no sovereignty, and hence no intent to control industrial activities. Second, DWP 1976 noted that Australia required systems integration and T&E capabilities in industry. The first is evident in the statement that the government sought the ‘capability of industry and Service establishments to modify and develop software and systems integration techniques to apply local tactical doctrine’ (Defence, 1976: 54). The commitment to T&E capabilities can also be seen in a note in the 1972 Australian Defence Review that $70m of the Defence Budget had been allocated to ‘research, development, testing and evaluation’ (Defence, 1972: 22). Both of these all-of-system aspects are therefore shaded dark red in Figure 11 to reflect the intended ability to control these activities.

Defence Policy – 1976 DWP | ***Oberon* submarine**

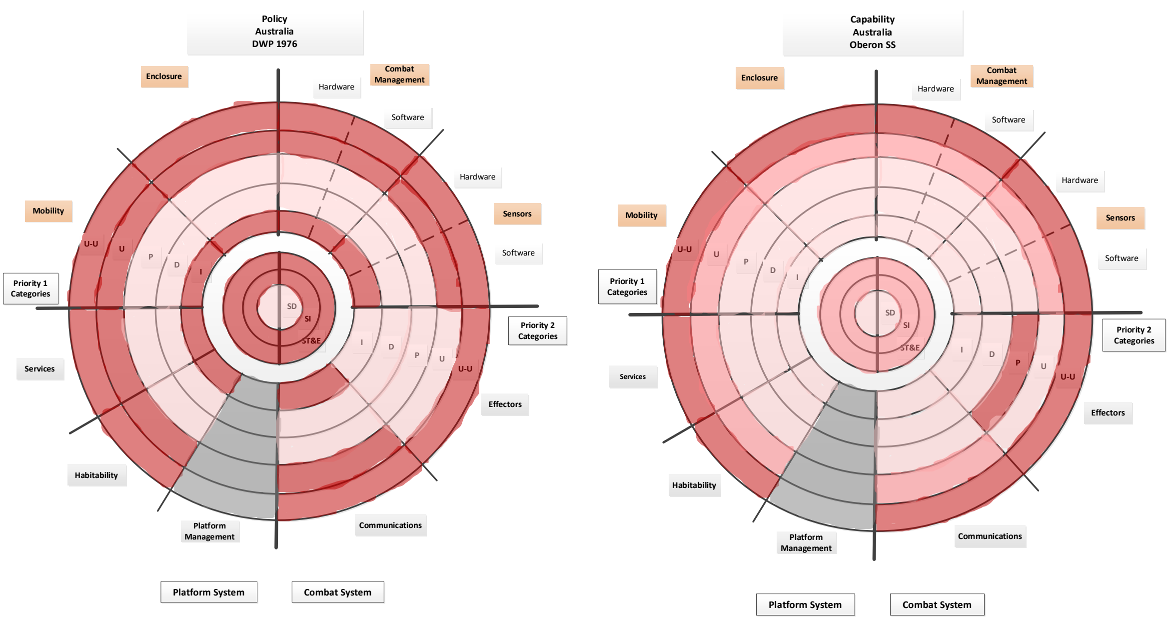


Figure 11. Comparison of control in defence industrial activities for *Oberon* class submarine against policy prior to 1983

The third policy aspect of Figure 11 to highlight is the general commitment to, and control over, a domestic research capability, and the ability to undertake both ‘local research on topics of special importance to Australian defence’ (Defence, 1976: 48). Finally, the upgrade ring, and the update-upkeep ring, of the circumplex diagram are dark red to reflect the policy intent for ‘the capability to repair, maintain, modify and adapt to the Australian environment a wide range of equipment and weapons systems’ (Defence, 1976: 51).

The capability diagram at Figure 11 is primarily shaded in light pink as Australia had neither the intellectual property nor the domestic capability and capacity to undertake most industrial activities for the *Oberon* submarine, with three exceptions. The first was in update-upkeep. At this time, general maintenance was undertaken by trained sailors and government employees, which implies that these personnel had the necessary information and training necessary for the update-upkeep task. The second was in system level systems integration and T&E, and in upgrade, with those activities being undertaken in Australia by Vickers Shipbuilding and Engineering Ltd (VSEL) as a DO-FC entity (Beazley, 1989; Yule and Woolner, 2008). There was, therefore, a limited ability to exercise control. The third was the Australian production of the Mk 8 heavyweight torpedo (HWT), the primary submarine weapon, as a "build-to-print" activity at the RAN Torpedo Maintenance Establishment (RANTME) at Neutral Bay in Sydney (Curran, 2013). The *Oberon* submarine did not have a platform management system and this functional category is therefore blanked out[6].

The large discrepancy between the diagrams is not unexpected as Australia was in the early stages of establishing both an operational and industrial submarine capability and was reliant upon the RN for the development and technical support of the *Oberon* submarines. Government investment was required to build industrial capability and capacity, but reliance upon a trusted ally meant that a large part of that investment could be minimised, avoided, or postponed. The downside of this situation was that control of the entirety of integrated logistics and technical support rested with a foreign organisation and if such support was withheld or delayed, the ability of Australia to operate its submarines as required could be compromised. This situation was, however, broadly consistent with the experiences of other nations that have introduced submarines into their military forces. The introduction of the *Foxtrot* class submarine into the Indian Navy, for example, also involved a heavy reliance on the Soviet Union and the involvement of Soviet personnel in domestic maintenance activities (Hiranandani, 2004).

Reliance on the United Kingdom for the majority of *Oberon* spares became more of a concern over time as the RN changed its focus to developing its SSN capability, with a consequent lack of 'money (and) expertise for improving its conventional submarines' (Yule and Woolner, 2008: 22). The lack of independent access to *Oberon* intellectual property was therefore a potentially serious inhibitor of any future Australian desire for operational advantage and for freedom of action related to its submarine capability.

To address the emerging limitations on operational performance that reliance on the RN had brought, and particularly as the RN did not want to participate in the development of the *Oberon* combat system, Australia progressively developed its own combat system know-how and know-why;

[6] L3Harris claim to be the first to invent and implement the concept of an Integrated Platform Management System on a Royal Canadian Navy Halifax frigate in the early 1980s (L3Harris, 2022).

activities that resulted in the implementation of the indigenously designed Submarine Weapons Upgrade Program (SWUP) (Killen, 1979a; Horobin, 2018, 2019b; Briggs, 2019; Johnson, 2022). The subsequent establishment of the Submarine Warfare Systems Centre (SWSC) at HMAS Watson in 1979 also provided the means for Australia to continuously develop the *Oberon* combat system to 'achieve the maximum level of fighting efficiency and tactics for the submarine force' (Killen, 1979b: 2). The importance of these developments has been summarised by Woolner (2009: 52) as:

> (t)he SWUP introduced a computerised system and the latest generation of submarine sonars. Integrating the acoustic data was complex and it took some changes of equipment and much RD&E effort but, when perfected, the RAN *Oberons* became the first conventional submarine capable of operating the USN's nuclear attack submarine weaponry of Mark 48 torpedoes and Harpoon sub-surface launched anti-shipping missiles. The SWUP also consolidated the capacity of the Submarine Warfare Systems Centre, both to sustain advanced electronics and to research further developments.

The change in the ability to exercise control over defence industrial activities with respect to the post-SWUP *Oberon* submarine is depicted in Figure 12. The SWUP was designed, integrated, and tested by organisations within the RAN, with industrial support from foreign sub-system providers (Johnson, 2022), and provided independent access for government to the SWUP all-of-system design intellectual property. At the time of implementation of the SWUP, both the capability and the capacity to undertake the required industrial activities resided in government organisations and not in Australian industry, and there was no significant Australian industry involvement in the original SWUP work (Johnson, 2022). The know-how was present in internal RAN engineering directorates, in the RAN Trials and Assessing Unit (RANTAU), and in the government owned Cockatoo Dockyard. The know-why resided in individuals with exposure to British and US systems, and in the RAN Research Laboratory (RANRL) (Johnson, 2010, 2022). The all-of-system industrial activities for the combat system are therefore coloured dark red to reflect the ability of the government, through the RAN and related organisations, to control related industrial activities.

Figure 12. Comparison of control for defence industrial activities for pre and post-SWUP *Oberon* against policy in 1976 Defence White Paper

The combat management and sensors categories in Figure 12 have been bifurcated to highlight differences in the ability to control applying to hardware and software. In both categories, hardware continued to be accessed from FO-FC entities, and with upgrade and update-upkeep provisions unchanged. The situation with respect to software was, however, significantly different. With respect to combat management software, the SWUP program provided Australia with the ability to control innovation, design, upgrade, and update-upkeep. With respect to sensors, the SWUP involved the domestic integration of sensors sourced directly from offshore suppliers, with software accessed domestically but not independently (Yule and Woolner, 2008; Briggs, 2019).

The capability developed within the SWSC was reportedly such that, when the Singer Librascope Submarine Fire Control System (SFCS) did not work as expected, local personnel were able to alter the supplied software without the supplier's knowledge, and to reverse-engineer the Harpoon missile, and thereby rectify the problems (Horobin, 2018, 2019b, Briggs, 2019). Importantly, according to retired Rear Admiral Peter Briggs, a one-time Director SWSC, the program worked brilliantly as SWSC had control over all aspects of the system from SWUP components to simulators, and could therefore develop tactics, test these in the simulators, observe operational employment, and quickly insert fixes into the software (Briggs, 2019).

The SWUP and SWSC initiatives also conducted *ab-initio* work on Harpoon missile salvo tactics and on an Automated Plotting and Chart Table (APACT), and were therefore important in terms of the ability of the RAN to control the development of the emerging combat systems elements for the submarine force. In the area of sonar processing, the developing capability of Australian industry was evident in developments such as the Passive Intercept Passive Ranging System (PIPRS) from research conducted by the Defence Science and Technology Organisation (DSTO) (DSTG, 2021). The position with respect to effectors had diminished as the change from the Mk 8 HWT to the US Mk 48 torpedo and the Harpoon missile meant that these weapons were imported directly from the US rather than being produced in Australia.

Australian defence industry sovereignty over the pre-SWUP *Oberon* submarine was *rudimentary*, with control exercised over update-upkeep. The *Oberon* SWUP improved the ability to control some defence industry activities and resulted in *focused sovereignty* for the software aspect of the combat management system and *limited sovereignty* for the software aspect of the sensor category as shown in Figure 12. The limitations associated with rudimentary sovereignty were exposed on at least one occasion when spare parts were withheld by the United Kingdom during the Falklands War with resultant operational limitations on RAN submarines and an inability to put to sea (Senate, 2014; Briggs, 2015a). In addition, the declining ability to source spare parts in general led to 'maintenance delays, higher costs and a depleted submarine capability' (ASC, 2018: 3).

Increasing Self-Reliance (1983 – 1996)

The change of government from the Fraser Coalition government to the Hawke Labor Government in 1983 saw an increased emphasis placed on self-reliance in defence policy. This position was emphasised by Resources and Energy Minister Evans (1984: 1956), in a speech to the Australian Senate addressing the *1983 Strategic Basis* document, when he stated that:

> befitting Australia's status as an independent nation, provision for self-reliant national defence should command priority in our defence policy; it should guide the structure of the Defence Force and the development of supporting infrastructure.

Additional guidance on the new government's focus was also provided by Ministers Scholes and Howe (1984) in the release of a *Defence Policy for Australian Industry* that addressed defence industry policy as a subsidiary of defence policy, noted ongoing issues associated with the Government's defence facilities, linked defence self-reliance with the capability of the local defence industry, and noted that there were elements within the defence industry sector that should command a greater priority with respect to the allocation of resources. The Government's policy towards defence was later further refined and defined with the appointment of Kim Beazley as Minister of Defence, and the commissioning of the *Review of Australia's Defence Capabilities* conducted by Paul Dibb, with the remit to examine defence forward planning, to advise on appropriate capabilities, and to make judgements on issues that included the balance between readiness and long-term investment.

The period of the Hawke and Keating Governments saw the above-mentioned review of the Strategic Basis, the 1986 review of defence capabilities conducted by Dibb (1986), Defence White Papers in 1987 and 1994, and a Force Structure Review in 1991. A 1990 review by Alan Wrigley into the civil-military relationship also included proposals for the greater use of civil infrastructure and industry in supporting defence activities (Wrigley, 1990). Importantly for defence industry, a detailed report that focused specifically on this sector and its activities was also published in 1992 (Price, 1992).

Policy

Although the concept of self-reliance had been promoted in the previous White Paper (Defence, 1976), the discussion had been conducted in terms that 'Australia will continue to rely on overseas sources for the design and construction of most of the larger and more complex weapon systems' (Defence, 1976: 51). The *Review of Australia's Defence Capabilities* reiterated previously-expressed risks associated with foreign supply and the potential withholding of industrial support in the statements that 'a measure of protection against restriction of overseas supply is appropriate', and that the 'industrial capacity to maintain, repair and adapt defence equipment to the Australian environment would be fundamental to our combat effectiveness' (Dibb, 1986: 13). These statements therefore emphasised the importance of sovereignty in mitigating certain operational risks. The 1987 Defence White Paper, *Defence of Australia*, extended this position and emphasised the importance of sovereignty in critical areas in the statement that 'defence self-reliance demands increased indigenous capabilities in areas where we previously depended on our allies' (Defence, 1987: 74).

Defence of Australia therefore promoted self-reliance and sovereignty considerations beyond the ability to undertake the independent adaptation, repair and maintenance of systems acquired from foreign suppliers, and included the need for 'Australian involvement in design, development and production to acquire the necessary detailed knowledge, skills and facilities' (Defence, 1987: 76). Furthermore, the link between operational and defence industrial sovereignty was implicit in the statement that it was the Government's policy to 'concentrate scarce indigenous resources in areas where we have special operations requirements' (Defence, 1987: 78), and that the 'Government's policy of self-reliance in defence calls particularly for the enhancement of our own capabilities for technological support, modification and development' (Defence, 1987: 69).

In these statements, the government also highlighted that a higher level of defence industrial sovereignty was also required, with priority areas stated as:

> there are also some important Australian defence requirements not readily met by systems available overseas. In these cases there is a need for indigenous Australian development. This applies in particular to intelligence, surveillance and sensor equipment, together with command and control systems, which need to be tailored to Australia's specific environment (Defence, 1987: 69)

The circumplex diagram at Figure 13 highlights the policy priority placed on systems integration and T&E, and for the capacity 'to maintain, repair, modify and adapt defence equipment to the Australian environment, independently of overseas sources' (Defence, 1987: 76). An ability to control defence industry activities was therefore required. The outermost rings of the diagram, representing the upgrade and the update-upkeep activities, are therefore coloured dark red. The statement above, and the emphasis placed on sensors, and command and control systems, results in the innovation and design aspects of these categories being coloured dark red in Figure 13. In the other categories deemed to be of high priority for operational advantage, namely enclosure and mobility, only the innovation activity represents a stated intent to be able to control due to the need to:

> be able to determine the performance in our own environment of equipment of both overseas and local origin and to modify and adapt overseas equipment as necessary to improve its performance in our likely theatres of military operations. For this we need a detailed knowledge of our physical environment … so that we can understand its influence on the conduct and effectiveness of operations and the performance of equipment and systems (Defence, 1987: 70).

Defence Policy (1987 DWP)

Figure 13. Illustration of intentions for the ability to control defence industry activities from the 1987 Defence White Paper

In the effector category the colouring of the circumplex diagram reflects the government intent to procure submarine weapons direct from overseas suppliers rather than develop them domestically. This assessment is supported by the 1987 DWP statement that specifically highlighted that the Mk48 torpedo and the Harpoon anti-ship missile, weapons obtained directly from the US, comprised an important element of the upgraded *Oberon* submarine (Defence, 1987).

Subsequent policy documents, including the 1991 *Force Structure Review*, the 1992 *Price Review* into defence industry, and the 1994 Defence White Paper, highlighted the importance of sovereignty in defence industry and reinforced the importance of self-reliance. The *Force Structure Review*, for example, was unequivocal in the statement that:

> Australia's national strategic policy has moved from a position of defence dependence on allies (and a consequent involvement in their strategic interests), to acceptance of … the need for self-reliance (Defence, 1991: 2).

The policy intent to develop sovereignty in defence industry over this period can also be discerned in the statement that 'Australia's capacity to support its defence effort has been strengthened over recent years by the development of an industrial sector geared to Defence needs' (Defence, 1991: 3). This was further highlighted in the *Price Review* in its description as the "fourth arm" helping to defend Australia and that prioritisation of industrial activities and capabilities was necessary as 'an effective Defence policy for industry must promote strategically relevant capabilities in local industry' (Price, 1992: 5).

The *Price Report* (1992) also emphasised the concept of prioritisation to structure the interaction and support between the Government and industry based on the strategic importance of the industry sector. First order priorities for Australia's defence industry were those considered essential to the development of the self-reliant defence posture, and included the 'industrial capability to adapt, repair and maintain the ADF's combat capabilities' (Price, 1992: 14). An ability to control these activities is inherent in this statement. Second and third order priorities, reflecting reduced strategic imperatives and a lesser defence need for domestic defence industry involvement, were also introduced. These reduced priorities included naval platforms as a second order priority. The *Price Report* therefore articulated an approach to operational and defence industrial sovereignty that had not existed in previous documents, an approach that emphasised the importance of sovereignty, and the ability to control, in critical areas.

Defending Australia, the 1994 Defence White Paper, reinforced the need to discriminate ambitions for sovereignty in the recognition that Australia's operational advantage was increasingly under threat and that Australia would therefore 'need to become more selective about identifying those areas in which we need to maintain a decisive lead, and give priority to them' (Defence, 1994b: 27). The Government's intent to adopt a more selective approach to industry, and to sovereignty, was further advanced with the statement that:

> Defence requires a capacity to modify and adapt equipment to meet the demands of Australia's environment and strategic circumstances. This includes a capacity for modifying equipment and systems acquired from overseas, optimising them for Australia's environment,

> and developing them throughout their service life to ensure they keep pace with developments in regional technology and systems (Defence, 1994b: 115).

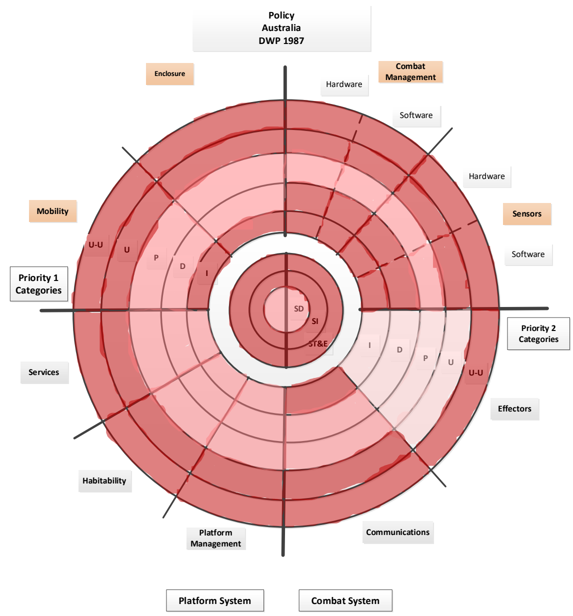
Such developments required knowledge of, and access to, the associated IP, and the ability to make use of that independent access, and the colouring of the circumplex diagrams at Figure 14 highlights the changes in submarine-related policy between the 1987 and the 1994 Defence White Papers. The combat management and sensor categories reflect the increasing importance of software and related aspects such as signal processing in policy documents. Figure 14 shows the differences between hardware and software in these categories, with the government content that, while hardware aspects could be provided by FO-FC entities, greater control was required over the software elements (Defence: 1994b).

In many respects the 1987 and 1994 policies are consistent, and reflect an ongoing desire for indigenous capability and capacity to undertake maintenance and modification of in-service systems. There was a continuing need for domestic capability in the software aspects of sensors, and in command and control systems. A significant addition to the early priorities was the inclusion of communications, with the expectation that Australia would develop and manufacture systems in these areas as evidenced by the statement that:

> the important defence-related skills which Australian companies develop will enable them to take advantage of wider commercial opportunities in Australia and in Asia and in the Pacific, and to compete for niche business in western Europe and North America (Defence, 1994b: 116).

The defence and related defence industry policies developed during the period of the Hawke and Keating Governments can therefore be seen to have extended the importance of self-reliance in the defence of Australia from earlier expressions. Moreover, a defence industry sector capable of supporting this self-reliant posture was considered to be critical. Whilst sovereignty *per se* was not mentioned, the policy positions adopted addressed the need for both operational advantage and for freedom of action, and were therefore consistent with the definition of operational sovereignty as adopted in this thesis. The need to develop the domestic defence industry to align with the operational imperatives was also emphasised, and policy positions advanced by which to facilitate this development. The following sections describe the activities and outcomes in capability that developed during the same period.

Defence Policy (1987 DWP)



Defence Policy (1994 DWP)

Figure 14. Comparison of intentions for the ability to control defence industry activities from the 1987 and 1994 Defence White Papers

Defence industry

The late 1970s and early 1980s saw an increased focus on the efficiency and effectiveness of Australia's government-owned defence facilities, and on the means through which defence industry supported the defence force. An attempt at improving the defence industrial situation was made with the establishment of the Department of Defence Support in 1982 following the interim report of the Defence Review Committee (Utz, 1982), with the aim to provide closer integration of private sector industrial capacity with the defence support effort and thereby to further the goal of increased self-reliance in industrial support for defence (Fraser, 1982). The sale of some government-owned assets to private ownership was also recommended by the Hawke Committee (Hamer, 1982).

A little more than two years following its creation, the Department of Defence Support was abolished and its functions transferred back to the Department of Defence (Hawke, 1984); again with the aim to improve efficiency and coordination across the defence acquisition and sustainment effort. Shortly after this departmental amalgamation, the Australian Government embarked on a process of rationalisation, corporatisation and privatisation of its defence-related industrial holdings and activities (Beazley, 1986). The initial actions included the sale of WND to private interests in 1987 (Beazley, 1987), and over the course of a few years the functions undertaken at GO-GO defence industry facilities were transferred into commercial organisations and the government workforce significantly reduced (Beazley, 2019). In 1989 the remaining Defence production establishments were consolidated into Australian Defence Industries Pty Ltd (ADI) as a government-owned company.

Two observations can be made regarding movements in defence industry with respect to sovereignty during this period. The first is that there was no substantial change in the structure of the industry base as the organisations that comprised that base remained predominantly as DO-DC entities and industrial control remained in Australia. The second observation is that the capability and capacity of the Australian defence industry to support the ADF was significantly developed and entrenched into the fabric of that support. Beazley (1989) has also noted that, whilst Australia remained dependent upon access to technology developed overseas, there was a substantial increase in the average local content level of equipment acquisitions, a position evident in the analysis presented at Appendix 3.

Improvements in *industry capability* are also evident in the increase in DO-DC companies that received ISO 9001 quality accreditation during this period (Millar, 2011; Beazley, 2019). The Australian Government was keen to build skills within the domestic defence industry, and ultimately in the production of major military systems in Australia to an international standard. Such a goal could only be developed over time as the domestic ability to design and produce major military systems evolved. The *Anzac* frigate project and the *Collins* class submarine project were keys to this approach, with Kim Beazley stating in a 2019 interview with the author that 'the *Collins* project did provide the higher quality result that was sought'.

Submarines

From the early 1980s, the RAN commenced the development of requirements for a submarine to replace the *Oberon* class. Following a series of separate platform and combat system pre-tender activities, in 1985 platform options from Germany and Sweden and combat system options from the United States and the Netherlands were down-selected for Preliminary Design Studies (PDS)[7]. The purpose of the PDS was to 'define the design configuration of the new submarines and to provide information to enable judgements on how many submarines are to be acquired, where they will be built and the scope and nature of Australian involvement' (Minister for Defence, 1985). At this time, given that Australia had never previously manufactured a submarine, the capability and capacity to do so did not exist and needed to be developed. The Government had a clear, stated preference for the production of the submarines in Australia due to the contribution that local construction would make 'towards providing facilities and skills necessary for through life support' (Beazley, 1985b: 6). Woolner (2001a: ii) has also stated that the decision to build the submarines in Australia 'was done because it was thought to be the best means of providing efficient and effective support throughout the submarines' service lives (and to) provide a basis for improving them over time to meet the demands of changing strategic circumstances'. Beazley (1987: 1097), as Minister for Defence, provided a synopsis of the separate threads of self-reliance, industrial involvement, and economic development associated with the submarine project in the statement that:

> (t)he biggest boost to Australian industry, however, will come from the opportunities provided to local enterprises in the development of a self reliant Australian Defence Force. … It will bring considerable high technology skills in ship construction and maintenance to this country and substantially enhance our ability to support independent maritime operations.

The initial level of control over defence industry elements associated with the *Collins* class is shown at Figure 15. Rather than being totally reliant upon a foreign provider as was the situation with the *Oberon*, significant aspects of platform intellectual property were expected to be transferred into Australia to support local manufacture and, hence, to develop the capability and capacity to undertake all the industrial activities required (Defence, 1988a). Both the capability and capacity of

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[7] The platform companies were a consortium that comprised Ingenieurkontor Lubeck (IKL)/Howaldtswerke-Deutsche Werft (HDW)/Ferrostaal from Germany, and Kockums A.B. from Sweden. The combat system companies were a group led by Rockwell International that included Singer Librascope, Thomson CSF and Computer Sciences of Australia, and the Netherlands company Hollandse Signaal Apparatin (HSA).

Australian industry were therefore expected to improve, the latter substantially with the establishment of a new construction facility in Port Adelaide. Domestic defence industry capability and capacity were also expected to increase with Australians being employed 'at all levels in the detailed design, management and construction of the submarines' (Minister for Defence, 1987: 9), and therefore to also result in the significant development of domestic know-how.

The intended end-state was to have an indigenous capability for 'fully integrated through life support, training, maintenance and development services for all the operating systems in the Collins Class submarines' (Cabinet, 1993: 3). In an interview with the author in 2019, Kim Beazley stated that the long-term aim was to produce an indigenously designed submarine. *Collins*, therefore, was the first step along a path that provided increased self-reliance, and increased operational and defence industrial sovereignty. Schank *et al* (2007) have highlighted how, in the early years of US nuclear submarine design, designers and builders gained experience through repeated, evolutionary submarine project activity. The evolution of an Australian submarine design capability therefore required ongoing improvement in the know-how of the design process, and the know-why that separated one design alternative from another. The long-term goal as outlined by Beazley with respect to defence industry capability, and sovereignty, therefore needed time to come to fruition as Australia became more adept with the repeated generation of ever-more complex intellectual property.

Figure 15 also highlights the difference between policy and domestic industrial activity for the platform and combat system aspects of the *Collins* class submarine. While the government wanted a high level of domestic industry involvement for the submarine, the challenges of achieving this for the combat system were recognised in the 1987 Cabinet Submission on the selection of ASC/Kockums/Rockwell as the preferred contractors that highlighted the involvement of Australian industry in various design, build and fit-out activities associated with the platform, but noted that:

> compared to the platform, local content in the combat systems is limited by the fact that a substantial element … must be imported because it is neither practical nor economic to establish Australian production for the many specialised electronic items involved (Minister for Defence, 1987).

The ministerial statement above, therefore, clearly recognised differences in the direction for the development of the *capability* and the *capacity* of Australian industry with respect to the submarine platform and the combat system (Defence, 1988a, 1988b). Technology transfer into Australia for components of the platform system was a deliberate strategy to develop Australian industry, and hence the ability to support the Collins class once operational, but that for the combat system focused on software elements rather than hardware.

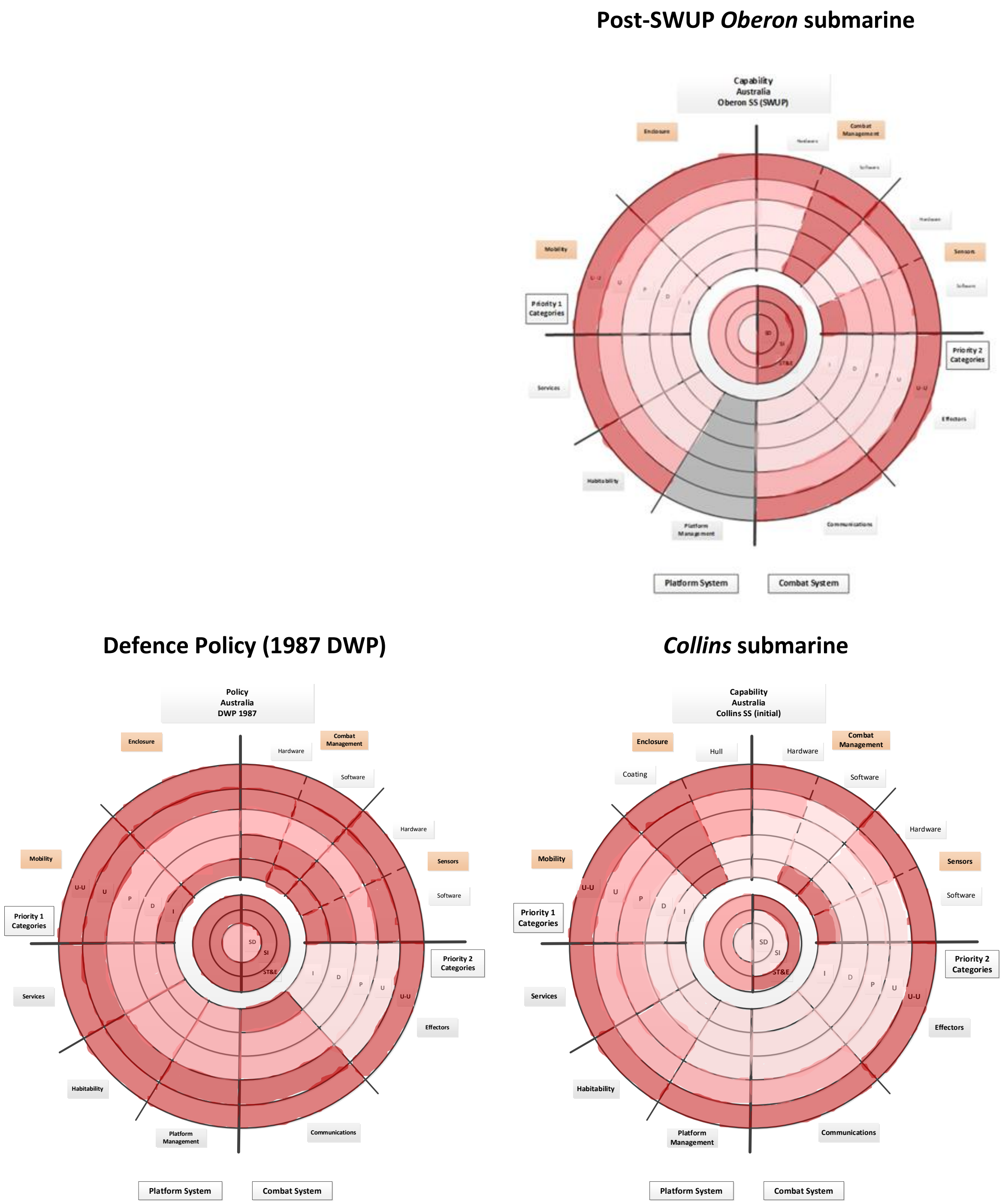


Figure 15. Comparison of ability to control defence industry activities for *Collins* against policy from 1987 DWP and *Oberon* SWUP

Under the *Oberon* SWUP program and the establishment of the SWSC, Australia had developed an indigenous ability to develop and upgrade combat system software. Whilst adequate for the approach adopted for the *Oberon* submarine, the Navy's requirements for an advanced combat system for *Collins* led to the selection of a completely new combat system architecture (Woolner, 2001b) and challenges for the domestic industry in meeting those requirements. The software for the new combat management system was developed in Australia with Rockwell and Computer Sciences Corporation Australia (CSC) as DO-FC entities, with the hardware elements sourced from FO-FC suppliers (Yule and Woolner, 2008; Woolner, 2009). For the sensor category, the design for the *Collins* sonar system was undertaken by Thomson Sintra Activites Sous-Marines (TSASM) in France, with hardware production in France and software production by both TSASM in France and Thomson Sintra Pacific (TSP) in Australia (Yule and Woolner, 2008). Australia had complete access to the intellectual property for both the combat management system and the sonar system, including the source code, as evidenced by the provision of the software source code to a third party Australian defence company to provide an independent assessment of the approach taken by the contractors when problems in *Collins* combat system performance surfaced (AUS Anon #4, 2019).

In a conversation with the author of this thesis, Andrew Johnson, the Engineering Director at SWSC and later the Director of CSC Australia, stated that the software design for the combat system was more complex than could then be built, and that there were also insufficient subject matter experts in Australia to address the task. Both the *capability* and the *capacity* of the Australian defence industry was therefore an issue in the realisation of the ambition (Johnson, 2022). There was, therefore, a reliance on the expertise of foreign contractors, either as FC-FO entities or through their DO-FC subsidiaries. An Australian industrial person with experience in the development of the *Collins* combat management system and the integrated sonar suite, has also stated that there was a corresponding lack of technical capability within the Defence project office, and that 'Defence simply acted as if it would make it work, but no-one there had the necessary experience or capability' to validate contractor actions (AUS Anon #4, 2019).

Relevant combat system capability within the Australian defence industry only existed in niche areas, and the government had few choices apart from the engagement of DO-FC entities to develop the systems. Moreover, the capability to contribute typically existed in small companies and therefore capacity for an undertaking as large as the submarine combat system was not present. The Australian company referenced above as the recipient of the combat system source code was an example of capability, but with limited capacity (AUS Anon #4, 2019). Australia had independent access to the combat system IP, had extensive know-why within DSTO, but did not have an independent ability to bring such innovation into reality due to capability and capacity constraints.

The development of the *Collins* sonar suite reflected a similar picture. In an interview given to the US Naval Institute, Alexis Morel, the CEO of Thales Underwater Systems France, highlighted the ongoing transfer of technology to Australia and the progressive build-up of sonar-related capability and capacity with the DO-FC subsidiary of Thales within Australia, and that:

> (o)ver the past 30 years Thales France has continuously transferred high level sonar technology to Thales Australia. A large part of the Collins Class submarine sonar was co-developed by Thomson Sintra and Plessey Australia, initially in France then in Australia by a large multi-domestic Integrated Project Team (IPT). After the initial design phase the entire project team moved to Australia together with the system design and software, to perform integration and at-sea trials. Eventually, what became Thales Australia had full autonomy in managing the system (Green, 2017)

Other examples were also present in the sonar industry, where the design and production of indigenous systems such as the KARIWARA towed array, developed from research undertaken by DSTO, were finalised and produced by DO-FC companies such as GEC-Marconi and TSP (Dunk, 1993, 1997). The shading of Figure 15 reflects the situation where this diversity of involvement across the combat management and sensor categories was inhibited by the lack of domestic industrial *capability* and *capacity*.

For the priority 2 combat system categories, submarine communications elements were to be supplied from offshore and maintained in Australia. There was no change in the effectors category, with Mk48 HWT and Harpoon missiles being sourced from FO-FC entities in the US and maintained domestically at GO- GO maintenance facilities.

For the platform system, despite the Minister's previous announcement regarding Australian participation, the detailed design was developed in Sweden by Kockums as a FO-FC entity and transferred into Australia for subsequent manufacture through ASC; at that time a 50/50 DO-DC (25% Wormald of Australia and 25% Australian Industry Development Corporation (AIDC)) and DO-FC (30% Kockums and 20% Chicago Bridge and Iron Company) entity. Systems integration was undertaken by ASC with IP transferred to Australia. Systems-level T&E was conducted by a combination of government and contractor personnel (Yule and Woolner, 2008), but an independent approach to T&E was not possible.

Manufacture and upgrade of the platform system was undertaken by ASC and the more than 100 Australian-based companies engaged as sub-contractors, either as DO-DC (71 of 112) or DO-FC (36 of 112) entities (Defence, 1995), although some critical items for the first submarine, such as the bow section, weapons discharge equipment, main propulsion system and generators, and the main storage battery were developed and manufactured overseas (Defence, 1988a). Components such as diesel engines, generators and main motors were subsequently built under licence in Australia, a situation that transferred important intellectual property into the country but not necessarily the important know-how and know-why required for independent industrial activity (Ludlam, 2019; Briggs, 2021). In some cases, the recipient of the design IP also had limited capacity, and therefore limited ability to contribute technically when problems arose. In one example, the local manufacturer of the generators subsequently went out of business, leaving an industrial hole in that important area (Moffitt, 2019).

During the early stages of the *Collins* project, both the capability and capacity of the Australian defence industry was thus problematic. A 1989 update to Cabinet noted that ASC was having difficulty in sourcing items such as piping, valves and pumps as ‘Australian suppliers do not meet the required quality standards’ (Defence, 1989b: 3). Capacity issues were also present, as demonstrated by problems that ADI Bendigo had in meeting the schedule for the production of components for the submarine Weapons Discharge System that resulted in that work being transferred back to the UK (Defence, 1990). The same report also noted, however, that capacity issues were being mitigated in some circumstances through new entrants, such as Pump Technology Pty Ltd, into the submarine industrial environment, and the associated transfer of work from overseas into Australia (Defence, 1990).

Industrial capability for the platform system was, however, progressively improved, through both the implementation of quality standards (Beazley, 1989) and technology transfer from FO-FC suppliers. Whilst the latter provided the ability to produce many of the submarine major components such as diesel engines, main motors and generators in country, the ability of the recipient domestic entities to problem solve when a design change was needed was sometimes limited or non-existent as, in some cases, the know-how and the know-why was lacking (Moffitt, 2019; Ludlam, 2019).

One aspect where a higher level of control was evident was in the enclosure category, and specifically in anechoic tiles fitted to the submarine for improved stealth. Figure 15 has been shaded to depict this higher level of control whilst recognising that the domestic capability did not extend to the complete innovation and design of the submarine hull. The development of the anechoic tiles was a necessary by-product of the fact that Australia could not obtain what was required for the *Collins* class from external sources. As noted by Yule and Woolner (2008; 177), Australia embarked on an indigenous development of the anechoic tiles required to reduce aspects of the acoustic signature of the submarine as:

> neither Britain nor America would share the technology and the usefulness of their tiles was questionable as the characteristics of the temperate waters around Australia differed from the cold waters of the far northern hemisphere.

The development of the anechoic tiles reinforces the importance of capacity, know-how and know-why for sovereignty in defence industry, and hence for operational sovereignty. Know-why, and the design, was the result of DSTO research to meet the Navy's requirement. Know-how for production and fitting was jointly developed in Australia by DSTO and ASC (Defence, 1993). The production of the tiles in a satisfactory timeframe indicates that industrial capacity was adequate. This example reinforces comments made by Rubin (2018) and Gould (2013) that capabilities required for operational advantage may not be available from the international market and the only way forward may therefore be to develop them domestically. Both the capability to develop, including the know-why and the know-how, and capacity in terms of skilled workforce and industrial infrastructure, is therefore necessary.

The differences between the policy depiction of the planned-for sovereignty as outlined in the 1987 DWP and the initial implementation in the *Collins* class are not surprising given that Australia had not previously produced a military system as complex as a submarine, and industrial capability and capacity needed to be established to an appropriate level. Intellectual property was transferred into Australia to support local industrial activities, but, in many cases, the supporting know-how and know-why was not (Moffitt, 2019; Ludlam, 2019). Nevertheless, the situation pertaining at the implementation of the *Collins* project provided the potential for sovereignty in defence industry to be increased over time.

As discussed previously, whilst *Defence of Australia* 1987 had provided a broad description of sought-after industrial capabilities, the 1993 *Strategic Review* and the 1994 DWP provided a more focused view of the domestic priorities for the defence industry. The primary difference was in the emphasis on the software aspects of combat systems and the management of data (Defence, 1993c, 1994b), with the related downplaying of the importance of the hardware component, and in an increased focus on communications. Figure 16 shows the differences between the sovereignty situation pertaining to *Collins* compared to the 1987 and 1994 Defence White Papers. The policy position in the latter had moved closer to the *Collins* situation for combat management and sensor hardware, but further away with respect to communications.

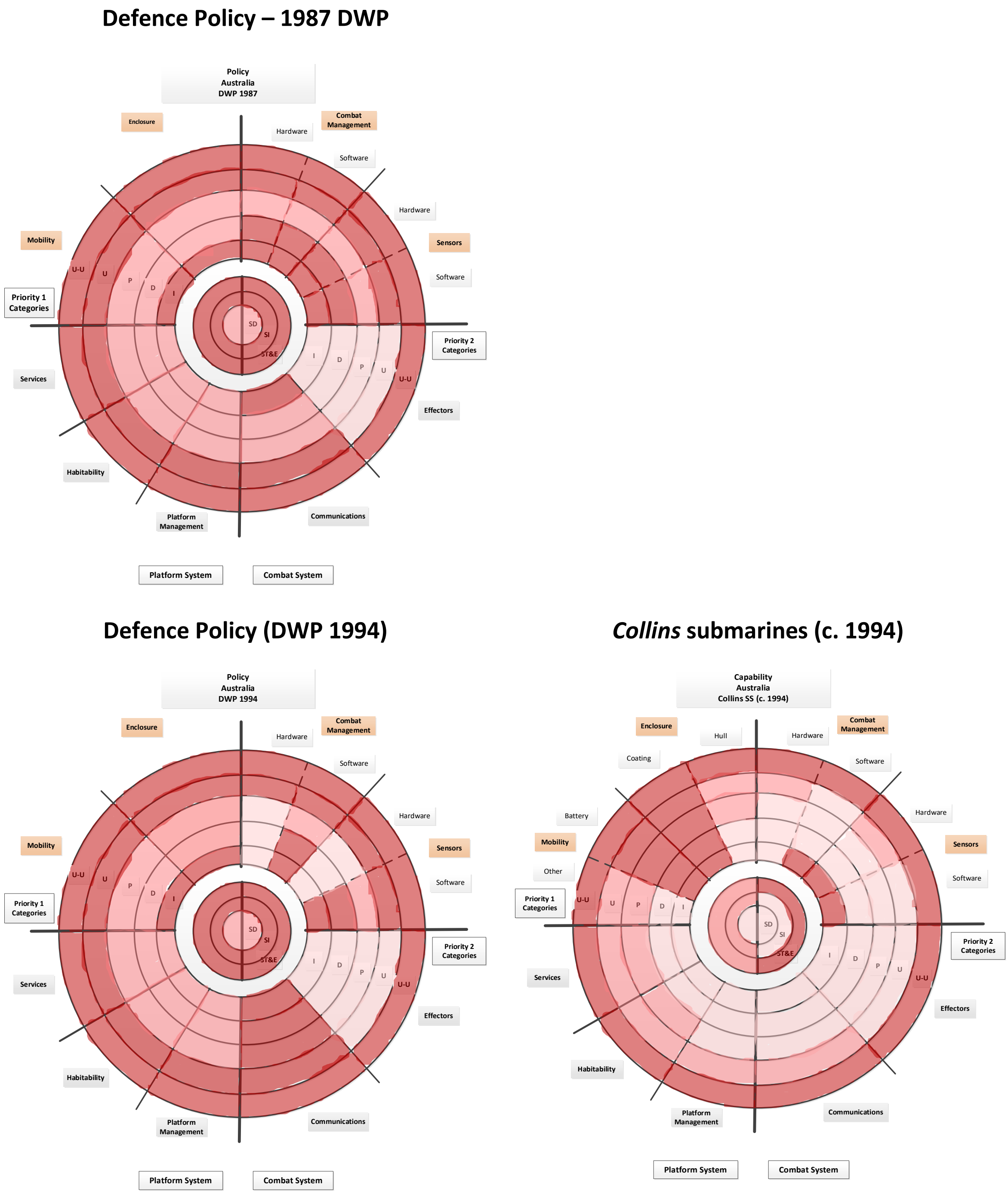


Figure 16. Comparison of intent for control over defence industrial activities for *Collins* against 1987 and 1994 DWP

The one major change in industrial capabilities and arrangements for *Collins* in the time between the 1987 and 1994 Defence White Papers was the establishment in Australia of the capability to design and manufacture submarine batteries through Pacific Marine Batteries (PMB) (PMB Defence, 2021). The mobility category in Figure 16 has been bifurcated to illustrate this change, with the battery component coloured dark red to show industry capability and capacity, and independent access to the IP.

The policy ambition for the *Collins* class during this period initially focused on having *rudimentary sovereignty*, and the ability to upgrade, coupled with *limited sovereignty* over the entirety of the submarine with the weapons acquired directly from foreign suppliers. This ambition in DWP 1994 remained as *rudimentary sovereignty*, and the ability to upgrade, and *limited sovereignty* over the platform system. In the combat system, the ambition was *focused sovereignty* in communications, and *limited sovereignty* in the software aspect of the combat management and the sensors categories. The reality at the capability level was *rudimentary sovereignty* coupled with *focused sovereignty* in anechoic tiles and batteries. The achievement of a position of sovereignty in both the combat management system and the sensor system software was inhibited by an ongoing inability to control events due to a lack of capability and capacity in industry, and in the *Collins* project office (Johnson, 2022; AUS Anon #4, 2019).

The general picture with respect to defence industry during this period was, however, positive, with the *Collins* project driving improvements in defence industry quality, and in overall capability through the transfer of technology associated with the platform system. Industrial capacity was exposed as an issue for the production of an advanced submarine platform, but also improved. However, the detailed position regarding the *Collins* project was not so healthy, with problems emerging in the development of the combat system software. The first indications of delays with the combat system were reported to Cabinet in June 1991 (Defence, 1991b), and subsequent reports note progressively more serious delays and limitations (Defence, 1993a, 1993b, 1995). This developing situation would assume greater prominence, and have implications for sovereignty, in the following period.

Market forces and industrial rationalisation (1996 – 2007)

The Keating Labor Government was defeated at the March 1996 federal election and replaced by the Howard Coalition Government, resulting in a major policy shift in many aspects of government. In a holistic sense, the ongoing themes throughout this new period were economic management and budget repair (Howard, 1996; Costello, 1996, 1997, 2006), the efficiency of government operations, and the associated question of whether governments should be the owner and operator of commercial businesses. The approach to defence and defence industry policy during this time can be considered in four broad themes: economic repair, coalition operations, market forces, and the US alliance. This period saw a Strategic Review in 1997, defence industry statements in 1998 and 2007, a Defence White Paper in 2000, defence updates in 2003, 2005 and 2007, and multiple reviews of defence processes.

Policy

The focus on economic management led to two main defence-related policy outcomes. The first was a deliberate effort to 'increase … the efficiency and effectiveness of the whole Defence organisation' (McLachlan, 1996: 5432) and reflected the government's philosophy to 'fix Australia's national economic problems, encourage private sector growth and work-place reform and increase national wealth' (McLachlan, 1997:6). This approach manifested in the establishment of the Defence Efficiency Review (DER) in 1996, and the subsequent Defence Reform Program (DRP) to implement the findings of that review and to make additional resources available for the acquisition of military capability. The second outcome, and related to the first, saw the government divest itself of a wide range of assets, including those related to the support of the defence force (Finance, 2016). The impact of this divestment was significant from a sovereignty perspective and will be covered in more detail in the following section on defence industry capability.

The Defence White Paper produced during this period, *Defence 2000: Our Future Defence Force* (Defence, 2000), reiterated the importance of Australian strategic interests and noted the increasing growth in regional military capabilities. Importantly for a consideration of sovereignty, DWP 2000 nuanced downward the importance of self-reliance. Whereas DWP 1994 had been unequivocal in the statements that 'self-reliance underpins our national self-confidence' (Defence, 1994: 5), that 'the foundation of the Government's defence policy is self-reliance' and that 'self-reliance in defence is essential to the Government's broader conception of Australia as a nation' (Defence, 1994: 13), the 1997 Strategic Review simply noted that 'we aim to be self-reliant in defending our territory, without relying on the combat forces of other countries' (McLachlan, 1997: 11745). The 2000 version of defence policy restated this position in that 'we must be able to defend Australia without relying on the combat forces of other countries – self-reliance' (Defence, 2000: XI). A subsequent statement of defence policy in the 2003 *Defence Update* did not mention self-reliance at all (Brangwin, Church, Dyer and Watt, 2015).

The Howard Government also oversaw a deliberate policy of closer engagement with the United States, with DWP 2000 identifying that the alliance would be pursued with 'renewed vigour' (Defence, 2000: 34); from 'conservative to ambitious' to use Hugh White's description (White, 2003). Ayson (2010: 184) has also suggested that during this period 'the alliance was becoming an end rather than a means for Australian policy'. The early period of the Howard Government therefore saw significant change in how sovereignty was addressed within defence policy, with close alliance relationships reducing the previous push for self-reliance, and laid the foundations for later developments.

Defence industry policy followed the same trajectory during this period. No industry-related issues were included in the Ministerial Statement associated with the 1997 *Strategic Review* (McLachlan, 1997b), and the comments made in the early stages of the Howard Government emphasised the need for reform due to inefficiency and waste (McLachlan, 1996, 1997a, 1997c). In 1998, a Defence Industry Statement was issued by the Minister for Defence Industry, Science and Personnel, Bronwyn Bishop, that recognised the pressures on industrial capability due to limited resources, recognised the reliance of the military upon defence industry, and advocated closer links between Defence and industry in order to improve capability outcomes. Importantly for the consideration of sovereignty, the *Defence and Industry Strategic Policy Statement* specifically noted that defence and industry cooperation was critical to self-reliance, and that a 'full range of industry that supports Australian defence' was required (Bishop, 1998: 3).

The *Defence and Industry Strategic Policy Statement* did not, however, result in any substantial change with respect to intentions for sovereignty in defence industry. *Defence 2000* retained verbatim the strategically-important industrial capabilities from the 1993 *Strategic Review* (Defence, 1993c) and the 1994 White Paper (Defence, 1994b). These were then subsequently repeated in the 2007 *Defence Industry Policy Statement* (DIPS) developed under Brendan Nelson as Minister for Defence, although renamed as Priority Local Industry Capabilities (PLICs) as 'those industry capabilities that confer an essential national security and strategic advantage by being resident in-country' (Nelson, 2007a: 4).

The overall position with respect to defence industry was, however, somewhat contradictory during this period, with *Defence 2000: Our Future Defence Force* stating on the one hand that '(w)e must take a strategic approach to our defence industry base, and not regard its capabilities as simply a by-product of procurement decisions' (Defence, 2000: 98) and on the other that 'the ability to develop a prosperous and effective Australian defence industry rests with industry itself' (Defence, 2000: 101). Defence industry under the Howard Government came to be seen more as a part of general industry rather than having specific links to defence capability and operational sovereignty through strategic relevance. This change in focus is made clear in the opening statement of the 2007 *Defence Industry Policy Statement* that:

> the Government's policy for defence and industry does not stand in isolation. It is a component of the Government's broader approach to Australian industry that seeks to create sustainable prosperity for the nation (Nelson, 2007a: 1).

Comparison of the expressions of sovereignty in defence industry policy from the 1994 and 2000 White Papers, shown in Figure 17, highlights the change in the government policy over that period with the former promoting self-reliance and the latter economic rationalism. The government's intent at this time was to 'make greater use of off-the-shelf purchases' (Defence, 2000: 100). Given the challenges facing the domestic defence industry due to market size, this approach translated to one where the default solution for Australia's capability acquisitions was to buy a system from a foreign supplier.

The colouring of Figure 17 reflects the policy emphasis of the Howard government. The previous government had promoted 'Australian involvement in design, development and production to acquire the necessary detailed knowledge, skills and facilities' (Defence, 1987: 76) during a time where the majority of industry remained as DO-DC. The implication of this situation was that the intellectual property developed, and the know-how and the know-why generated, would reside in DO-DC entities, and the extent of sovereignty would be expanded beyond the historical rudimentary base level of providing update-upkeep. The policy emphasis of the new government was to be a skilled user of technology, with certain industrial capabilities 'resident in-country' (Nelson, 2007a: 4), rather than on having independence in the conduct of those industrial activities. The implication is that the government was content with having control over update-upkeep, and with limited ability to exercise control in some other selected areas. For these reasons, even when a specific capability of industrial activity has been nominated as a PLIC, the corresponding areas within the circumplex diagrams have been coloured light red to reflect limited sovereignty.

At the all-of-system level, systems integration was specifically noted as a PLIC. The need for the domestic ability to exercise limited control over the conduct of T&E is therefore implied. With respect to system design, the combination of combat system elements as PLICs combined with the emphasis on off-the-shelf procurement, implied a higher priority for domestic control over the combat system and acceptance of FO-FC activity, with no control, for the platform system design. Within the platform system categories, where the previous intent was for an industry capable of exercising limited control over domestic design and production through DO-FC entities, the government now accepted that these could be acquired off-the-shelf through FO-FC entities and, therefore, that an independent ability to address the design was not a priority.

Defence Policy (1994 DWP)

Defence Policy (DWP 2000 / DIPS 2007)

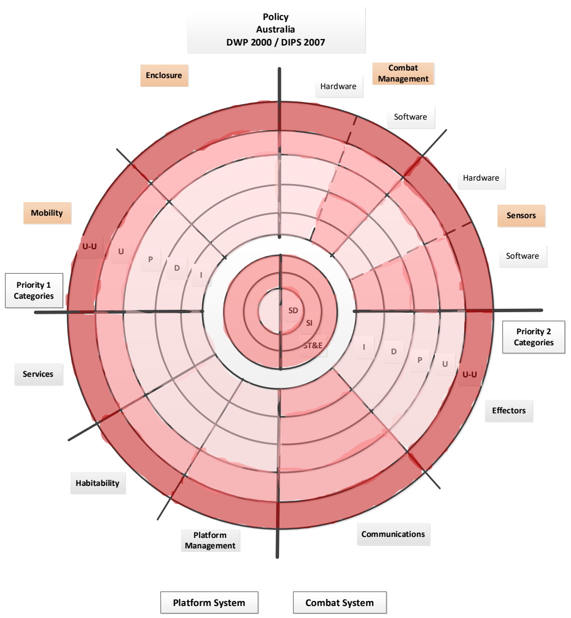


Figure 17. Comparison of intent for control over defence industrial activities from DWP 1994 and DWP 2000 / DIPS 2007

Figure 17 also shows the continuation with the different approaches to hardware and software in the priority combat management and sensor categories with emphasis placed on 'combat and systems software' and on 'data management and signal processing' (Defence, 2000: 99) as priority areas for Australian industrial involvement, and by implication for sovereignty. The lack of any treatment of the hardware components implies that the Government was content for these to be sourced from FO-FC entities.

The update-upkeep, and the upgrade rings in Figure 17 reflect the differences in policy that applied to these industrial activities although both were classified as a priority industry capability (Defence: 2000; Nelson, 2007). The ability to independently conduct repair and maintenance was a long-standing defence policy and would remain a standard Defence requirement (Dunstall, 2019). With respect to upgrade, whilst DIPS 2007 highlighted the need for this industrial capability, the focus was on the ability to undertake the activity in-country rather than to do so independently. Upgrade by the DO-FC subsidiary of an offshore supplier, without the government having independent access to the intellectual property associated with the upgrade, could therefore fit within this description.

Defence Industry

Developments within the Australian defence industry during this period were primarily associated with structural change, and with potential impact on the independent access to intellectual property. Three key changes, or expected changes, are of importance to this thesis. The first was the privatisation of ADI and its sale to foreign interests. Successive governments had recognised the inefficiencies associated with the government-owned defence factories and dockyards, the often 'obsolescent and dilapidated' buildings (Defence, 1976: 43), and the need for substantial investment and managerial reform in this sector (Killen, 1982; Howe, 1983; Dibb, 1986; Beazley, 1986; Holland, 2014). Initial actions had been taken under the previous government, including the sale of WND and the establishment of ADI. The next stage in the evolution of the Australian defence industry was the sale of the corporatised ADI to joint Australian and foreign interests in November 1999, and the subsequent resale of the Australian component of ADI to foreign interests in 2006.

The sale of ADI occurred as part of the Howard Government's program of divestment of government assets (Finance, 2016) with the overall objective 'to revitalise the Australian defence industry and make it globally competitive' (Senate FADT, 2000: 3). At the time, ADI was Australia's largest defence contractor, with ongoing interests in multiple shipbuilding projects, and the Australian leader for command and control systems, communications and munitions (Global Security, 2012). The successful tenderers, the Australian company Transfield and Thomson-CSF of France (later renamed Thales), assumed ownership and full control on 29 November 1999. Somewhat belatedly, the Senate Foreign Affairs, Defence and Trade (FADT) References Committee conducted a review of the sale process, and industry issues arising from that sale. Sovereignty-related issues included in the report highlighted that a moratorium of only 18 months existed with respect to subsequent disposal of ADI assets, and questioned whether the commercial interests of the parent company, or the foreign policy of the parent country, might take precedence over Australia's national interests (Senate FADT, 2000). In spite of protestations to the contrary, and the description of suggestions from the Senate

FADT References Committee that Transfield would seek to withdraw from joint ownership of ADI as ‘a mischievous allegation’ (Hansard, 1999: 26), within two years Thales had sought to increase its interest in ADI to 100 per cent; a bid thwarted at that time only due to a lack of US agreement regarding the potential handling of sensitive US-sourced technology (Walters, 2006).

A further bid from Thales in 2006 resulted in United States agreement to the deal and the transfer of the Australian 50 per cent of ADI to foreign control. In stark contrast with the initial transaction that resulted in a Senate Inquiry, a previously 100 per cent owned and controlled Australian defence industry asset passed out of Australian ownership with a simple statement that there were:

> no objections under the Foreign Acquisitions and Takeovers Act 1975 to the proposed acquisition by Thales Australia Holdings Pty Limited, from Transfield Holdings Pty Limited, of the remaining 50 per cent of the shares that it does not own in ADI Limited (Costello, 2006).

Unlike in some other jurisdictions, the Government maintained no “golden share” to enable it to counter corporate decisions that might be considered not to be in the national interest. Given the contributory effect of defence industry structure on Australia’s ability to exercise sovereignty, the sale of ADI in this way could be considered as strategically significant in that it fundamentally changed the industrial landscape. That there was no definable near-term threat undoubtedly made the decision easier.

The second change, with particular relevance to the submarine capability, was the nationalisation of ASC. This action might be considered unusual for a government focussed on improving the efficiency of government functions and on the divestment of government-owned organisations, but was driven by industry consolidation in Europe, and the sale of Kockums to HDW of Germany in 1999, a sale that included the Kockums 48.5% shareholding in ASC. The Australian Government, in a supposedly short-term action, acquired both the Kockums shareholding and that of James Hardie Industries to achieve complete ownership. John Fahey, then Minister for Finance, described the acquisition as the ‘first stage of a reform process expected to lead to ASC’s onward sale to the private sector’ (Moore, Minchin and Fahey: 2000a; Moore, 2000b). Given that the ASC was already majority-owned by the private sector, the action has been characterised as the Australian Government attempting to achieve a US owner in order to obtain assistance in resolving the technical issues being faced by the *Collins* class submarine at the time (La Franchi, 2000; Kelton, 2005; Bergmann, 2014). This position is supported by the report of a briefing given to journalists by the Minister of Defence in 2000 that the ASC action was ‘essential to ensuring long-term access to U.S. submarine technology’ (La Franchi, 2000). Despite a series of machinations, including an additional scoping study in 2005 to investigate selling the company (Minchin, 2005), the ASC has remained in Commonwealth hands, with the ongoing potential for the exercise of control over submarine-related activities through the independent development of submarine-related industrial capability and capacity, and through the generation of, and independent access to, intellectual property.

The expected change was the consolidation of the domestic defence industry along the lines that had been witnessed in the United States and, to a lesser extent, in Europe. This expectation is evident in the DWP 2000 statement that:

> (i)ndustry consolidation has occurred, but not yet on the scales of North America and Europe. Many of the Australian mergers and acquisitions in the defence sector have consisted of larger companies absorbing smaller ones, rather than a consolidation among the larger companies themselves (Defence, 2000: 102).

In this sense the Australian policy misread the imperatives for consolidation in these other jurisdictions. Whilst the drivers for overseas industry consolidation were primarily economic and reflected the envisaged way to increase defence industry efficiency in the face of a dramatic reduction in defence budgets following the end of the Cold War, the same drivers did not exist in the Australian context. The rapid changes in the United States commenced with the "Last Supper" speech given to US defence companies in 1993 that advocated consolidation of industry as the way of the future (Augustine, 1997; Deutch, 2001). In the United States, and to a lesser extent in Europe, the companies facing the choice between consolidation or extinction were primarily the developers and manufacturers of advanced military systems. These companies did not exist in Australia. Moreover, the United States DoD was willing to pay to support the various consolidation activities, bending the existing Federal regulations in order to achieve the hoped-for efficiencies (GAO, 1995; Korb, 1996; Deutch, 2001). Australian defence policy was therefore seeking the economic benefits being projected in the United States but across a differently-structured industry, undertaking different industrial activities and without the financial support being offered to American companies. The United States Government approach to defence industry consolidation was essentially to protect its sovereignty, through hoped-for efficiency gains across the sector (Korb, 1996; Gholz and Sapolsky, 1999a, 1999b; Sapolsky and Gholz, 1997, 1999, 2001; Hoff, 2007; Hensel, 2010). In contrast, the Australian Government simply wanted the economic benefits and was content to allow market forces to determine the future makeup of the domestic defence industry.

Submarines

The developing capability and capacity in Australian defence industry with respect to the submarine enterprise to this point is evident in a statement by the Australian National Audit Office (ANAO) that the project 'in many ways demonstrates the capacity of Australian industry to produce to world-class standards' (ANAO, 1998: xiv). There were, however, problems with *Collins* that had been emerging under the previous Labor Governments, and these came to prominence during the period under review. Woolner (2001a) has categorised these problems into three broad groups; components, noise (comprising the radiated signature and the propeller), and the combat management system. Each of these problem groups highlighted aspects of Australia's defence industry capability and capacity, and the ability to control industrial activities associated with sovereignty.

The component problem concerned diesel engines (required for recharging the submarine batteries during snorting[8]), generators, and the main motor. Significant changes to originally planned in-service equipment were necessary to meet the *Collins* requirements but the European designers were not interested to assist, and, in some cases, the Australian entity contracted to provide in-country support had little if any actual capability (Woolner, 2001a; Moffitt, 2019; Ludlam, 2019). Moreover, the Department of Defence did not have the requisite technical expertise to provide assurance for the design changes, and the altered designs encountered a variety of performance, reliability and supportability issues (Moffitt, 2019). The diesel engines, for example, were designed by Hedemora in Europe, were manufactured by ADI at Garden Island in Sydney (Briggs, 2021) and the rights for the provision of support were contracted to a small company in Tasmania that was later determined to have no capability (Ludlam, 2019). In a similar vein, both the main motors and generators were manufactured in Australia to an amended design, but oversight of the new design or of the production effort by the original designer was not obtained. Consequently, while the design intellectual property had been transferred into Australia, the know-how and the know-why associated with the original design was not available, and subsequent problems were not easily resolved (Moffitt, 2019). In other cases, companies accepted into the *Collins* supply chain had gone out business by the time that orders were placed, thereby reducing the overall capacity of industry to support the *Collins* project (Moffitt, 2019; AUS Anon #5).

That problems were encountered during the *Collins* trials is not, in itself, a significant issue. Multiple sources indicate that in shipbuilding the "first of class" typically encounters a raft of problems, that solutions to these problems are implemented in the following vessels, and that by hull number four the shipbuilding process is typically at its most efficient (Cairns, 2006; King, 2014; Roos, 2014b; Dunk, 2014a, 2014b; Davies, 2014; US GAO, 2018). With *Collins*, finding the solution to these problems contributed to the acquisition of the know-how and the know-why of the submarine design, and

[8] Snorting is a process when submarine masts are exposed above the surface of the ocean to enable oxygen to be drawn in and contaminants such as carbon dioxide expelled.

built more lasting capability and capacity in Australian industry and the submarine supply chain (Ludlam, 2019).

The problems with noise, a combination of excessive noise generated by the diesel engines while snorting, the design of the hull that contributed to flow noise, and cavitation from the propeller, became evident during the conduct of system-level test and evaluation (Yule and Woolner, 2008). The conduct of this T&E followed the development of additional capacity in the form of a suitable measurement facility. The site selection for, and implementation of, this facility was itself possible only through the know-why and the know-how of DSTO and industry partners such as the DO-DC company Nautronix, and foreign entities such as Thales and Ultra (Jones *et al*, 1995; Cato, 1997; Xenthos, 2017; Yule and Woolner, 2008). Local investigations and local design changes were therefore instrumental in overcoming the first two of these issues, and both the know-how and know-why relating to submarine noise was increased.

With respect to the propeller noise problem, Australia had no control and hence no sovereignty: no access to intellectual property, no capacity, and no capability. Resolution of the problem was therefore dependent upon external parties. The intellectual property was held by Kockums of Sweden, and subsequently HDW of Germany when Kockums was sold to that company. In an interview with the author in 2019, retired Rear Admiral Peter Briggs, Head of the New Submarine Capability Team at the time of the propeller issue, stated that he considered that Kockums had run out of technology and R&D capacity, and money to resolve the issue. The propeller noise problem was finally solved by Australia ignoring propeller IP rights restrictions, and involving the United States Navy (USN) to replace the Swedish-designed propeller blades with blades that had been designed and manufactured for USN SSNs (Briggs, 2019). Overcoming the excessive noise issues highlighted the sovereignty implications of being able to conduct independent test and evaluation, and in having the knowledge and capability to amend the design.

The third of Woolner's (2001a) problem groups for *Collins*, the combat management system, also contained significant sovereignty implications. As noted in the previous chapter, the combat system provides the capability for the submarine to fight. The combat management system can be considered as the submarine's "central nervous system", making sense of incoming information, distributing that information to where it needs to go in the form that is required, and thereby allowing both decision-making and operational actions to take place. As noted by a previous Australian Chief of Navy, combat systems:

> embody the knowledge and doctrine of the navy to help their crews operate and fight the submarine in the way they want to do it. This changes over time, and so the capability of the combat system has to evolve to ensure there is a winning edge (Shackleton, 2016).

Under the *Oberon* SWUP, and with the establishment of the SWSC, the RAN had developed a sophisticated capability in submarine combat management systems and therefore wished to leverage that capability to provide an advanced system for the *Collins* class. Yule and Woolner (2008) have provided a detailed account of the plan to implement a distributed architecture, fully-integrated, completely redundant combat system combined with a highly-automated ship control and management system. Woolner (2001b) has summarised the overall approach as:

> the Navy wanted a combat data system (CDS) that would allow it more often to use the submarines' weapons out to their maximum range of around 60 nm and to improve on the Oberons' ability to attack only two targets simultaneously. To achieve this involved the integration of a large range of sensors feeding data into a computerised system capable of filtering the faint signs of distant vessels from the ambient noise of the ocean environment. The input from several types of sonar systems, as well as electronic warfare sensors, radar, infra-red detectors (and the more traditional periscope) and sophisticated navigation systems, would have to be handled simultaneously by this data system. To be useful, the CDS then would have to be capable of identifying possible targets (frequently checking against its library of pre-recorded ship noises), of determining relative positions and of tracking dozens of them simultaneously. All this data would have to be presented so that quick and effective command decisions could be made.

As noted in various sources (ANAO, 1998; Woolner, 2001a, 2001b; Kelton, 2005; Walters, 2006), the objective for the combat system was ambitious, and aimed to provide sovereignty over a critical element of the overall submarine capability. From an early stage there were problems and delays with the development (Defence, 1990, 1991b). One of the issues, as stated by Johnson (2022), was that of capability and capacity, and an inadequate number of in-country subject matter experts. According to an anonymous source for this research, the problems with the development of the combat system were compounded by a similar lack of both know-how and know-why within the *Collins* project office and the reliance upon contractor claims that the system specifications would be met (AUS Anon #4, 2019). Briggs (2019) has also suggested that inadequate project management capability was to blame for the delays as:

> the Project Office let the contract for the Collins combat system to a Prime with a diverse team working on its components. There was competition within the team, with everyone only

> interested in their part, with their own priorities. No-one was interested in ensuring that the whole system came together and that whole-system aims were met.

By May 1993, reports to Cabinet raised the potential for the development of the combat system software to impact on submarine trials and delivery, although performance parameters were still expected to be met (Defence, 1993a). Despite ongoing claims that full functionality would be met (Defence, 1994a; NSC: 1997), the *Collins* combat systems continued to be beset by problems which culminated in 1999 in a review of the *Collins* programme. The report by McIntosh and Prescott (1999) noted that the combat system did not work, that the tracking, classification and display of sonar targets was less effective than on the *Oberon* class, and that no satisfactory solution was envisaged. McIntosh and Prescott recommended that a competition be conducted for a replacement Commercial-Off-The-Shelf (COTS) combat system.

This competition was conducted in 2000 and the German ISUS 90-55 was judged as being superior, whilst the runner-up, the US CCS Mk2 system proposed by Raytheon, was still under development for a nuclear submarine application (Dunk, 2001b; Woolner, 2001a; Kelton, 2005; Yule and Woolner, 2008). In mid-2001 the Government terminated the tender process for the replacement combat system and announced that 'a new acquisition strategy, based on closer cooperation with the USA, would be developed' (Reith, 2001). That cooperation saw Australia sign *a Statement of Principles for Enhanced Cooperation between the United States Navy and the Royal Australian Navy in matters relating to Submarines* on 10 September 2001, and subsequently enter into a joint development with the United States for the development, production and support of the AN/BYG-1 Tactical System, and for ongoing Australian participation through the Advanced Processing Build (APB) and Technical Insertions (TI) processes (State Department, 2004).

The change in the combat system resulted in no change to Australia's control over a system of critical operational importance to the operational performance of the *Collins* submarine as illustrated at Figure 18, although the decision changed the potential for control to be exercised. The decision to proceed with the AN/BYG-1 system and the APB process provided no opportunity to independently evolve the combat system (State Department, 2004) and hence no control (Dunk, 2016b), whereas the earlier position had arisen due to inadequate domestic industrial capability and capacity (Shackleton, 2016). Australia forewent the ability to increase control with increasing capability and capacity in favour of perceived alliance benefits of closer relationships with the USN as the primary submarine operator in the Pacific, and as the supplier of weapons and systems that the RAN employed (Shackleton, 2019).

Figure 18. Comparison of intent for control over defence industrial activities for *Collins* against 2007 DIPS

A contrary viewpoint was provided in an interview with retired submariner Rear Admiral Peter Briggs (Briggs, 2019). This alternative position was that the German system was mature, stable, and very capable, and far ahead of the system proposed by the Americans, and therefore provided greater operational advantage. The selection of the German ISUS 90-55 combat system, as stated by Briggs

(2019) and as reported by Yule and Woolner (2008), would have included the procurement of the system source code. Together with the developing capability and capacity within industry, this would therefore have provided the ability to make independent modifications as required. Yule and Woolner (2008) have also reported positions within the RAN that suggest that Australia was on this path to sovereignty in submarine combat systems, and that the *Collins* combat management system was too hastily replaced as the impact of the final fixes for the problems then being experienced had not been fully assessed. This point of view has also been supported by an ex-RAN officer involved in the combat system development who stated in an interview with the author that Release 2.0 version of the combat system had more functionality, and was more stable, than the AN/BYG-1 system at the time, and remained so into 2019 (AUS Anon #1, 2019).

For the combat system, the decision to move to the US AN/BYG-1 combat management system continued the situation whereby Australia had no ability to control activities associated with that system, but for different reasons. The earlier situation resulted from inadequate capability and capacity; a situation that could have been improved as these aspects increased over time. The change to the US AN/BYG-1 combat system removed independent access to IP for perceived benefits through closer alliance engagement with the US, with the consequence that the ability to control industrial activities associated with the CMS could not be increased as the domestic capability and capacity increased.

Throughout this period, the policy ambition was to have *rudimentary sovereignty* for the *Collins* class submarine, coupled with *limited sovereignty* in combat management software, sensor software and communications. The capability reality was *rudimentary sovereignty* with *focused sovereignty* in anechoic tiles, the submarine battery, and in the Hydro-Acoustic Information Link (HAIL) through-water communications systems designed and developed in Australia by Nautronix that had been fitted to all Australian submarines by 2004 (Friedman, 2004). Resolution of platform-related issues in the *Collins* submarine associated with components and noise increased overall capability in ASC and DSTO, and, through the involvement of sub-contractors, in the local industry (Ludlam, 2019). Capacity was similarly increased as the local supply chain expanded.

In the sensors category, Figure 18 reflects the development of capability and capacity within Thales Australia to support the Collins submarine, and the inclusion of Thales Australia as a participant in the AN/BYG-1 APB program (Green, 2017). This included the approval from the French Government to transfer sonar system source code and design data to Thales Australia for adaption and development as required (Green, 2017). The commencement of the indigenous development of a

Mine and Obstacle Avoidance Sonar (MOAS) by Thales Australia and DSTO also reflected the growing domestic capability and capacity in sonar technologies.

The difference between this period and the preceding one was that the ambition to use the *Collins* class contracts as the first steps towards the ultimate aim to achieve an indigenously-designed Australian submarine (Beazley, 2019) was curtailed. The original plan, if successful, would have seen significant Australian involvement in the design and innovation aspects of both the platform system and the combat system. Implementation of this plan would also have required significant investment, on a continuing and probably increasing basis, for many years, and the need to address ever-more complex and expensive weapon systems (Hartley, 2016; Nordlund, 2016; Bitzinger, 2017; Watts and Harrison, 2011; Markowski and Hall, 2006). Decisions taken during this period therefore led to the offsetting of financial imposts through closer alliance relations.

Increasing uncertainty (2007 – 2018)

The final period for examination in this Australian case study commenced in 2007 with the election of the Rudd Labor Government and extends to the release of the 2018 *Defence Industry Capability Plan*, a document that provided more substance to the broad industry engagement that had been sketched in the 2016 *Defence Industry Policy Statement*. Although covering Labor and Liberal governments under Rudd, Gillard, Rudd, Abbott and Turnbull, the period can be characterised through three enduring themes: increasing strategic risk driven largely by the rise and increasingly muscular positioning of China, the continued erosion of Australia's historical technological advantage within the region, and the ongoing development of a closer military relationship and enhanced interoperability with the United States. The period has also seen the development of three Defence White Papers (Defence, 2009b, 2013, 2016a), two Defence Industry Policy Statements (Defence, 2010a, 2016b), the Defence Industrial Capability Plan (Defence, 2018a) and further reviews of the Department of Defence.

Policy

Defending Australia in the Asia Pacific Century: Force 2030, the Defence White Paper released in 2009, contained no fundamental changes to defence policy, although it recognised the increasing level of uncertainty in the geo-strategic environment. The document maintained the ongoing focus on a market-driven approach to force development, with domestic industry solutions only pursued on an exception basis. International defence materiel relationships were valued, particularly those with the US, and there was no real commitment to the Australian defence industry. In the realm of defence industry policy, the importance of certain aspects of industry were increasingly defined and promoted, but the potential for DO-DC entities to participate, other than as sub-contractors to the global primes, was simultaneously reduced. The *Going to the Next Level* review by Mortimer (2008) reinforced the earlier recommendations of Kinnaird (2003) with respect to the primacy of off-the-shelf military system solutions on the basis of overall reduction in the cost, schedule and risk of defence acquisition projects. The importance, or otherwise, of strategic factors that may have affected the desirability of local design from a sovereignty perspective, access to intellectual property and the development of industrial capability and capacity, were not included in the report. With respect to local capability development, DWP 2009 subsequently merely stated that:

> the Government has decided that military-off-the-shelf and commercial-off-the-shelf solutions to Defence's capability requirements will be the benchmark against which a rigorous cost-benefit analysis of the military effects and schedule aspects of all proposals will be undertaken (Defence, 2009b: 127).

The 2010 defence industry policy continued the government's balancing act between the stated need for a degree of self-reliance, the cost of supporting the military force, increased interoperability with the US military, and the political aim to provide support for the local defence industry (Carr, 2016; Conroy, 2019). The concept of PLICs developed in the 2007 DIPS was replaced with Priority Industry Capabilities with the publication of the 2009 Defence White Paper and the subsequent publication of *Building Defence Capability: A Policy for a Smarter and More Agile Defence Industry Base* in 2010, which:

> confer an essential strategic advantage by being resident in Australia, and which, if not available, would significantly undermine defence self-reliance and ADF operational capability (Defence, 2010a: 40).

Building Defence Capability also maintained the previous market-driven approach to the development of defence industry capability and capacity as evidenced by the statement that:

> (i)ndustry must become more resilient and self-reliant if it is to prosper and grow in the future. It can no longer expect the Government to use offsets or local content quotas to help protect Australian defence industry from overseas competition (Defence, 2010a: 9).

The top circumplex diagram at Figure 19 depicts the DIPS 2010 policy intent with respect to the ability to control submarine-related industrial activities. The colouring of the diagram reflects four policy positions as enunciated in DWP 2009 and DIPS 2010. The first addresses Australian defence industry with respect to future submarines in the statement that the:

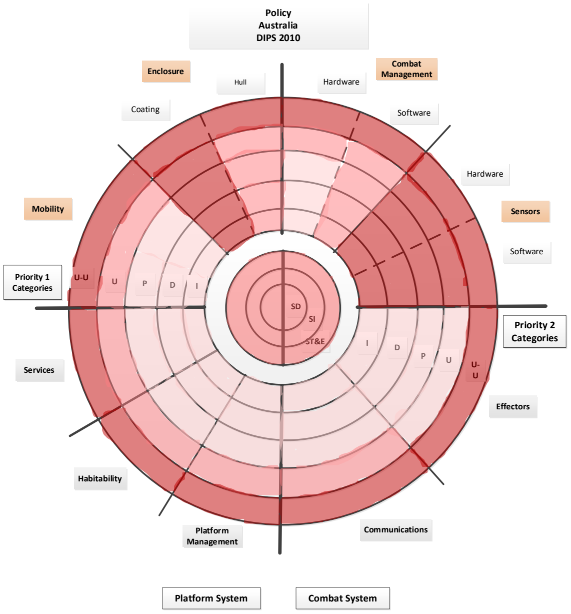
> strategic importance of this capability is such that Australian industry involvement will need to be factored into the design, development and construction phases, and the sustainment and maintenance life cycle of these boats (Defence, 2009b: 70).

The implication from this statement is that an Australian defence industry with the capability and capability to contribute to system level activities was required, an assessment reinforced by the nomination of ''high end' systems and 'system of systems' integration' (Defence, 2010a: 86) as PICs. An independent ability to undertake these activities is, however, not stated and the colouring of Figure 19 reflects the government's intent for *limited sovereignty*. Whilst the need to conduct T&E within Australia is not specifically mentioned, it is also coloured for limited sovereignty due to the somewhat nonsensical position that would be involved in having DO-DC or DO-FC entities do the systems integration and then to ship the integrated system offshore for testing. The colouring of the industrial activities associated with the submarine enclosure is similarly coloured as the above statement implies that all associated industrial activities can also be undertaken domestically, either by DO-FC or DO-DC entities.

The second policy position of interest is the nomination of additional PICs, four of which are relevant to this discussion of sovereignty, and to the colouring of Figure 19. Signature management, and the importance of coatings on the submarine hull for stealth through sound minimisation, and acoustic technologies and systems, were both nominated as PICs as they involved 'leading edge capabilities that are not always available from overseas sources' (Defence, 2010a: 85), and consequently were required in Australia. The recognition of the importance of these capabilities, coupled with the acknowledged risk that foreign suppliers might not be available, implies the need for *focused sovereignty* with domestic industry having adequate capability and capacity, and government having independent access to associated IP. Ongoing investment was therefore required if the technological know-why and the industrial know-how, together with adequate capacity within the domestic defence industry, was to be developed and maintained to mitigate the identified risk (Rockart and Dutt, 2015; Smallwood and Ulrich, 2004; Drezner *et al,* 1992; Schank *et al*, 2011b). These areas have therefore been coloured dark red on the circumplex diagram.

The final two PICs of interest to the *Collins* submarine both relate to the combat system, namely in-service support of the *Collins*-class submarine combat system and through-life support of mission critical and safety critical software. The software component of the combat management system in Figure 19 is coloured light red as a domestic, not independent, capability was deemed necessary, whilst the hardware component is pink and reflects that sovereignty in this area was not considered as important.

Defence Policy (DIPS 2010)



Defence Policy (2016 DWP/ 2018 DICP)

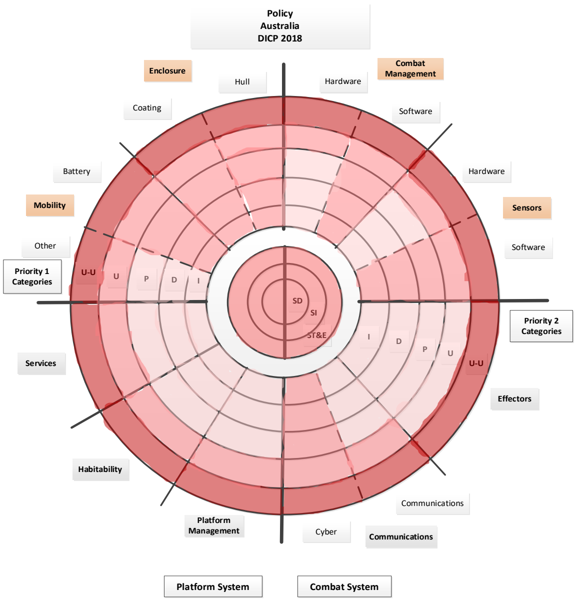


Figure 19. Illustration of intent for control over defence industrial activities from DIPS 2010 and DICP 2018

The third policy position is the continuation of previous policies relating to *rudimentary sovereignty*, and reflects the general position that Defence would seek the IP rights necessary for an independent approach to in-country maintenance (Dunstall, 2019). These industrial activities are therefore coloured dark red. The final position to note is the preference for off-the-shelf procurement as recommended by the Mortimer Review (2008) and the overall vague commitment to the domestic defence industry in DWP 2009 that ‘Defence will seek to maximise the spending in local defence industry’ (Defence, 2009b: 127). The default colouring for all other submarine categories is therefore pink with the government content that systems can be acquired, in the absence of major Australian defence manufacturing companies with off-the-shelf systems, from FO-FC entities.

In 2013, the Gillard Government released a new Defence White Paper. Defence industry policy incorporated in this document reiterated previously expressed positions that ‘defence industry is a major partner in the Government’s plans for the current and future ADF’, that ‘a highly skilled and capable Australian defence industry is necessary for Defence to achieve its strategic objectives’, and that ‘a competitive, efficient and skilled Australian defence industry is vital to support Australia’s defence needs’ (Defence, 2013: 115). Fruehling (2013) has noted that the 2013 White Paper was strategic guidance without strategy, and that industry was approached solely from an industrial viewpoint, with no supporting arguments for industry in the sustainment of the defence force. No corresponding defence industry policy was provided and DWP 2013 maintained the positions as outlined in *Building Defence Capability: A Policy for a Smarter and More Agile Defence Industry Base.* A separate circumplex diagram has not been developed as such a representation of sovereignty is a continuation of that at Figure 19.

The final White Paper of the period was released in 2016 together with a Defence Industry Policy Statement (Defence, 2016a, 2016b). Detail with respect to defence industry was released in the 2018 DICP (Defence, 2018) and is reflected in Figure 19. The PICs of 2010 had been replaced with Sovereign Industrial Capability Priorities that were considered as being ‘operationally critical to the Defence mission’ (Defence, 2018: 19). The policy had minor differences when compared to DIPS 2010 (Defence, 2010a), with the stated requirement for *Collins* class submarine activity being that:

> Australian industry must have an ability to enhance, sustain, repair, operate and upgrade our submarine capability with particular importance being placed on the sonar subsystem, tactical and weapons control system, signature management and endurance. Endurance includes batteries for energy storage and propulsion system (Defence, 2018: 36).

The key words in the 2010 DIPS regarding ‘leading edge capabilities that are not always available from overseas sources’ (Defence, 2010a: 85) were removed from the 2018 version, and the policy emphasis was therefore, by default, focused on the ability to conduct an activity in Australia but not necessarily being able to independently address that activity. The only industrial activity for which the government required sovereignty was update-upkeep; that is, *rudimentary sovereignty*. All other activities, across all the submarine system and sub-system categories, could be realised through having limited or no sovereignty, and with the primary involvement being through DO-FC and FO-FC entities.

At the all-of-system level, there were no specific industrial policy requirements with the exception of T&E which was envisaged to 'support Australia's unique requirement, and allow indigenous design, development and implementation of modifications and upgrades' (Defence, 2018: 39). Through this statement there is an implied capability for system level design and systems integration within the domestic defence industry, and these areas are therefore coloured light red at Figure 19 to signify an intent for *limited sovereignty*.

In the categories considered high priority for operational advantage, the defence industry policy emphasised the need for industry to:

> understand, design, develop and use technology applications to maintain an advanced signal processing capability in the areas of cyber and information security, radar, sonar and acoustic technologies, electronic warfare operational support (including threat recognition, targeting and planning), and signature management (Defence, 2018: 38).

Furthermore, with respect to the government's aim for shipbuilding, the DICP stated the need for Australian industry to:

> have the technical, managerial, heavy engineering and advanced manufacturing capabilities …. and employ a highly skilled workforce both for shipbuilding and sustainment (and) for design, construction and optimal production efficiency of our future submarines (Defence, 2018: 37).

For the above reasons, the software aspects of the sensor, combat management and communications (cyber) categories, the enclosure category, and the battery component of the mobility category, have all been coloured light red in the circumplex diagram.

Defence Industry

The period between 2007 and 2018 continued to see substantial change in the Australian defence industry, with the ongoing diminution in activities of consequence undertaken by DO-DC entities and an ongoing preference for off-the-shelf systems. Over the period, the Australian defence industrial landscape came to be dominated by companies controlled from foreign, albeit aligned, countries. In 2008, the second largest defence company in Australia, Tenix Defence Pty Ltd, then the largest DO-DC company, was sold to BAE Systems of the United Kingdom. Any potential impact on Australia's self-reliance or operational sovereignty was seemingly not an issue, with the then Defence Minister Joel Fitzgibbon merely congratulating BAE Systems Australia for 'their investment in the Australian defence industry' (Fitzgibbon, 2008). Within two years, under two different governments of different political persuasions, the two largest DO-DC companies had been transformed into DO-FC entities, and the control passed to foreign countries.

Foreign domination of the local defence industry sector occurred in spite of repeated earlier warnings on the risks associated with reliance on foreign entities and the benefits of local industrial activity for the mitigation of strategic risk (JCFAD, 1977; Dibb, 1986, 2006; Industry Commission, 1994; Senate FADT, 2000; Barrie, 2006). Analysis undertaken by the author for this research, and presented at Appendix 3, shows that the direct contracting of DO-DC entities for the acquisition of military systems, and for their support, fell consistently throughout this period to about 10% and 20% respectively. As noted earlier, defence industry policy focused merely on the domestic ability to conduct an industrial activity. Whilst this required both capacity within the local industry, and the capability to undertake the associated activities, independence in the conduct of that activity was of secondary importance.

Submarines

Two significant issues with relevance to this thesis developed in the period 2007 – 2018: the crisis affecting submarine sustainment, and the procurement of the *Collins* IP from Sweden. The first, which developed from an ongoing series of issues with the operational availability of the *Collins* class, (ANAO, 2009, 2010; Thomson, 2010; Oakes, 2010; ABC, 2010a, 2010b; Dodd, 2010; Aldred, 2011) resulted in a review of submarine maintenance in 2011. The review, undertaken by John Coles from the United Kingdom, identified and described deficiencies with respect to *Collins* sustainment, proposed changes to overcome these deficiencies, and monitored progress from the application of the remedies (Coles, Greenfield and Fisher, 2012; Coles, Greenfield, Fisher and Davies, 2014; Coles, Greenfield, Spark and Savage, 2016). This series of reports highlighted that capability and capacity in the government client were partially responsible for the situation, namely that:

> It was all too clear … that the lack of suitably qualified experienced personnel in the DMO to operate within and fulfil their role in an output focused Enterprise, may stall or even reverse the achievement of benchmark availability (Coles, Greenfield, Fisher and Davies, 2014: ii).

The Coles review therefore emphasised the importance of developing and maintaining capability and capacity across all the elements associated with the operation of submarines: not solely the industrial elements. There was a need for managerial capability within the customer, together with the technical know-how and the know-why associated with related decision-making and the allocations of funds. The specific recommendation to 'strengthen the RAN as the Intelligent

Customer for sustainment' (Coles, Greenfield and Fisher, 2012: 112) indicated that this capability and capacity was lacking, and Australia's ability to address freedom of action was therefore impacted. Operational sovereignty was therefore affected.

The second major development was the acquisition of the *Collins* IP by Australia in 2013. Whilst ASC, from the commencement of the *Collins* project, had had the ability to use any Kockums IP for the purpose of sustainment without reference to Kockums (Ludlam, 2019), the ability to independently evolve the submarine was constrained. In an interview with the author with the then Ministerial staffer, later Minister for Defence Industry, Pat Conroy (2019), he stated that, whilst Australia needed control of the *Collins* IP to avoid problems that had been faced with the *Oberon* submarines when spares had been withheld by the UK, adequate thought had not been given to the need for independent upgrade of the submarines, and sovereignty was therefore impacted.

Figure 20 compares the level of defence industrial control exercised over the *Collins* submarine both before and after the acquisition of the platform IP in 2013 to the policies outlined in DIPS 2010 and the 2018 DICP respectively. Acquisition of the *Collins* platform IP provided the legal basis for the evolution of the platform, but the ability to design and implement changes also required the know-how and know-why associated with that intellectual property (Ludlam, 2019; AUS Anon #5, 2019), and the capability and capacity to do so. Through the establishment of Deep Blue Tech Pty Ltd (DBT) in 2007, ASC had progressively developed design capability and had produced some high-level submarine designs (Ludlam, 2019, 2021; Briggs, 2019), but this effort was suddenly curtailed in 2018 following the refusal of the DMO to fund the activity (Ludlam, 2021; Eliasson, 2017). The capability and capacity that had been developed was not entirely lost at this point, however, as 22 persons from DBT were seconded to the Department of Defence and formed the nucleus of the Future Submarine Project Office (Ludlam, 2019). It is important to note, however, that at this point Australia did not have the ability to design a complete submarine, and that the intention was to develop capability sufficient to understand the offerings from an international designer (Ludlam, 2019). Consequently, there was no ability to control the design of either *Collins* or a future submarine.

The level of control over systems integration and T&E at the all-of-system level increased with the acquisition of the *Collins* IP as Australia had previously had both the capability and the capacity to undertake the associated industrial activities for the submarine. For the combat system categories, as shown at Figure 20, the level of control was unchanged. Australia remained reliant on FO-FC entities for design, manufacture, and upgrade activities associated with the combat management system (State, 2004), and for weapons. Whilst Australia continued to have DO-DC companies with the capability to innovate, the ability of such innovation to be incorporated into the submarine systems remained inhibited and subject to agreement from the US (AUS Anon #4, 2019).

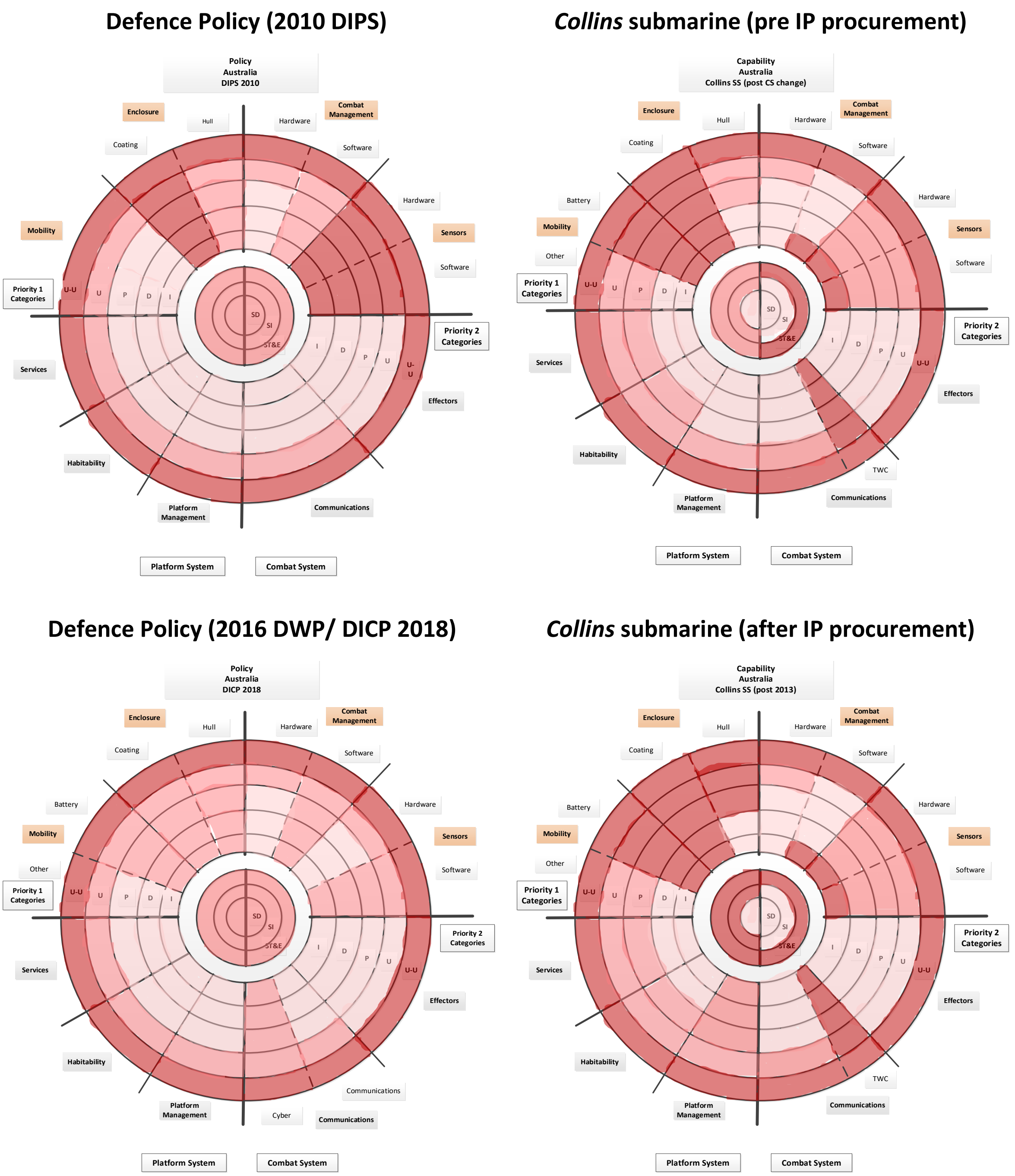


Figure 20. Comparison of intent for control over defence industrial activities for *Collins* against DIPS 2010 and DICP 2018

Sensor-related activities continued to be largely undertaken in Australia by DO-FC companies. The main contractor, Thales Australia, manufactured, integrated, developed and supported technology that had been transferred to Australia from France at the commencement of the *Collins* program (Thales, 2018; Green, 2017). Other systems, such as the MOAS, and the KARIWARA and NARAMA towed arrays, had been designed and developed in Australia (Dunk, 1993, 1997). The *Collins* sonar suite was therefore a combination of sub-systems and industrial activities over which the government had various levels of control. The circumplex diagram at Figure 20 is coloured accordingly.

In the platform system categories, the acquisition of the *Collins* IP changed very little with the exception of the enclosure category. Innovation and associated upgrade of this category could be undertaken independently as Australia had access to the IP and, during the course of the *Collins* program, had developed both the capability and the capacity within ASC to undertake these activities (Ludlam, 2019). An ability to independently design the enclosure continued to be hampered by a lack of both capability and capacity within the local industry, and consequently Australia had no control. With respect to the platform management system, whilst the original system had been designed in Sweden, the contractor, Saab, had progressively transferred technology to, and established capability in, its DO-FC subsidiary. The development of the domestic know-how was such that the design, software and hardware development work for the update of the Integrated Ship Control Management and Monitoring System (ISCMMS) was conducted by Saab Australia (Saab Australia, 2018). The platform management category of Figure 20 is therefore coloured to reflect the exercise of limited control.

Throughout the period, the Australian Government maintained its ongoing focus on having *rudimentary sovereignty*, and the ability to independently address maintenance of systems acquired, largely, off-the-shelf. In addition, higher levels of sovereignty, extending to *focused sovereignty* in some cases, were placed on aspects such signature management, submarine stealth and acoustic technologies and systems. In the combat management system there was no ability for Australia to exercise control over the development of the AN/BYG-1 CMS and, as a consequence, there was no sovereignty despite the policy ambition for Australian industry to 'enhance, …and upgrade ….the tactical and weapons control system' (Defence, 2018: 36). Despite the replacement of the original *Collins* CMS by the US alternative, development of the original system continued until 2017, and there were 'people in Australia capable of developing the combat system code' (AUS Anon #1, 2018). The numbers of such people were, however, limited, and capacity in combat system matters remained an ongoing issue.

The know-why related to defence industry sovereignty in submarines increased over the period. The finalisation of the acquisition of the *Collins* intellectual property in 2013 provided the legal basis for any future evolution of the platform system. By 2016 the design intent for the *Collins* class was understood to such an extent that the design authority was held in Australia (ASC, 2016: 9), thereby demonstrating the growth in submarine know-how in both government organisations and in industry over the life of the *Collins* program. The growth in know-how, and in industrial capacity, can also be inferred from a submission by ASC to an Australian Senate Foreign Affairs, Defence and Trade Legislation Committee Inquiry into shipbuilding that stated that the *Collins* supply chain managed by ASC comprised more than 2,600 suppliers, and that, excluding the combat system, the Australian industry contribution to submarine sustainment was above 90 percent (ASC, 2018).

Conclusion

This chapter has investigated how well Australia has translated notions of sovereignty as expressed in defence and defence industry policy into sovereignty outcomes at the capability level. The level of direct threat facing Australia over the period of the case study remained low. Although the latter Defence White Papers of the period highlighted the increasing challenge posed by a rising China, as late as 2016 the assessment was that there was 'no more than a remote chance of a military attack on Australian territory by another country' (Defence, 2016b: 32). The Australian case study has highlighted the importance of the elements identified in Chapter 2 and Chapter 3 as having impact on defence industry sovereignty. The following conclusions are drawn from the case study.

First, Australia has typically sought *rudimentary sovereignty* for its submarines, coupled with some *limited sovereignty* for off-the-shelf systems. This overarching ambition has been achieved in both the *Oberon* and the *Collins* submarines. In this way, Australian has sought to balance the investment required to build *industrial capability and capacity*, and to generate important IP, with the potential benefits of engagement and integration with larger alliance partners. With the exception of communications in the 1994 DWP, *focused sovereignty* has not been a policy ambition.

Outside the consideration of *rudimentary sovereignty*, the translation from policy to capability has been mixed. In some cases, policy positions have not been attained whilst in others the level of sovereignty has exceeded that as expressed in the policy. The CMS is an example of the former, anechoic tiles is an example of the latter. The intent at the commencement of the *Collins* program was to build upon the capability developed through the *Oberon* SWUP program and for Australia to have *focused sovereignty* with respect to the combat management function. The decision to replace the *Collins* combat system with the US AN/BYG-1 alternative had far-reaching consequences for operational and defence industry sovereignty that continue to the present day. As a result of this decision, and in contrast to policy statements that continued to exhort the importance of industry capability associated with combat systems, developments and improvements to the *Collins* CMS were only possible through US processes and controls (AUS Anon #4, 2019), and the potential for independent decision-making was lost (Briggs, 2019; Horobin, 2018). In the case of the anechoic tiles, Australia could not obtain suitable tiles from partner organisations and was forced to develop its own (Yule and Woolner, 2008).

Second, despite the variability in defence industry policy ambition beyond that of *rudimentary sovereignty*, the overall level of sovereignty in capability has progressively increased over the life of the *Collins* submarine. This increase has been driven by two factors. The first is the development of submarine-related capabilities by the domestic defence industry that have been incorporated into the submarine; anechoic tiles, through water communications systems, and submarine batteries are examples. These developments have provided independent access to IP, and have established the requisite capability and capacity for *focused sovereignty*. The second is the progressive establishment of domestic capability and capacity in DO-FC entities in support of the objectives of the FO-FC parent. This dynamic resulted in *limited sovereignty* in sensors as Thales developed its Australian subsidiary, and in the platform management system as Saab undertook a similar approach.

Third, the structure of the Australian defence industry experienced great change over the period of the case study, driven in large part by the preference of successive governments for off-the-shelf procurements. From the initial stages of the case study where GO-GO entities comprised the majority of the defence industrial base, the industry moved to a position at the conclusion where the industry was dominated by the DO-FC subsidiaries of multi-national companies such as Kockums, Thales, Raytheon, and Saab, and the majority of contracts placed by the Department of Defence were with DO-FC and FO-FC entities. The structural change has not had any demonstrable negative impact on defence industrial sovereignty for the *Collins* submarine, largely due to the fact that Australian industry had neither the capability nor the capacity to undertake the activities required. The involvement of foreign companies, and the establishment of DO-FC subsidiaries, was therefore a requirement to move the project forward. The longer term impact of this structural change may be to restrict the level of sovereignty that can realistically be achieved to *limited sovereignty* as the provision of independent access to the intellectual property associated with off-the-shelf procurements from foreign suppliers has repeatedly proved problematic (Barrie, 2006, 2018; Thomson, 2006; Markowski and Hall, 2006; Wylie, 2006a; Defence, 2010a; Rusbridge, 2014; Beazley, 2018).

Fourth, the level of assessed threat and strategic risk has been an important driver of government intent for sovereignty in Australian defence industry. The decision to produce the *Collins* submarines in Australia represented a step change from the previous reliance upon the United Kingdom for support of the *Oberon* submarine, and a desire to increase the capability of the domestic defence industry. The 1987 Defence White Paper promoted self-reliance and sovereignty considerations beyond the historical need to undertake in-country adaptation, repair and maintenance of systems acquired from foreign suppliers, and included the need for 'Australian involvement in design, development and production to acquire the necessary detailed knowledge, skills and facilities' (Defence, 1987: 76). A low level of direct threat made the ambitious position adopted in the 1987 Defence of Australia difficult to sustain over an extended period, particularly when governments changed, and different political outlooks were involved.

Fifth, the acquisition of technology, and more complex systems associated with that technology, has also been a driver of changes in policy and in the associated investment in capability. One example from the Australian case study is the decision to acquire *Harpoon* and to move from the MK 8 HWT to US Mk 48. In order to obtain the maximum operational value from the new weapons, the RAN undertook the *Oberon* SWUP program and the establishment of the SWSC. The success of these programs subsequently influenced the decision to develop the *Collins* combat system in Australia. Although outside the boundaries for this case study, the decision for Australia to move from conventional technology to nuclear power for its submarines is also likely to have far-reaching and enduring policy implications (White House, 2021, Morrison, 2021).

Although the overall sovereignty ambition in defence industry policy has been low, and despite the various challenges faced by the *Collins* submarine during the period of the case study, the Australian defence industry has evolved in both capability and capacity. As indicated by ASC becoming the design authority for the *Collins* platform, and Saab Australia's and PMB's key roles in the ongoing development of ISCMMS and submarine battery technology respectively, and putting aside the restrictions associated with the CMS, the domestic industry has progressively moved towards higher levels of control over important elements of the submarine capability.

5 – Case Study – Sweden

Our approach to existential risks cannot be one of trial-and-error. There is no opportunity to learn from errors. The reactive approach — see what happens, limit damages, and learn from experience — is unworkable.

— **Nick Bostrom**

Introduction

Sweden is an open, multi-cultural society that operates as a constitutional monarchy with a parliamentary government system. The nation shares a common strategic outlook with many other western countries, including both Australia and the United Kingdom, through promotion of a global rules-based order and adherence to a set of international norms and behaviours (Lofven, 2017, 2019; Hultqvist, 2020, Bildt, 2008, 2014; Wallstrom, 2017).

Sweden has a history of neutrality in its international relations. Since the end of the Napoleonic Wars in 1815 it has not been involved in any military conflict (Andren, 1976; Wunderlich, 2013). Neutrality has become a major component of the national identity (Brommesson, 2018) and, as stated by Ferreira-Pereira (2005: 466), the Swedish principle of *'en alliansfri politik syftande till neutralitet i krig* ('non-participation in alliances in peace time, aiming at neutrality in the event of war'), came to embody the fundamental underpinning of Swedish foreign, security and defence policy[9]. For many years, therefore, Sweden actively sought to remain outside international groupings that could be considered as being politically or militarily inspired, whilst promoting its social and human rights agenda.

The size of the Swedish military has reduced substantially since the end of World War II, and has diminished from being able to mobilise 850,000 troops and having the world's fourth-largest air force in 1945 to a size of 50,000 in 2010 when conscription was abolished (CSS, 2013). As shown in Figure 21, the government commitment to the defence effort has steadily reduced from approximately 4.0% of GDP in the mid-1960s to a more recent level of around 1.0%[10]. Acquisition

[9] This long history of neutrality was dramatically overturned following the 2022 Russian invasion of Ukraine when Sweden applied to join NATO.
[10] The Russian invasion of Ukraine in 2022 has seen the commitment to defence rise from 0.9% of GDP in 2015 to approximately 1.3% in 2022, with further advances to 2% by 2028 (Reuters, 2022).

and sustainment of military systems is undertaken by *Försvarets Materielverk* or Defence Materiel Administration (FMV), a government agency acting under the Ministry of Defence.

Sweden is a middle power; being neither a superpower nor reliant upon external support for all aspects of its security. That is, Sweden is capable of addressing some, but not all, of its potential security challenges. It is also capable of both protecting its core interests and initiating change in aspects of the existing international order (Hill, 2000; Carr, 2014). This capability is evident, *inter alia*, in its long period as a non-aligned, neutral state with a focus on having the ability to defend itself.

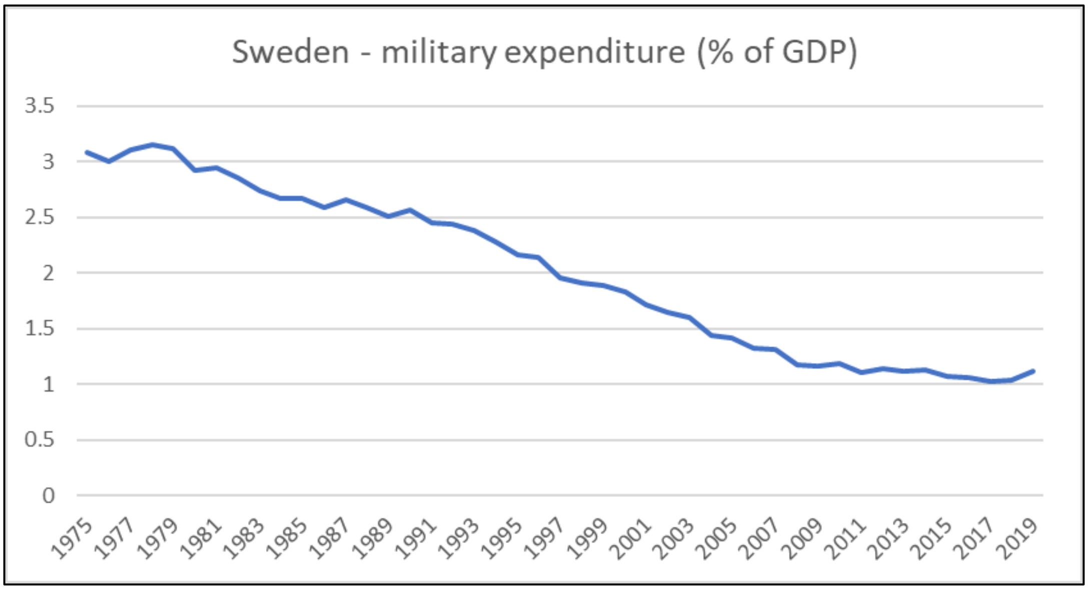


Figure 21. Sweden military expenditure as percentage of GDP (World Bank, 2021)

The Swedish strategy of armed neutrality has required a high level of self-sufficiency in military systems. The contribution of defence industry to national security has therefore been an ongoing factor in Swedish defence policy, with the country having maintained a substantial defence industrial base capable of designing and manufacturing a range of high technology platforms from fighter jets to submarines. Industry capability has therefore attracted significant domestic investment for R&D, and for the provision of systems to the Swedish armed forces to maintain industrial capability and to support strategic credibility (Ikegami, 2013; Sandvik, 2014; Hagelin, 1986; Hagelin and Wallensteen, 1992; Fagersten, Danielson and Hakansson, 2018). In order to partially offset the level of government investment required to support the neutrality position, Sweden has also been a significant exporter of military systems (Hartley, 2006).

Bounding the Sweden case study

The Swedish case study has been bounded in a manner consistent with the Australian study to ensure that the results of both can be directly compared. As for each of the studies in this thesis, the military system boundary is the submarine. The industry capability boundary comprises the same industrial elements as defined in the industrial sovereignty framework presented earlier in this thesis, namely submarine related innovation, design, manufacture, upgrade, and update-upkeep, together with system design, systems integration and system-level test and evaluation. The spatial boundary for this case study is the geographic area of Sweden. The temporal boundary is the period from the latter stages of the Cold War to 2020 and covers developments with significant implications for the consideration of sovereignty in policy, including the improvement in the threat environment once the Cold War had ended and the later re-emergence of a more uncertain strategic situation. From a capability perspective, the period includes the transition across three classes of conventional submarine.

Structuring the Sweden Case Study

Policy considerations in Sweden with respect to operational and defence industrial sovereignty can be categorised into three broad periods. The first covers activities in the latter part of the Cold War and therefore ends in 1991. This period serves as a baseline for the case study. The second is the immediate aftermath of the Cold War, and the intent on the part of Sweden to substantially reduce its budgetary commitment to defence. This period commences in 1991 and concludes with the Russian annexation of Crimea in April 2014. The third period covers contemporary events following that annexation and continues to 2020. This latter period includes ongoing re-assessment of Sweden’s security in the face of a more forceful Russia, and the role, size, and structure of the military contribution to countering that threat. These periods are examined in detail in the following sections to ascertain the Swedish intent with respect to operational advantage and freedom of action in defence and defence industry policy, and the manifestation of defence industrial sovereignty over the submarine capability.

Policy and industry baseline (prior to 1991)

Defence Policy

The Swedish defence policy for the period to the end of the Cold War was consistently one of armed neutrality. In neutrality, Sweden sought to balance its geographically exposed position vis-à-vis the threat from the Soviet Union with its cultural, social and political heritage that was closely aligned with the West (Brodin, Goldmann and Lange, 1968; Agius and Agius, 2006). The Swedish approach to neutrality was therefore not simply to avoid the fight, or as Agius and Devine (2011: 267) have suggested 'neutrality means not taking part in a war', but to avoid being captured in someone else's fight and to enter armed conflict only when Sweden itself was directly impacted. Swedish policy leading up to the end of the Cold War therefore better fits the description provided by Moller and Bjereld (2010: 364) that:

> neutrality is a status that concerns the conduct of states during wartime; it prescribes impartiality and the respective states' non-participation in wars between third countries.

To this end, Sweden aimed to deter and, if necessary, defend itself against any conceivable threat without having to rely upon alliance partners; that is, to maintain a 'defence force against invasion' (Moller and Bjereld, 2010: 366). Such a policy required both the internal and external perception of credibility, and was addressed through the application of 'total defence', or the engagement of the whole of society in the defence of the country (Agius and Agius, 2006; CSS, 2013). Despite the overt position of neutrality, Sweden had, however, secretly negotiated with other Western countries, primarily the United States and the United Kingdom, to both receive and provide aid in the event of war with the Soviet Union, and took deliberate steps to cooperate with the North Atlantic Treaty Organisation (NATO) (Petersson, 2012; Dalsjo , 2013, 2014; Bailes, 2012; CSS, 2013).

Sweden during the Cold War can therefore be considered as playing a delicate balancing game; facing an identified, significantly larger, geographically-close threat in the Soviet Union, supportive of the cultural and social values of Western civilisation, but pointedly and publicly eschewing the alliance responsibilities and alignment represented by NATO. The sought-after ends were security for the Swedish nation and its social norms. The ways were to deter and, if necessary, to defend. The means were to maintain control over the development, manufacture and support of the military systems required. That is, Sweden sought self-sufficiency in both operational advantage and freedom of action and therefore, in order to achieve this, 'a constant in Swedish defence policy has been to defend Sweden by Swedish means and, thus, to maintain a sizeable military industry'

(Hagelin and Wallensteen, 1992: 416) capable of producing sophisticated systems and platforms such as tanks, fighter aircraft and submarines (CSS, 2013; Anonymous, 2016; Ikegami, 2013).

Swedish defence industry

As noted above, the non-aligned, national defence, armed neutrality, posture adopted by Sweden required a defence industry largely under domestic control. Lundmark (2021: 402) has stated that:

> Sweden was at the height of its national defence technology development capacity by the mid-1980s. Sweden was by then largely autonomous within a broad spectrum of defence technology expertise and arms development. It produced its own combat aircraft, surface combatants, submarines, armoured vehicles, artillery, radars, ground combat weapons, ammunition and C3I solutions.

The advanced tanks, fighter jets, and submarines developed by Sweden's domestic arms industry therefore reinforced the credibility of the country's armed neutrality (CSS, 2013; Aselius, 2005). A significant portion of this industry, such as the submarine builder Kockums, was owned by the government, a situation that therefore provided unfettered access to the intellectual property associated with these platforms. In addition, the 1971 Swedish law on defence inventions provided avenues for State access to military-related innovations made in Sweden, and the associated IP (Ministry of Justice, 1971).

Two points regarding the Swedish defence industry in the period leading up to the end of the Cold War are relevant. The first, as raised by Nilsson and Wyss (2016), is that armed neutrality creates a paradox as neutral states are typically not autarkic and are therefore reliant upon other states for the supply of specific components necessary for the production of their large military platforms and complex systems. In the case of Sweden, the dependency was upon the West for the provision of electronic components for 'communication systems and systems for fire support, command and control, jamming as well as sensors' (Hagelin, 1986: 24). Morth and Sundelius (1993) have made a similar observation as a "vulnerability trap" that creates a technological dependency in small states that seek to develop advanced systems. This reliance therefore created a position whereby Swedish defence policy, and by extension defence industry policy, whilst outwardly and overtly neutral, reinforced a natural bias towards western Europe and NATO. In addition, during this period, the Swedish military secretly collaborated with NATO with respect to military intelligence and the provision of support during potential operations against the Soviet Union whilst the Swedish government continued its overt position with respect to neutrality and the promotion of its global agenda (Tunander, 2005; Nilsson and Wyss, 2016). Such collaboration was, however, essentially operational and did not extend into the industrial arena.

Secondly, due to application of total defence, there was a close collaboration between the Swedish Ministry of Defence and the defence industry. Whilst such collaboration was not unusual, as many states both supported and guided their defence industries, the Swedish efforts included activities such as government partnerships with private companies and national universities to develop specialist tools and procedures. Total defence therefore required a level of interaction between the government, the military and the industry in excess of that observed in other western economies, and direct official involvement in both the development and the consolidation of the domestic defence industrial base (De Vore, 2015, 2016).

Submarines in Sweden

The Swedish industrial experience with submarines commenced in 1885 when a steam-powered submarine was built in Stockholm and demonstrated to a number of foreign navies (Saab, 2015; Sutton, 2020). Operational experience commenced in 1904 with the introduction of the *Hajen*, a submarine based on a United States design and built at the Navy Yard in Sweden. *Hajen* was subsequently renamed as U-boat No.1, and two extra submarines were added to the fleet in 1909 (HNSA, 2008; Ericsson, 2003). Submarine production in Sweden continued in an unbroken sequence at shipyards in Malmo and Karlskrona from that time. This early production was initially based on a design licensed from the Italian Fiat shipyard and then progressively on designs developed in Sweden.

In the immediate aftermath of World War II, Sweden was able to salvage a modern German U-boat and immediately commenced work on a new design based on the German technology. Innovation in submarine matters, and the translation of that innovation into submarine design, has been an enduring feature of the Swedish submarine enterprise as evidenced by the introduction into service of the Stirling engine Air Independent Propulsion (AIP) system[11] in 1988 (Saab, 2015b) and the X-rudder design that later revolutionised both the underwater endurance and the manoeuvrability of conventional submarines (Saab, 2015a; Hauschildt, Larsson and Bonsignore, 2003).

In the period immediately prior to the end of the Cold War, Sweden operated two classes of conventional submarine; five vessels of the *Sjöormen* class and three of the *Näcken* (A14) class. The former were laid up in 1993 due to lack of funding and subsequently sold to Singapore. Both classes

[11] The Stirling engine AIP system was an adaption from the original Stirling engine invented and patented by Robert Stirling in 1816.

of submarines were designed and built in Sweden, primarily with Swedish systems but with an integrated German sonar system and French diesel engines and electric propulsion systems. The extent of the control exercised of defence industry activities for the A14 submarine, reflecting this reliance on external sources for sonar and mobility systems is shown in Figure 22. The colouring of the circumplex diagram illustrates the Swedish Government's independent ability to address all-of-system design, integration, and test, and for the majority of the A14 categories. The pale orange colouring to the sensor and mobility categories highlights the reliance on FO-FC entities for the innovation, design, and manufacture of these subsidiary systems. As the Swedish position has consistently been that, even for components and sub-systems procured from foreign suppliers, 'Sweden needs to have full control over the IP' (SWE Anon #2, 2020), the upgrade for the sensors and mobility categories reflects independent access to that intellectual property and the independent capability and capacity to utilise it. In Figure 22, the platform management system category is blanked out as such a system was not fitted to early submarines.

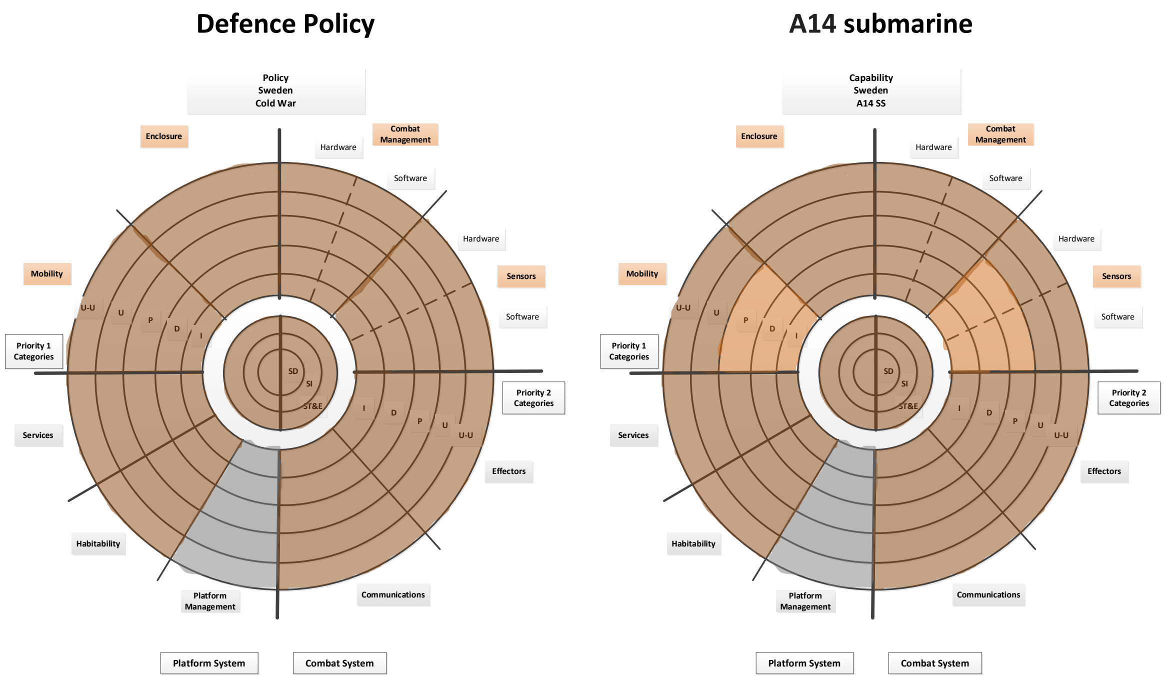


Figure 22. Illustration of the intent for defence industrial control for A14 class submarine during Cold War

Comparison of the circumplex diagrams at Figure 22 shows a general alignment between policy and capability. The Swedish strategy of armed neutrality required a high level of control over the industrial activities associated with both operational advantage and freedom of action for its military forces. This policy in turn required a high level of sovereignty over the Swedish defence industry. The design and production of successive classes of submarine ensured that IP, including both the know-how and the know-why, continued to develop in line with technological advancements. Adequate industrial capability and capacity was also maintained through the repeated manufacture of submarines. At the level of the submarine capability, during the period to the end of Cold War, Sweden achieved the translation of its defence policy into sovereignty, albeit with a reduction in the aspects of submarine sensors and submarine mobility.

End of the Cold War and European integration (1991 – 2014)

The end of the Cold War resulted in substantial changes in Swedish defence policy as the threat upon which that policy had been developed had ceased to exist. The position of armed neutrality, aiming to balance a general cultural alignment and support for the West with a geographically exposed position to the Soviet Union, was no longer relevant. The national defence posture that had served Sweden during the Cold War, albeit at significant cost with respect to the maintenance of a largely self-sufficient military and its supporting industrial base, was no longer required. The country could also overtly align with other European countries for mutual benefit, and formally acceded to the EU in 1995.

Towards the end of the period under examination, the overall defence and defence industry policy commenced a slow shift back towards an increased focus on territorial defence following the emergence of a more assertive military posture from Russia, and Russia’s war against Georgia. Whilst these concerns did not overtly play a part in the policy positions adopted by Sweden in this period, they did presage the changes that would later appear following the Russian invasion of Crimea in 2014, and which are examined in the following section.

Policy

As in the majority of western-aligned countries, the end of the Cold War and the demise of the Soviet Union resulted in a reduction in budget allocations for the military and the “banking” of a peace dividend. For Sweden, however, the reconsideration of its approach to security was both profound and challenging. The basis for pursing security through total defence had been swept away, but neutrality had become ingrained in the Swedish psyche (Christiansson, 2010; The Economist , 2017; Ferreira-Pereira, 2005; Agius and Agius, 2006; Forsberg and Vaahtoranta, 2001), and the previous reluctance to commit to collective defence through a formal military alliance remained. This position regarding alliances was regularly reinforced by the Swedish Prime Minister through statements such as ‘Sweden’s non-participation in military alliances, with the aim of making it possible for our country to remain neutral in the event of war in our vicinity, remains unchanged' (Persson, 2000: 4) and '(t)he Swedish policy of non-participation in military alliances has broad popular support' (Persson, 2005: 14).

Despite this underlying sentiment, almost immediately, Sweden sought to move closer to both the EU and to NATO. Some commentators have suggested that the change in policy was pragmatically driven by the serious financial crisis that faced Sweden in the early 1990s. Bieler (2000: 132), for example, has ascribed the sudden change in strategic and foreign policy to these economic challenges in the statement that ' it can be concluded that Sweden's application for membership was a response to severe economic problems, not an attempt to gain more security in a less stable world'. Fagersten, Danielson and Hakansson (2018: 1) have suggested that Sweden's accession to the EU was a 'rational economic risk management strategy rather than as a foreign and security policy platform', whilst Lindh (2016: 1) has drawn a similar conclusion in that the 'plan for Swedish EU membership was launched as part of a larger crisis package to stabilise the Swedish economy'. From its accession to the EU in 1995, Sweden therefore adopted the conditions of the Treaty on European Union, and its amendments, including acceptance of the EU Common Foreign and Security Policy (CFSP) and the stated intent to work towards the framing of a common defence policy (Council European Communities, 1992; European Union, 1997).

Sweden's membership of the EU therefore required a philosophical and policy balancing act. This balancing is evident in the articulation of the difference between the maintenance of a reduced form of neutrality, one that eschewed formal military alliances, with integration with other European structures. This is evident in the contrast between the Prime Ministerial statement in 1991 that 'it is obvious that the term "policy of neutrality" can no longer adequately be applied as an overall description of the foreign and security policies we wish to pursue within the European framework' (as stated in Bieler (2000: 133)), and the later statement that 'Sweden does not participate in military alliances' (Persson, 2004:1). The result was a close engagement with the EU and its associated security structures, albeit with a focus on peacekeeping and crisis management activities (Fagersten, Danielson and Hakansson, 2018; Wieslander, 2018; Bergman, 2004), and a deliberate decision to remain outside of NATO. The engagement with the EU was such that by 2008 the Foreign Minister stated to Parliament that '(t)he European Union has a special position in Swedish foreign and security policy' (Bildt , 2008:1), and in 2010 that '(o)ur foreign policy is a part of the common European foreign policy' (Bildt, 2010: 2).

Although Sweden deliberately eschewed formally acceding to NATO, that did not mean that the country remained separate from NATO activities, structures, and procedures. In May 1994, Sweden commenced a formal relationship with NATO when it joined the Partnership for Peace (PfP) program, and subsequently the PfP Planning and Review Process (PARP), a planning mechanism to assist NATO partners develop capabilities suitable for NATO-led operations (NATO, 2014, 2021; Wunderlich, 2013, Agius, 2011a). In 1997 Sweden also joined the Euro-Atlantic Partnership Council (EAPC) when it was established to provide a political framework and dimension for PfP cooperation. The importance of these bodies to Swedish military activities were clearly stated by the Ministry for Foreign Affairs as:

> EAPC and PfP are central to NATO's cooperation with countries that are not members of the Alliance. For some countries the partnership with NATO is a preparation for membership, while for others, such as Sweden and Finland, it constitutes the prime instrument for developing the military and civil interoperability that countries must have in order to be able to contribute to international crisis management and peace support operations (Ministry Foreign Affairs, 2004: 1).

NATO therefore became an important feature of Swedish foreign and security policy. The military benefit from interaction with NATO was emphasised by a statement by the Foreign Minister in 2007 that:

> (i)ntensified cooperation with NATO in the area of crisis management is in Sweden's interest. As a partner country we have already a broad commitment, focusing on joint crisis management measures and military interoperability (Bildt, 2007:11).

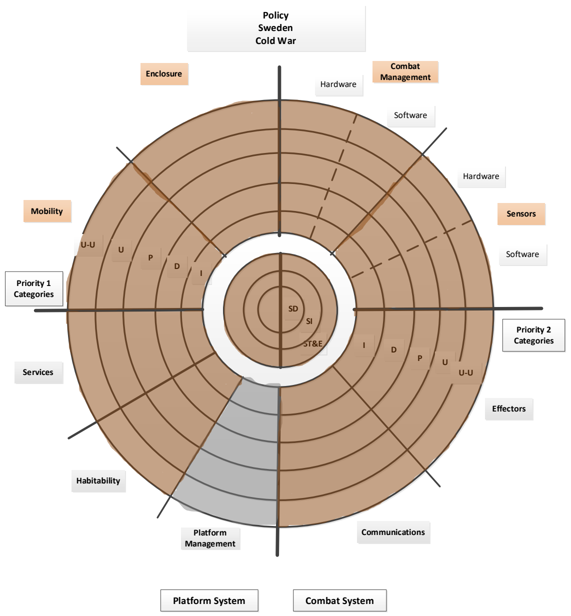
Although there was no formal defence industry policy issued by Sweden during this time, industry-related trends derived from defence policy can be discerned. The first is the change in focus from security to economics and the concomitant need to maximise the peace dividend. This change resulted in a marked reduction in the willingness of the Swedish Government to support the domestic development of military systems, and hence a reduction in the direct investment into that industry. The change in strategic circumstances, compounded by the challenges from the economic crisis in the early 1990s, reduced the need for an independent approach to the development and support of the capabilities fielded by the Swedish military, and hence for sovereignty. The second and related trend was the increasing engagement by Sweden with both the EU and NATO, in both wider industrial cooperation and in increasing military interoperability (Dalsjo, 2013). This situation was summarised in the Swedish Government defence document *Our Defence* that development 'of a common European security and defence policy is changing the prerequisites of Sweden's own defence policy' (Sweden MOD, 2004: 8).

The priorities for defence procurement also changed radically during this period. As reported by multiple commentators, the defence materiel acquisition strategy changed in 2007 to prioritise the procurement of off-the-shelf systems, then the collaborative development of defence systems, and as a last resort indigenous Swedish development without partners (Bekkers *et al,* 2009; Lundmark, 2013, 2021). Lundmark (2021) has further commented that the policy was nuanced in 2009 with the primary option being to upgrade existing systems, preferably in collaboration with other nations. The national attitude to self-reliance, and in having a high degree of sovereignty over its defence industrial activities, had therefore changed substantially with the downgrade of the assessed threat.

Closer collaboration in the development of military systems with other European states was a natural response for the post-Cold War Sweden, and one that reflected both its challenges and the post-Cold War reality. The assessed threat had disappeared. Sweden wanted closer engagement with Europe, principally for the economic benefits that EU membership provided. Rising costs associated with the development of military systems in the period leading to the end of the Cold War also meant that the ability to develop and produce certain types of sophisticated systems locally had decreased (Andren, 1976; Hartley, 2007, 2008, 2011; Arena *et al*, 2008). Collaboration in the development of advanced military systems was, therefore, a means to spread the investment and the risk. Sweden's industrial engagement through the *Framework Agreement to Facilitate the Restructuring and Operation of the European Defence Industry* (CFO, 2001), and subsequently its membership of the European Defence Agency (EDA) (EU, 2007), was therefore consistent with its revised security needs.

Figure 23 illustrates the marked change with respect to the intent for defence industry sovereignty that was evident in Swedish defence policy in the immediate post-Cold War period. The change was a paradigm shift for Swedish defence policy and an abandonment of the position that the state had held as a fundamental principle of its international engagement for over a century. Having followed a policy whereby Sweden wanted to be, and planned to be, largely self-reliant in military systems, it had moved to a position of acceptance that an independent approach to operational advantage and to freedom of action was no longer important. Integration with Europe was the driver of policy, not any perception of a high threat.

Defence Policy



Defence Policy

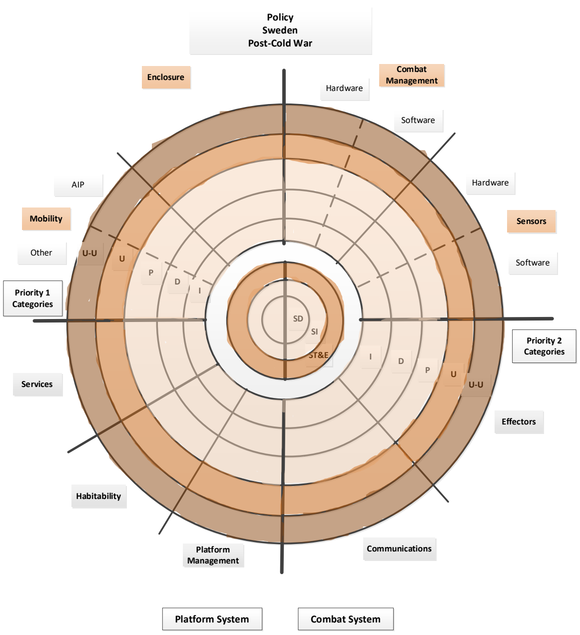


Figure 23. Illustration of intent for control of defence industrial activities post-Cold War

The general pale orange colouring of the circumplex diagram reflects the priorities for capability development as outlined above, and acceptance for off-the-shelf systems from FO-FC entities. This policy position indicates that sovereignty was not an issue for all-of-system design, or for systems integration. System level T&E is however coloured for limited control as it is assumed that Sweden, having sourced a system from a foreign supplier, would want to conduct its own evaluation to ensure that that system met its operational requirements. Figure 23 is coloured accordingly. The dark orange update-upkeep circle is covered by FMV regulations concerning the use of intellectual property for these purposes (FMV, 2020). The light orange upgrade circle is a mid-range deduction in that systems fitted to a submarine would not typically be sent abroad for upgrade and that DO-FC entities and collaborative arrangements were acceptable to the Government.

Defence Industry

The changes in strategic and defence industry policies directly impacted the structure of the Swedish defence industry in the period following the end of the Cold War. Post-Cold War threat assessments removed the need for the strategy of total defence and the maintenance of a high level of self-sufficiency in military systems and in defence industry. The economic challenges facing Sweden in the early 1990s required new ways of thinking, and international engagement. Membership of the EU came with expectations of closer engagement and collaboration. Closer military engagement called for greater interoperability with EU and NATO partners. For defence industry this resulted in the gradual increase in foreign ownership of Swedish defence companies, and the Swedish Government also divested itself of all state ownership of defence companies from the end of the 1990s (Belin *et a*l, 2017; Fagersten, Danielson and Hakansson, 2018; Agius, 2011; Agius and Agius, 2006; Britz, 2010; Olsson, Gutensparr and Elofsson, 2018).

The restructuring of the Swedish defence industry occurred relatively rapidly, with Lundmark (2013: 6) commenting that ‘Sweden was very liberal compared to other nations in allowing foreign acquisition of defence companies’, and that this was partly due to Sweden having very limited experience in multilateral arms development and collaboration. Belin *et al* (2017) have supported this assessment and have noted that Sweden was early in allowing foreign ownership of the national defence industry. For a nation that had pursued a policy of national defence and a high level of self-sufficiency in support of its policy of armed neutrality, this was a step change in approach to national security.

The changes that manifested in the Swedish defence industry also occurred during a period of intense and sustained consolidation in other nation’s defence industries, driven by the substantial reduction in defence budgets following the end of the Cold War, and as highlighted in the *Last Supper* dinner in the United States in 1993. Whilst Swedish defence industry internally consolidated around Celsius and Saab, and eventually just Saab, significant restructuring occurred with foreign ownership from 1997. The armoured vehicle company Hägglunds was acquired by British Alvis. British Aerospace acquired 35 % of Saab in 1998. The US company FLIR acquired Agema in 1998.

United Defense acquired parts of Bofors in 2001. BAE Systems later acquired Alvis and United Defense, meaning that Hägglunds and some parts of Bofors both became parts of BAE Systems (Sweden Foreign Affairs, 2000; Belin *et al*, 2017). The transfer of ownership with most impact on submarine sovereignty matters, and hence on this thesis, was the sale of Kockums to HDW of Germany in 1999, and subsequently to Thyssen-Krupp in 2005. The impact of this decision with respect to Swedish submarines is covered in the section below.

Submarines

At the commencement of the period under review, Sweden continued to have a high degree of defence industrial sovereignty over its submarine force, and hence over both the operational advantage and the freedom of action aspects of that force. The conduct of those industrial activities was exercised through Kockums, the GO-GO entity that had a long history in submarine matters and hence accumulated substantial 'know-how' and 'how-why' associated with the design and maintenance of submarines, as well as the ownership of the designs for those submarines.

The most modern Swedish submarines during this period were the three A19 *Gotland* class submarines that had been introduced into service in the years immediately following the end of the Cold War. Commissioning of the submarines in the mid-1990s meant that the decision for the acquisition of this class was made during the Cold War, when Swedish policy dictated high levels of sovereignty over the design and manufacture of its military systems, and Sweden held correspondingly high levels of sovereignty over its defence industry. At that time, the sovereignty across the various categories of the A19 was largely the same as the earlier A14 class submarine: Swedish combat system, weapons and platform management system, with German diesels and a German integrated sonar suite. The A19 also incorporated the Swedish designed and manufactured Stirling engine AIP system. The intent at the time of planning, designing and the initial construction of the A19 submarine was for Sweden to maintain the high level of defence industry sovereignty, and control of activities for operational advantage and freedom of action, that had categorised earlier classes of submarine. This position is represented in the top row of Figure 24.

The sale of Kockums to HDW in 1999 did not change the status of Swedish defence industrial control over industrial activities associated with the A19 class submarines. Whilst the ownership of Kockums passed to Germany, the capability and capacity to undertake the various industrial activities in Sweden remained largely unchanged, and independent access to A19 intellectual property also remained (SWE Anon #2, 2020). In private correspondence, an anonymous Swedish industry person stated that following the sale to HDW:

all activities related to the A19 submarines were undertaken in Sweden. This includes yearly overhauls, mid- and full cycle dockings and modernisation and upgrades (SWE Anon #2, 2020).

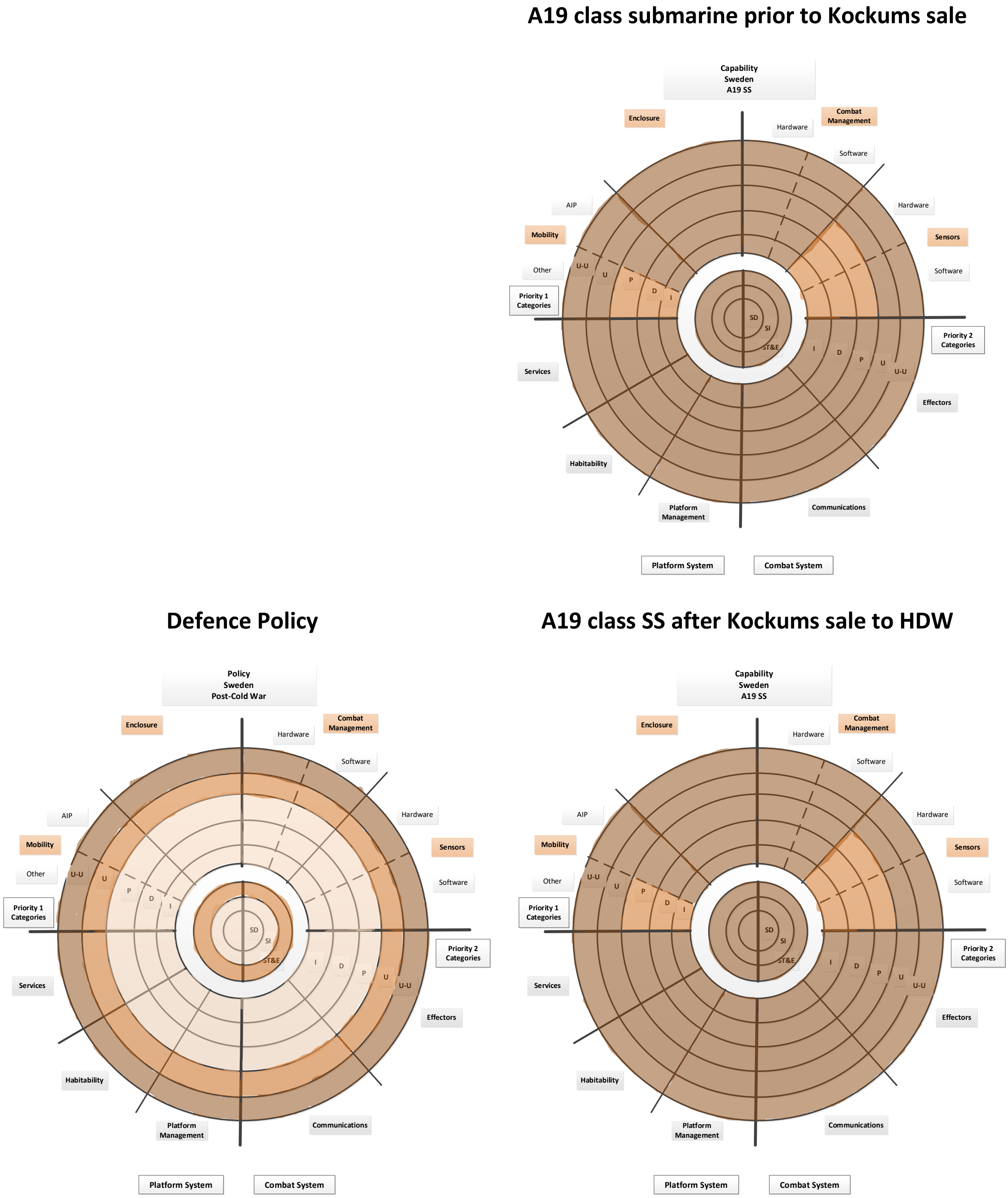


Figure 24. Comparison of intent for control over defence industrial activities for A19 (Gotland) class submarine before and after sale to HDW

Sweden continued to undertake submarine-related research after the sale, with the results of this research remaining in Sweden (SWE Anon #2, 2020). At the system design level, Sweden retained the ability to independently design a submarine as evidenced by the early design work undertaken for the planned *Viking* submarine project, a collaborative project between Sweden, Norway and Denmark that was established in the mid-1990s (Harboe-Hansen, 1998; Forsberg, 2013). Whilst the *Viking* project subsequently collapsed following the withdrawal of Norway in 2003, and Denmark in 2004, FMV regulations concerning the development of goods for, and funded by, the government provided unrestricted access to, and use of, that IP (FMV, 2020, 2022). All IP generated by Sweden during the early stages of the project remained in Sweden (SWE Anon #2, 2020). The ability to exercise control over system level T&E for the A19 submarine was also unchanged (SWE Anon #2, 2020).

The sale of Kockums to HDW did not result in any significant change for the Swedish exercise of control over its submarines. Sweden retained independent access to submarine IP, and the domestic industry capability and capacity remained intact. The Saab combat management system and the German- supplied sensor suite were unaffected by the sale. The intellectual property associated with the Stirling engine also remained with Sweden. In the other categories, the Saab platform control system and communications remained in Sweden. The Swedish heavyweight torpedo capability also remained in Swedish control as it had not been included when the designer and manufacturer, Bofors, was sold to United Defense in 2001, and subsequently to BAE Systems (SWE Anon #2, 2020). The overall level of sovereignty over the A19 submarine capability was therefore unaffected, and therefore there is no change in the circumplex diagram.

In an interview conducted by the author with Swedish naval and FMV personnel in 2018 it was commented that the initial relationship with HDW was good and had been made in an overall atmosphere of increasing friendliness and the perceived benefits of Europeanisation. This started to deteriorate, however, after about 18 months as the perception developed that HDW had made the Kockums purchase to rid themselves of an international competitor rather than for the joint development of improved submarines (Olsson, Gutensparr and Elofsson, 2018). Similar sentiments were also expressed in a subsequent interview by the author with unnamed Swedish industry sources in 2019 (Sweden Anon #1, 2019).

The lack of Swedish influence over the commercial entity providing support to its submarines was exposed in 2002 when HDW was sold to the US private equity firm One Equity Partners, supposedly as a vehicle to facilitate the sale of conventional submarines to Taiwan. This sale removed the submarine industrial activity away from the intent of the Swedish Government to build closer industrial engagement with its new EU partners, and the desire for collaborative development of military systems, to a more transactional relationship. When neither Germany nor Sweden gave export approval for the Taiwan proposal, HDW was subsequently on-sold to ThyssenKrupp Marine Systems (TKMS) of Germany in 2005 (Allison, 2002; PEI Staff, 2002; European Commission, 2004; Bitzinger, 2009). The passage of time and the changes in corporate control meant that the friendliness that characterised the initial sale of Kockums to Germany had dissipated, and the Swedish and the German elements of the overall TKMS submarine-building capability were in competition (Erixon, 2014). TKMS prioritised activities within their own shipyards, Kockums was not allowed to compete on the international market, and there was a significant drop-off in investment in Swedish facilities by TKMS (SWE Anon #1, 2019).

The Swedish decision to proceed with the A26 submarine in 2010 to replace the A19 class progressively brought the tensions with TKMS regarding the Swedish submarine capability into stark relief. On the one hand, Sweden had control of the IP associated with its submarines, as evidenced by the statement by Lena Erixon, the then Head of FMV, that:

> (w)hen it was decided in 2010 that there should be new Swedish submarines, there was an agreement with (TKMS) that the IP on that inherited Swedish technology should remain in Swedish hands, and therefore in FMV hands (Erixon, 2014: 5).

On the other hand, the declining capability and capacity within Sweden to produce and maintain submarines due to the changed circumstances regarding Kockums after 2005 meant that the ability for Sweden to independently utilise the IP was diminishing. This tension was brought into stark relief when it became clear that TKMS would not produce the A26 submarine proposed by Sweden and would only make the German Type 214 submarine available for purchase off-the-shelf (Olsson, Gutensparr and Elofsson, 2018).

The dilemma for Sweden was whether to accept the diminution of sovereignty over its submarine capability that the A26 proposal had exposed, or whether to attempt to rebuild it in some form. Acceptance of the Type 214 proposal would have led to a circumstance as depicted in the bottom row of Figure 25, with German control over all submarine-related industrial activities, including the intellectual property, the submarine design, the know-how and the know-why, and the industrial facilities. As noted in a 2019 interview with the author, Swedish domestic submarine capacity was under threat as there had been a significant reduction in investment in Kockums facilities, and there was a developing perception that TKMS was trying to shut Kockums down (SWE Anon #1, 2019). Moreover, Swedish-developed technologies such as its heavyweight torpedo and Stirling engine AIP would have been made redundant in favour of German-developed alternatives (Olsson, Gutensparr and Elofsson, 2018). Whilst the situation as depicted in the bottom row of Figure 25 would have aligned sovereignty for the submarine with Sweden's broader post-Cold War defence policy, the overall security sentiment was changing after Russian military intervention in Georgia in 2008.

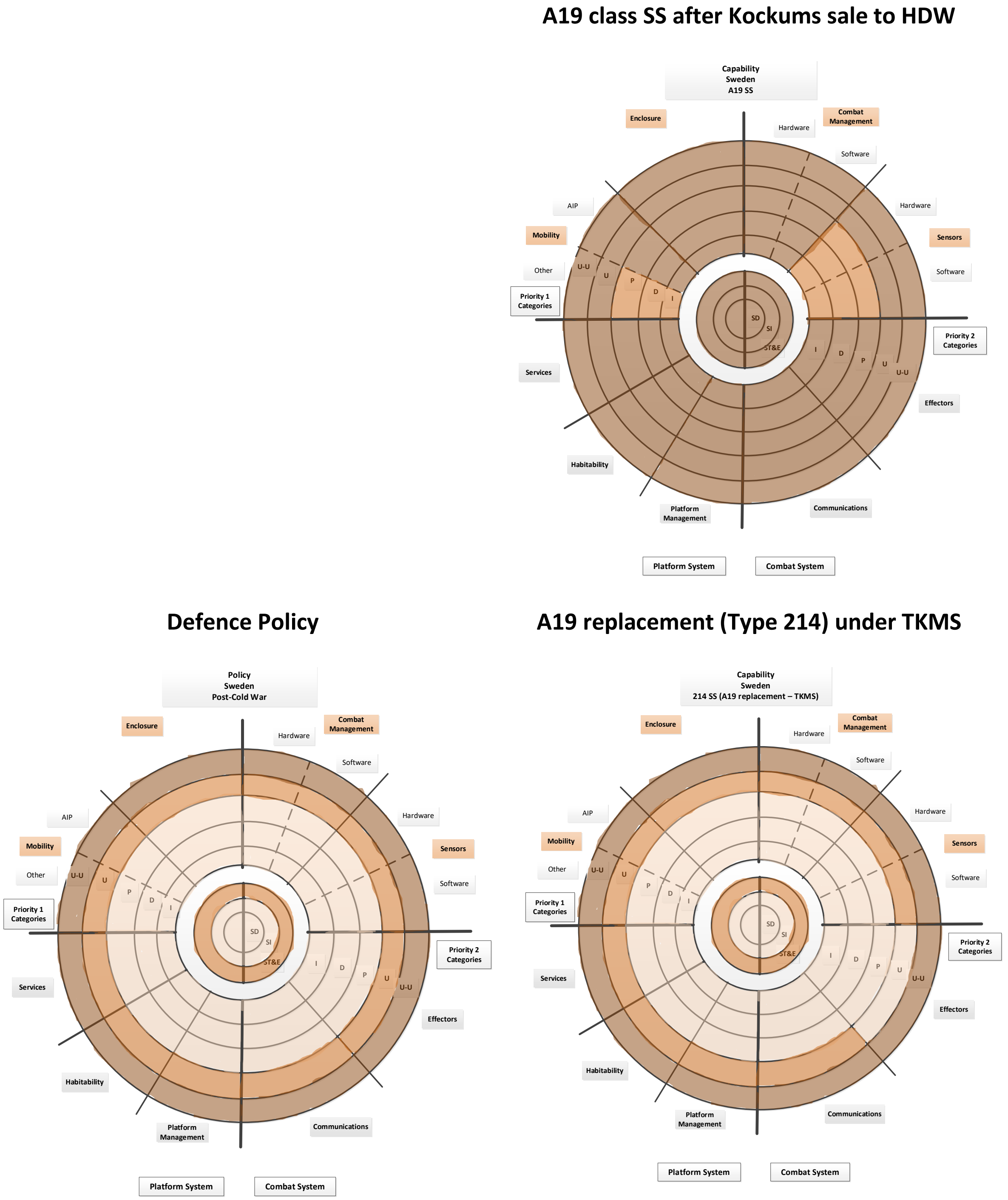


Figure 25. Comparison of intent for control over defence industrial activities for the Swedish submarine enterprise after sale to TKMS

The Swedish decision to acquire the A26 submarine, and the TKMS refusal to produce that submarine and only offering the German designed and built Type 214, amplified the security and sovereignty challenges for Sweden. In an interview between the author and Rear Admiral Andreas Olsson, Special Advisor to the Department of Acquisition, Research and Development within the Swedish Ministry of Defence in 2018, he stated that the Swedish Prime Minister had described the original sale of Kockums to HDW as 'the worst decision ever made' (Olsson, Gutensparr and Elofsson, 2018). Overall, the Swedish experience has highlighted the potential for a rapid change of policy to have unintended, enduring consequences. The alternative to reduced sovereignty was to attempt to regain independence over the national submarine activities.

Return to total defence (2014 – 2020)

The geostrategic situation facing Sweden was fundamentally changed with the Russian invasion of Crimea in 2014. A clear definable threat to Swedish security had reappeared. Given Sweden's membership of the EU, and the close collaboration with NATO, a return to the earlier policy of armed neutrality was not possible as Sweden was 'more dependent on the outside world than ever before' (Lofven, 2017: 5), and Sweden needed to determine a new way forward. That new way included a return to the past.

Policy

The Russian invasion of Ukraine in 2014 brought a sudden awakening and rapid change in strategic outlook and security policy within Sweden. The Crimean annexation also exposed the overly optimistic posture adopted by Sweden with respect to its security, and its expectations regarding the future trajectory for world events. As noted in a document developed by the Swedish Defence Research Agency (FOI), as late as January 2014 the Swedish Prime Minister, Fredrick Reinfeldt, was reported as stating that an interstate war in Europe was no longer conceivable (Dalsjo and Jonsson, 2017). The strategy adopted following the end of the Cold War had integrated Sweden more fully into Europe but had left it poorly protected. For Sweden a clear, definable threat had re-emerged, as expressed in the statement by the Foreign Minister that 'in country after country in our Eastern European neighbourhood we see unacceptable Russian pressure and threats' (Bildt (2014: 3). Commentators including the Swedish Defence Minister, Peter Hultqvist, have suggested that there was an early naivety concerning developments with Russia (Hultqvist, 2017a, 2017b), and that the Swedish Government moved too late to address the threat (Christensen, 2019; Milne, 2017).

In 2015, Sweden released a new defence policy to address the changed strategic reality (Swedish MOD, 2015). The new policy aimed to address the assessed challenges to Sweden's security by recreating a version of the Cold War defence posture. *Total Defence*, defined by Swedish law as 'the planning and measures required to prepare the country for war' (von Sydow, 2018), was back. The extent of the total defence concept across Swedish society was further described by von Sydow as 'the parliament, the government, government authorities, municipalities, private enterprises, voluntary defence organisations as well as individuals are all part of the Swedish Total Defence'.

Swedish society and the economy had, however, changed markedly since the previous iteration of total defence implemented during the Cold War. The economy had been transformed to be "just in time", and market driven, with large proportions of the overall economic activity controlled from foreign locations, albeit from partner nations within the EU and NATO. Sweden was not able to depend entirely on its own resources, and no longer was self-sufficient in key aspects such as energy, telecommunications, transportation, or most aspects within the defence industry (Jermalavicius, Pernik and Hurt, 2014; Lindgren and Odlund, 2017). These changes were manifestations of the post-Cold War policy that had promoted the benefits of collaboration and cooperation, and had minimised the direct investment needed to maintain the industrial sectors that were again required for the implementation of total defence. The 21st century version of total defence could not therefore be a carbon copy of its 20th century predecessor and, as noted in a FOI memorandum in 2017, the practical ability to achieve the outcome sought by the government was directly impacted by the changes that had occurred since the end of the Cold War (Lindgren and Odlund, 2017).

The sought-after end for the total defence policy was a resilient society capable of withstanding an attack, identified as being from Russia, for a period of three months (Defence Commission, 2017, 2018; von Sydow, 2018), after which, presumably, assistance would come from partners. Total defence therefore required a high degree of government control and regulation over all the entities that comprised Swedish society, from the military to the civil defence, and encompassing all functions and activities throughout the Swedish economy. In this way the government could direct what developments might be needed, and both where and when the need was to be realised. There was, therefore, an acceptance in Swedish defence policy that 'security is built in solidarity with others' (Swedish MOD, 2015: 1), and that it required 'an active, broad and responsible foreign and security policy combined with credible national defence capabilities' (Wallstrom, 2016: 1). Peter Hultquist, then Sweden's Minister for Defence, referred to this situation as comprising two pillars of the defence policy, namely reinforced national military capability and deepened cooperation with other nations and organisations (Hultqvist, 2017b).

The Swedish membership of the EU also impacted on the Swedish defence policy position during this period. Although the national security of each member state remained the sole responsibility of that state (European Union, 2007, 2009), Directive 2009/81/EC of the European Parliament (European Union, 2009), which aimed to advance the establishment of a European defence equipment market, placed implicit pressure on Swedish authorities to minimise their direct engagement of the domestic defence industry for activities including research and development, industrial development, production, repair, modernisation, modification, and maintenance (European Union, 2009; Lundmark, 2021). States within the EU were therefore expected to limit their protected local contracting to:

> where this is justified on grounds of public security or necessary for the protection of essential security interests of a Member State. This can be the case for contracts … which necessitate such extremely demanding security of supply requirements or which are so confidential and/or important for national sovereignty that even the specific provisions of this Directive are not sufficient to safeguard Member States' essential security interests, the definition of which is the sole responsibility of Member States (European Union, 2009: Clause 16).

In 2014, Sweden declared that the combat aircraft capability and the underwater capability were essential security interests, and added integrity-critical areas in the Command, Control, Communications and Intelligence (C3I) domain in 2018 (Lundmark, 2021). The importance of aircraft and submarines was also reinforced in the 2017 *National Security Strategy* in the statement that:

> (i)t is an essential security interest to our country to have our own military capabilities in terms of combat aircraft and submarine capabilities. It is important for Sweden's defence capability that these essential security interests, and the associated industrial and technical skills, are retained and developed rationally in relation to the requirements for war capability and what may be deemed appropriate use of State resources (Lofven, 2017: 18).

Figure 26 illustrates the level of sovereignty inherent in this new policy for the Swedish submarine force. As befitting a capability denoted as essential, Sweden sought to have independent access to submarine system-level design, systems integration and T&E intellectual property, and the industrial capability and capacity to utilise that IP. As a nominated essential security capability, Sweden also required the highest level of sovereignty over the submarine categories considered as the highest priority for the development and maintenance of operational advantage at Table 3; namely those submarine aspects associated with stealth, mobility, and combat management. The deviation from this overall picture is in the sensor category as Sweden did not have a developed submarine sonar capability and had typically sourced its sonar capabilities from other European suppliers, with update-upkeep undertaken independently within Sweden.

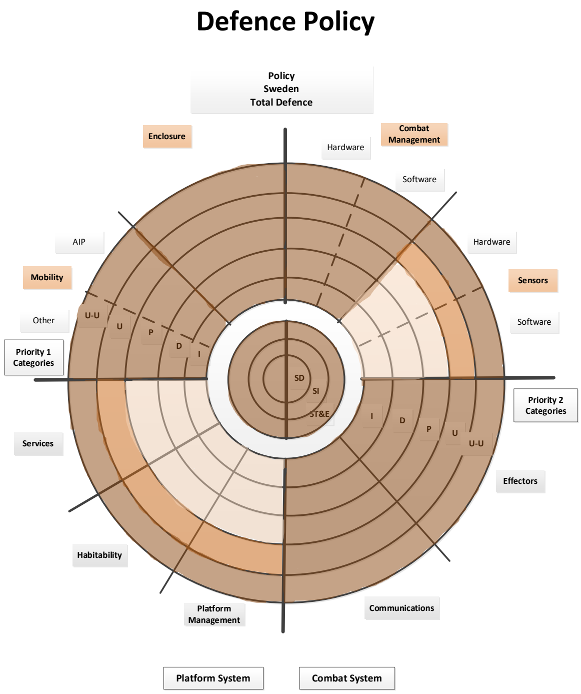


Figure 26. Illustration of intent for control over defence industrial activities after return to Total Defence

For the priority 2 categories, the designation of integrity-critical C3I elements as an essential security capability implied that Sweden also sought the highest level of independence and sovereignty in the communications category. In an interview with the author in 2018, Rear Admiral Olsson, then Special Advisor to the Department of Acquisition, Research and Development of the Swedish Ministry of Defence, also noted that it was important to Sweden to also control the heavyweight torpedo (Olsson, Gutensparr and Elofsson, 2018). The effector category in Figure 26 is therefore coloured accordingly.

For the submarine categories of lesser priority for operational advantage, such as electrical generators, refrigeration, and crew amenities, there was no over-riding need for all industrial activities to be independently available in Sweden and hence these could potentially be sourced from external suppliers. Independent access to IP for update-upkeep was, however, a necessity. Given that systems were unlikely to be removed from the submarine and exported for upgrade, an ability to undertake this activity was required in-country.

The policy position towards the defence industry was, therefore, a combination of supporting domestic industry for the development and provision of essential security interests such as submarines and jet fighters (Erixon, 2014; Sweden Anon #1, 2019; Lundmark, 2021), and an acceptance of the need to acquire lesser-critical capabilities from partners. Government policy pronouncements placed a priority on systems associated with sensing, command and control, communications and cyber, and in the provision of in-country maintenance for the Swedish force structure (Lofven, 2017; Hultqvist, 2017a; Swedish Defence Commission, 2017, 2018; Swedish MOD, 2018; Von Sydow, 2018). The importance of the domestic defence industry, including but not exclusively focused on the designated essential security domains, was reinforced in the 2018 Swedish Defence Commission white book on *Sweden's Security Policy and the Development of the Military Defence 2021-2025* in the statement that:

> the continued existence of a Swedish-based defence industry, which develops and produces qualified defence materiel, is important. Therefore, the proposed defence materiel supply strategy should provide strategic direction, clarify the respective roles and responsibilities of the Swedish state and the defence industry, as well as the state's commitment vis-à-vis the defence industry, including regarding the essential security interests (Swedish Defence Commission, 2018: 8).

Swedish policy with respect to defence and defence industry therefore specifically included notions of sovereignty for the domestic defence industry, and expectations for how these notions should manifest at the capability level. Implicit in the statement above is ongoing investment by the government to fund both the innovation upon which those capabilities would rest, and the capability and the capacity in the domestic defence industry necessary for the production and sustainment of Swedish military systems.

Defence Industry

One of the earliest and most far-reaching changes in the Swedish defence industry landscape during this period of increased tension with Russia was the reacquisition of Kockums from Germany in 2014. The desire on the part of the Swedish Government at the time of the sale was to 'exploit technological synergies between its German and Swedish facilities, and continue building in both locations' (DeVore, 2016: 40). The envisaged end state did not materialise and Sweden became increasingly concerned that its domestic capability and capacity in the critical area of undersea warfare was being deliberately eroded in order to support the German owner's international markets (DeVore, 2015, 2016; Erixon, 2014). As noted in an interview with the Swedish Rear Admiral

Andreas Olsson in 2018, it was assessed that, at the time that Kockums was reacquired, the Swedish submarine capability had deteriorated to a critical point and there was risk to the continuity of the domestic submarine design capability (Olsson, Gutensparr and Elofsson, 2018). On 8 April 2014 Swedish government personnel, accompanied by military police, seized the Swedish intellectual property for the A26 submarine at the Kockums shipyard in Malmo in southern Sweden to forestall disagreements concerning the ownership of, and access to, that IP (Roos, 2014; Gee, 2014; Editors, 2014; Lundmark, 2014), and the formal transfer of the ownership of Kockums from TKMS to Saab occurred shortly thereafter (Saab, 2014). The Kockums reacquisition, coupled with a reinvestment into submarine-related facilities and infrastructure (Sweden Anon #1), ensured that Sweden had a high level of control over the industrial activities associated with its submarines, a designated essential security interest within its defence planning. Sweden therefore had a high level of defence industry sovereignty for this capability.

The structure of the Swedish defence industry during the period under review primarily comprised entities where internal capability and capacity existed, and where Sweden had independent access the relevant intellectual property. These companies were typically DO-DC entities where control resided inside Sweden. This group comprised the largest section of the Swedish defence industry, with Saab alone accounting for between two thirds and four fifths of the production of Sweden's defence materiel (Lundmark, 2014; Masson, Mölling, Hartley, Lundmark, and Soloch, 2013). Sweden was therefore in a strong position to pursue a defence industrial strategy that involved limited self-sufficiency if it chose to do so.

Submarines

As noted in the post-Cold War section above, the decision on the part of Sweden to make ownership of the IP part of the agreement with TKMS for the A26 submarine was far-sighted. Whilst changes in the ownership structure of the Swedish defence industry across a range of military systems meant that sovereignty could not effectively be regained short of nationalisation, re-acquisition of submarine design and manufacture capability through Saab was possible and was vigorously pursued. In essence, for the submarine capability, a return to a largely self-sufficient position for a designated essential security capability could be achieved.

For the Swedish submarine capability, the reacquisition of Kockums from TKMS represented a quantum step back-to-the-future in terms of defence industry sovereignty, and hence in having an independent capability to address both operational advantage and freedom of action. The extent of the change from the potential acquisition of the Type 214 submarine from TKMS to the design and production of the A26 through the re-acquired Kockums can be seen in Figure 27. Sovereignty with respect to the A19 submarine replacement had moved from the potential position of being reliant on a FO-FC entity for almost every aspect of the Type 214 as the submarine capability, albeit one within another EU member state, to having an A26 submarine capability that had essentially had returned to the Cold War levels as represented earlier at Figure 24.

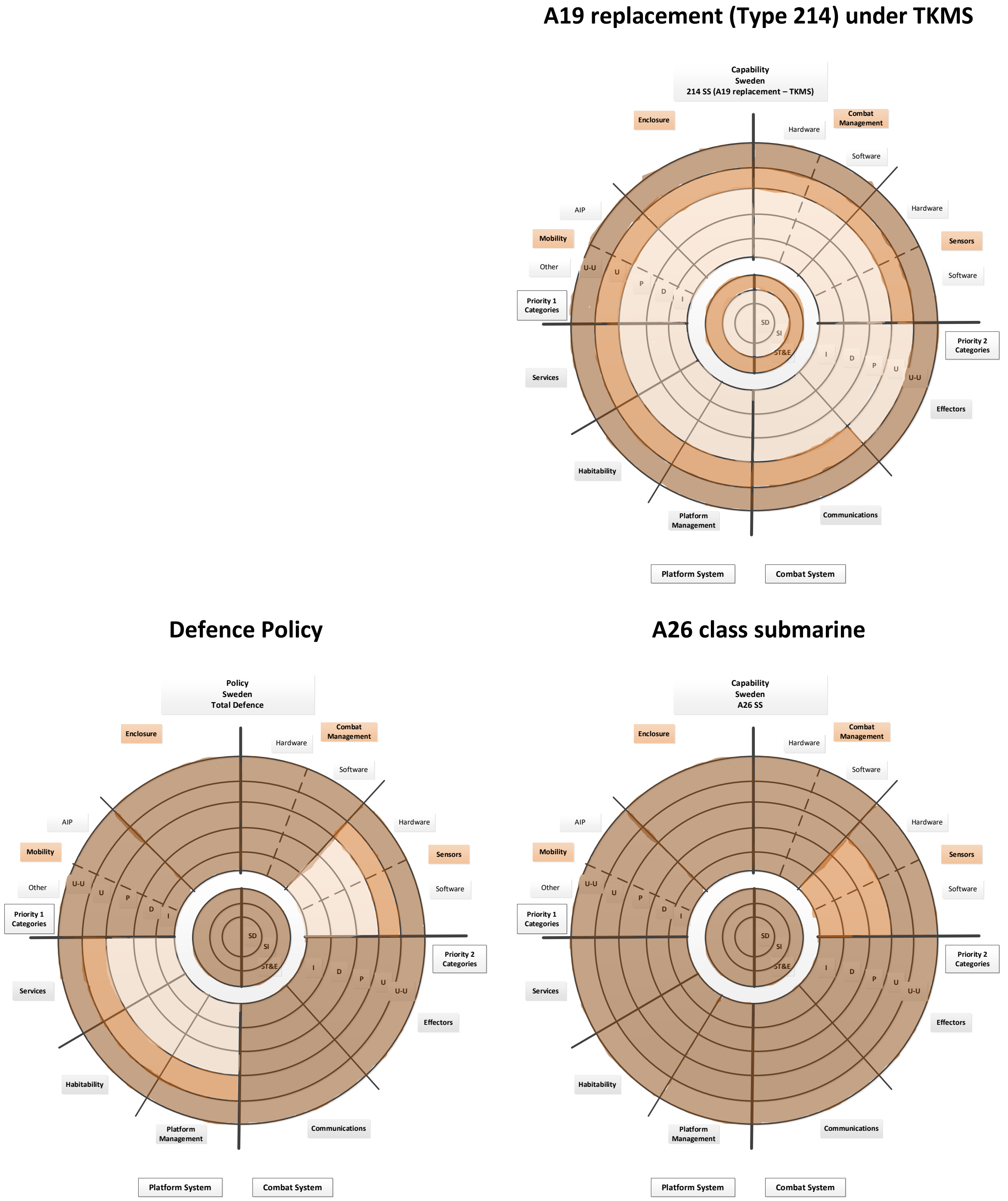


Figure 27. Comparison of intent for control over defence industrial activities for the A26 (*Blekinge*) class submarine

At the all-of-system level, Sweden had reacquired the ability to independently address design, systems integration, and T&E. As advised to the author by an unnamed Swedish industry executive (Sweden Anon #2, 2020), some limited A26 pre-design and study activities had been undertaken during the period that Kockums was owned by TKMS, and this had been performed by Swedish designers. The detailed design had subsequently been undertaken by Swedish designers in Sweden and operational advantage design issues could therefore be addressed under Swedish control. Sweden, through Saab, also now owned and controlled the capability and capacity aspects of the industry, together with modernised shipyard facilities in Karlskrona.

In the submarine categories determined as priority for the development of operational advantage, Saab provided the enclosure and associated fittings critical for stealth, the combat management system, and the Stirling engine AIP system. Whereas diesel engines in earlier submarines had been acquired from Germany, those for the A26 were designed and manufactured by Scania in Sweden (Sweden Anon #2, 2020). The one exception to this picture was in the sensors category where, given that Sweden did not have a highly-developed capability, systems were acquired from other European countries. In the case of the A26, these included the German company Atlas-Electronik (Peruzzi, 2019; Lipka, 2018) and Kongsberg of Norway (Kongsberg Maritime, 2015, 2016; Peruzzi, 2019). The other A26 submarine categories were all provided by Swedish industry, with the HWT, the platform management system, and the communications being sourced from Saab.

In the Swedish case, the impact of previous policy decisions regarding the submarine capability could be readily reversed, together with the decline in the domestic capability and capacity to produce submarines. In separate interviews with the author, Olsson, Gutensparr and Elofsson (2018) and anonymous Swedish commercial personnel (SWE Anon #1, 2019) referred to the decline in the Swedish submarine design capability, and to the capacity within submarine facilities in Sweden, and that both were approaching critical stages. The passage of time had not been such as to make the re-establishment of the local submarine capability a long-term or unaffordable task.

Conclusion

The Swedish case study has investigated the period from the end of the Cold War to the present day and includes multiple classes of submarines. The policy aspirations for sovereignty changed significantly over that period, from deliberately focusing on a highly capable domestic defence industry in the face of the Soviet threat to “peace in our time” and back again as the threat from

Russia rose following the invasion of Crimea in 2014. Changes in the level of defence industry sovereignty as expressed in policy have been directly related to changes in the perceived threat, whilst that at the capability level has barely moved.

The Swedish example has also demonstrated that a small nation, confident in its ability to address the technological challenges associated with innovation in military systems and operational advantage, can achieve high levels of operational sovereignty at an acceptable cost. The post-Cold War period, where sovereignty expectations were reduced in favour of economic advantages, has also reinforced that 'an acceptable cost' is closely related to the assessed level of the threat. Sweden, in its declaration that aircraft, underwater capabilities including submarines, and elements of C3I were essential security capabilities, also reinforced the notion that not all capabilities are of equal value to the defence effort and, therefore, not all need to have the same level of defence industry sovereignty.

Whilst Sweden retained independent access to submarine design IP throughout the period of the case study, and retained both the know-why to that information and the know-how and capacity to produce submarines, that would not have been the case under the TKMS proposal to provide the German Type 214 built in Germany rather than the Swedish-designed A26 built in Sweden. Acceptance of the German proposal would have seen the erosion of both domestic submarine-related design and manufacture skills, and the state of relevant facilities (DeVore, 2015, 2016; Erixon, 2014; Olsson, Gutensparr and Elofsson, 2018). Under this arrangement, Sweden would only have *rudimentary sovereignty* over its submarine force.

The decision to reacquire the submarine capability from Germany reflected the assessment that the weakening Swedish position with respect to submarine sovereignty was unacceptable in the face of a redeveloping threat. Re-establishment of the ability to control industrial activities associated with the submarine enterprise ensured that Sweden would retain *full sovereignty* (with the exception of sensors where the result was *limited sovereignty*) through ongoing independent access to associated intellectual property, and the industrial capability and capacity to utilise it as required to address both operational advantage and freedom of action.

The Swedish case study has, overall, shown a close relationship between the expression of notions of sovereignty in defence policy and its translation into sovereignty outcomes at the capability level, albeit time-delayed. During the Cold War, the policy of total defence matched with the situation where Sweden had extended sovereignty over almost all aspects of its submarines. In the period following the end of the Cold War, where sovereignty expectations reduced substantially, the trajectory for submarine sovereignty was such that the policy position would be attained through erosion given sufficient time. In the final period following the Russian invasion of Crimea in 2014, defence policy returned to total defence and, given that the passage of time had not resulted in submarine sovereignty decaying to an unmanageable level, Sweden was in the somewhat fortunate position of being able to reverse the impact of the decision to sell Kockums and quickly return to the extended defence industry sovereignty desired by government policy.

6 – Case Study – United Kingdom

Nothing is gained by debate on non-debatable subjects.

- **Theodore Roosevelt**

Introduction

The United Kingdom is an open, multi-cultural, democratic society that operates under the Westminster political system, and with long-established legislative and social structures. The United Kingdom shares a common strategic outlook with many other western countries through promotion of a global rules-based order and adherence to a set of international norms and behaviours (HM Govt, 2015; DCDC, 2015, 2018). Clarke (2008: 5) has described this as 'the UK is a thoroughly interdependent actor on the international stage whose fate is bound up more than most with the stability of a rule-based and legitimate global system'.

In the period since World War II, the United Kingdom's defence expenditure has progressively declined as the nation has repeatedly reassessed its security needs and its global commitments in the face of repeated economic challenges. In 2019, this contribution was below the two percent of GDP target commitment for all North Atlantic Treaty Organisation (NATO) countries as depicted at Figure 28. The United Kingdom has maintained a technologically-advanced defence force that comprises separate navy, army, and air force elements with a supporting civilian bureaucracy. The overall size of the military has, however, decreased steadily from 320,000 in 1980 to approximately 200,000 in 2018 (MOD UK, 2018). The defence force has focused primarily on the provision of collective security through its membership and support for NATO, and on the promotion and protection of 'global reach and global influence' (HM Govt, 2015: 5).

The United Kingdom is neither a superpower nor reliant upon external support for all aspects of its security, and hence meets the definition of Hill (2000) as a medium power. That is, the UK is capable of addressing some, but not all, of its potential security challenges. The definition of middle powers as advanced by Carr (2014) is also applicable in that the UK is capable of both protecting its core interests and initiating change in aspects of the existing international order. This capability is evident, *inter alia*, in the response to the seizure of the Falkland Islands in 1982, the deployments to Iraq and Afghanistan in the 1990s and 2000s, and in the withdrawal from the European Union in 2020.

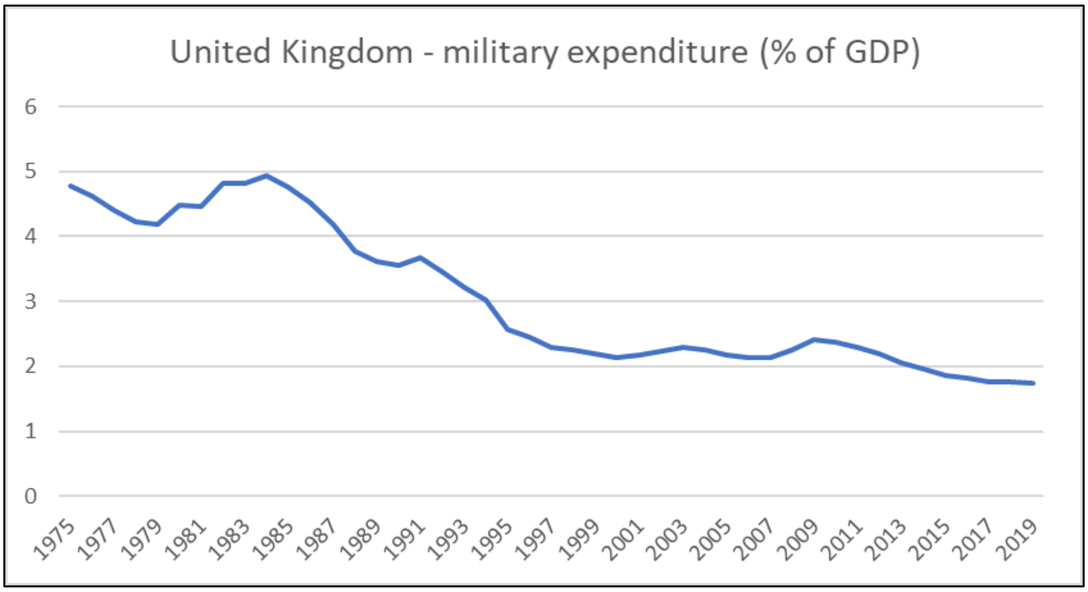


Figure 28. United Kingdom defence expenditure as a percentage of GDP (World Bank, 2021)

The contribution of defence industry to national security has long been recognised by United Kingdom governments, initially through the continuation of an independent military posture in the years following World War II, later through the nationalisation and subsequent re-privatisation of key elements of that industry in the face of economic challenges, in the nomination of certain technologies and industrial activities as strategically important, and subsequently in ongoing investment in the science and technology that has underpinned both the development of operationally-critical capabilities and the selection of military systems (Chin, 2004; Secretary Defence, 2010). The amount available for investment in military systems has, however, been periodically reassessed due to a series of economic crises. The overall challenges and the position of the UK Government regarding the investment required for the development of defence equipment has been summarised by a House of Commons Defence Committee (1987: 88) report that stated:

> to try to stay at the forefront of weapons technology may make the cost of independence unacceptably high, but there is little point in seeking to remain independent if it means relying on outdated equipment which may not be effective in countering the threat posed by an increasingly sophisticated enemy.

Bounding the United Kingdom case study

This case study will be bounded in a manner consistent with the earlier Australian and Swedish cases to ensure that results can be directly compared. The military system boundary for the UK case study is the submarine; the *Trafalgar* class and the *Astute* classes of SSN, and the *Oberon* and *Upholder* SSK. The fact that the *Trafalgar* and *Astute* class submarines are nuclear-powered hunter-killer submarines whereas other submarines examined in this thesis are conventionally-powered is not considered significant as the employment options for both SSN and SSK are generally equivalent (Wiltshire, 2001; Hennessy and Jinks, 2015; Bateman, 2011), although the means of undertaking those tasks in terms of tactical issues such as speed and length of deployment will differ. There are, however, two major exceptions to this general consistency of tasking that relate to anti-submarine warfare. The first is that the SSN has an additional role to contribute to the nuclear deterrent through the provision of anti-submarine screening support to deployed SSBNs, and to hunt for an adversary's SSBNs (Hennessy and Jinks, 2015; Roberts, 2009). Maintenance of a SSBN capability will therefore have ongoing ramifications for the associated SSN capability. In addition, the two types will have a number of common technologies and industrial processes that impact on industrial sovereignty, on freedom of action, and, particularly given the stealth requirements of both, on operational advantage. The second is that SSN submerged speed and endurance enable the submarine to provide direct operational support to a surface Task Group. Neither of these additional tasks are considered of sufficient difference as to invalidate the sovereignty considerations in this thesis.

The temporal boundary covers the period leading up to the election of the Thatcher Government in 1979 to UK's vote to depart the EU in 2016, commonly known as Brexit. The period covers a number of developments with significant implications for the consideration of sovereignty, including an increase in Cold War tension in the period leading up to the appointment of Mikhail Gorbachev as Secretary General of the Communist Party of the Soviet Union in 1985, the subsequent fall of the Berlin Wall in 1989, and the end of the Cold War in 1991. From a United Kingdom domestic viewpoint, the period includes actions to realise a post-Cold War "peace dividend", a subsequent increase in uncertainty following the terrorist events of 11 September 2001, and the later reappearance of a more assertive Russia. From a capability perspective, the period includes the transition of the Royal Navy away from a mixed fleet of nuclear and conventional submarines to nuclear power only.

The industry capability boundary comprises the same industrial elements as defined in the industrial sovereignty framework presented at Chapter 3, namely submarine related innovation, design, production, upgrade, and update-upkeep, together with system design, system integration and system-level test and evaluation. The spatial boundary for this case study is the geographic area of the United Kingdom and Gibraltar. The latter area is included as SSNs operate from the RN base in Gibraltar, and maintenance-related activities occur in that location. As examples, Rolls-Royce has conducted submarine maintenance in Gibraltar and the UK unloaded weapons in that location following a collision between a British submarine and a merchant ship in the Mediterranean in 2016 (Canas and Gonzalez, 2016; Ludlam, 2019).

Structuring the United Kingdom Case Study

Policy considerations in the United Kingdom with respect to operational and defence industrial sovereignty in the context of various classes of submarines can be categorised into four broad periods. The first is the period of the Cold War immediately prior to the election of the Thatcher Government in 1979. These years are important as they lay the foundation for the later discussion, and provide industrial and operational context. The second covers the years of the Thatcher Conservative Government, and includes both the leadup to the end of the Cold War and the conflict with Argentina over the Falkland Islands. This period also includes economic challenges and 'a realisation that the UK was not and could not afford to be a military power within the Cold War structure' (Taylor, 2010: 7). The third period covers the aftermath of the Cold War, and the intent on the part of the United Kingdom Government to reap a peace dividend. This period therefore includes significant optimism about the future and a reassessment of the role of military forces. The period commences with the end of the Thatcher Government in 1990, shortly after the fall of the Berlin Wall in 1989, and concludes with the terrorist attacks on New York and Washington DC in 2001. The final period covers contemporary events from 11 September 2001 and continues to the 2016 vote for Britain to leave the EU. This period includes ongoing assessment of Britain's place in the modern world, and the role, size, and structure of the military contribution to that role.

Policy and industry baseline (prior to 1979)

The twentieth and early twenty-first centuries have been challenging for the United Kingdom in strategic, economic, and social areas. Although ultimately successful in both World Wars, the nation suffered millions of casualties that substantially impacted upon the social structure, and necessitated the expenditure of significant resources in order to ensure national survival. One immediate consequence of the undermining of its economic capacity and political impact was that, following the conclusion of war in 1945, the United Kingdom slipped out of great power status, supplanted by the United States and the Soviet Union. The United Kingdom retained some foreign territorial possessions and continued to view itself as a great power with global capabilities and commitments, but was not in the financial position to support and defend these commitments (Chancellor Exchequer, 1946).

Defence policy

At the conclusion of World War II, the United Kingdom was faced with the challenges of turning war-orientated industries into commercially-orientated ones, ensuring the protection of the nation in the new international environment, and maintaining its global interests and prestige. By 1966 the defence policy had morphed into three substantial and enduring pillars; the maintenance of an independent nuclear deterrent, the protection of the United Kingdom through NATO, and the fulfilment of obligations outside Europe (Secretary Defence, 1966; Healey, 1966). The first of these pillars, the independent nuclear deterrent, commenced in 1947 following the passage of the McMahon Act in the United States and the renunciation of wartime agreements between the US and the UK on the sharing of nuclear technology (Milne, 2003; National Archives, 2019). British plans for an independent nuclear deterrent were abandoned in 1960 with the failure of the *Blue Streak* missile development, and the United Kingdom turned to the United States for access to US nuclear programmes. Following the cancellation of the US bomber-deployed *Skybolt* weapon system in 1962, the UK gained access to the US submarine-launched *Polaris* ballistic missile as the means of delivering the UK-designed nuclear warhead. A submarine-launched nuclear deterrent was introduced with the commissioning of the *Resolution* class nuclear-powered ballistic missile submarines in the late 1960s. From this point onwards, the UK has been reliant on US ballistic missile technology for the realisation of its nuclear deterrent.

The second pillar was the defence of the United Kingdom through NATO as evidenced by repeated policy statements such as '(p)resent-day military preparations can no longer be planned on a national basis' (Minister Defence, 1958: 1), 'we regard the North Atlantic alliance as the key to our survival' (Secretary Defence, 1966: 7), and 'NATO is already the bedrock of our defence and security policies' (Secretary Defence, 1994: Ch 2). To this end, the United Kingdom, during the Cold War, committed 'virtually the whole of the Royal Navy, most of the combat units of the Army and the majority of the combat aircraft of the Royal Air Force' (Secretary Defence, 1972: 6) to NATO for European defence efforts. Similar statements were regularly made by the Secretary of State for Defence in the annual *Statement on the Defence Estimates* (1973, 1976, 1977, 1979, 1983, 1985), and NATO remained the foundation of UK defence and security policies after the Cold War had ended (Rifkind, 1994; Secretary Defence, 1994; HM Govt, 2010).

The third pillar, the support of British possessions and interests globally, and variously described as 'outside Europe' (Secretary Defence, 1973: 9), 'non-NATO commitments' (Secretary Defence, 1976: 32), 'wider defence interests' (Secretary Defence, 1981: 4.1), to 'tackle … instability' (HM Govt, 2010: 11), and having 'global reach and global influence' (HM Govt, 2015: 5), has been subject to the most change. In the immediate post-World War II years, the British Government attempted to retain its global defence presence (Prime Minister and Defence Minister, 1946; Defence Minister, 1958) but by 1966 decisions had been taken to reduce this presence (Defence Minister, 1966), and in 1968, driven by economic factors, Prime Minister Harold Wilson announced the withdrawal forces "east of Suez" (Wilson, 1968). Economic factors, and strategic shocks such as the Falklands War, have fundamentally influenced the approach and the importance placed on this pillar of defence policy. The link between the cost of global ambitions and the ability to pay for these can be seen in the 1976 *Defence Statement*, for example, that the intent was to "reduce … non-NATO commitments or to seek increases in contributions towards their costs (Secretary Defence, 1976: 32).

Repeated national economic challenges have led to repeated reviews of the size and role of the military, accompanied by a regular downsizing. The importance of the first two of these three pillars has been reconfirmed in each of these reviews, but the importance of, the nature of, and the role of the military in the third pillar has varied. The involvement of the British defence industry has underpinned the three strategy pillars, as evidenced by commentary around the development and introduction into service of locally-developed systems such as aircraft, ships and missiles (Secretary Defence, 1966, 1971b, 1974), and reinforced by a statement by the Secretary of State for Defence that the:

> ability to develop and produce arms is thus an important national asset. It ensures supply; it enables British Service requirement to be met in an appropriate and timely way….. Above all, because of its contribution to our defence, it helps maintain our national security. The Government intends therefore to give full support to British industry in providing these benefits (Secretary Defence, 1980: 30).

United Kingdom defence industry

The United Kingdom has a long history in the design, manufacture, and support of military systems, and ended World War II with an industrial base totally focused on supporting the war effort. In the immediate post-war period, the UK Government focused on sovereignty-related aspects of defence industry as demonstrated by a Cabinet submission by the Prime Minister and the Minister of Defence that concentrated on research and the 'limited introduction of equipment of the most modern kind' (1946: 7). The importance of the research component for operational advantage was evident in the same Cabinet submission that 'scientific and technical progress at the present time is so rapid that safety lies far more in the maintenance of an adequate organisation for pure and applied research than in the building up of stocks of obsolescent equipment'.

The trajectory of the British defence industry in the early period of this case study can be summarised as three separate but related themes, overlaid and impacted by repeated national economic challenges. The first theme was the ongoing support for the local defence industry and the development of British-designed and developed equipment. In the immediate post-war period the default position for the equipping of the UK's armed forces was for British equipment 'except when that policy would have been extraordinarily extravagant … or when a British project failed … and foreign equipment was needed to repair the resulting gap in UK military capability' (Kirkpatrick, 2008: 293). Kirkpatrick has also described the UK domestic industry base as being considered as a national asset during this period, with those in the position to make procurement decisions being charged with the responsibility for its development and prosperity. The aim during this period was for the UK to directly address operational advantage and freedom of action from its own resources by maintaining a high level of defence industry sovereignty. The aim was a high level of self-sufficiency.

The second theme, collaborative development with European partners for projects such as the Jaguar ground-attack aircraft (Secretary Defence, 1966), originated in the 1960s and was driven by the increasing costs associated with the development of some types of military equipment. Sovereignty within these collaborative projects was to be addressed through 'retaining onshore all of the technological and industrial capabilities required for the national development and manufacture of such projects if necessary' (Kirkpatrick, 2008: 293). Whilst the importance and the scope of collaboration in defence equipment procurement was progressively reinforced over the following years (Secretary Defence, 1975, 1976), the United Kingdom continued to address operational advantage through the maintenance of its own research and development programme to 'initiate and investigate advances in science and technology relevant to defence and to determine their application to weapon systems' (Secretary Defence, 1975: VII-1).

The third theme was nationalisation. Although nationalisation had been a topic of debate in the United Kingdom since the early part of the 20th century, and elements of the British industry had been nationalised immediately following World War II (Murphy, 1952; Nuttall, Holweg and Leybovich, 2011; Myddelton, 2014), it was an increasingly difficult economic environment, a reduction in the competitiveness of British companies, some less-than-optimum business decisions by UK companies, and the actions of the Labour Governments in the mid-1970s that most impacted on the United Kingdom defence industry. The first two of these four drivers saw repeated reductions in defence budgets and the consolidation of many defence companies into an integrated few. The third saw Rolls-Royce undertake an ill-fated project to develop the RB211 jet engine that ultimately led to its bankruptcy in 1971. As a result of this corporate collapse, Rolls-Royce was nationalised, with the Secretary of State for Defence querying at the time whether as a consequence 'other sub-contracting firms, essential for defence purposes, are likely to go into bankruptcy and will require to be rescued' (1971a: 5). A second example of the move towards nationalisation is the creation of British Aerospace and British Shipbuilders. Following the declining competitiveness of the myriad British aerospace companies, the Government, commencing in 1960, forced the amalgamation of these into three main companies and subsequently nationalised the aerospace industry as British Aerospace in 1977 (Nuttall, Holweg and Leybovich, 2011). Also in 1977, under the Aircraft and Shipbuilding Industries Act, 19 separate shipbuilding companies, including submarine builders, were consolidated under Government control as British Shipbuilders. The Rolls-Royce, British Aerospace and British Shipbuilders examples demonstrate that, whilst the Government was acutely aware of the impact of corporate collapses on United Kingdom employment and economy, it also had the specific aim to maintain self-sufficiency in key areas of its defence requirement.

Submarines in the United Kingdom

The United Kingdom's involvement with submersibles and submarines stretches back to a demonstration in 1623 of a boat propelled by oarsmen that reportedly made a submerged transit along the River Thames (Fontenoy and Tucker, 2007), and in 1784 a series of unsuccessful experiments were conducted on a Robert Fulton-designed submarine boat (Nordenfelt, 1886). Initial construction of five experimental *Holland* class submarines occurred in 1901, built under licence to a US design with working drawings supplied by Holland Torpedo Boat Company of America, later to be known as General Dynamics Electric Boat. The initial British-designed submarine was the 'D' class which entered service in 1908, and submarine operation and design has since continued in an unbroken sequence from that time to the present day. Although originally denigrated and distained as being "unfair and un-English" (Tall, 2001; Carolan, 2014), submarines rapidly became an invaluable part of the RN and currently provide the vehicle for the hosting of the UK nuclear deterrent.

In the immediate post-WWII period, the primary operational tasking of British submarines focused on countering the growing Soviet submarine force, thereby necessitating quieter boats, with increased submerged endurance, and improved weapons and sensors (Tall, 2001; Hennessy and

Jinks, 2015). Once the US nuclear power program for submarine propulsion was known to be successful, the UK focused on the development of this technology. The first RN SSN, HMS *Dreadnought,* was commissioned in 1963 following provision of support from the US. The first entirely British designed and developed SSN, HMS *Valiant*, was commissioned in 1966 (Schank *et al*, 2011b). Whilst the move towards nuclear powered submarines was progressing, new classes of conventional submarine, the *Porpoise*, *Oberon*, and *Upholder* classes, were designed, built, and introduced into service.

In the early period of this case study, the United Kingdom operated six different classes of submarine: the diesel-electric *Oberon* class, the soon-to-be-retired *Dreadnought*, two SSNs of the *Valiant* class, three *Churchill* class SSNs, the majority of the new *Swiftsure* class SSNs, and the *Resolution* class SSBN. A degree of rationalisation was however taking place as the older submarines were decommissioned and replaced with newer versions. With the exception of the *Dreadnought*, all these submarines were designed and constructed in the United Kingdom with DO-DC entities. The United Kingdom had independent access to related intellectual property, and had both the know-why and the know-how to utilise that IP. The capability and the capacity of the domestic industrial base to support the submarine effort is therefore self-evident. The UK therefore had *full sovereignty* over its submarine capability.

Cold War (1979 – 1990)

The election of the Conservative Government of Margaret Thatcher in May 1979 came at a time of economic challenges, increasing inflation, declining national productivity, and deteriorating relations between the Soviet Union and the West (Hunt, 1979; Broadberry and Crafts, 2003; Njolstad, 2010). Figure 28 shows that at the time the defence budget represented 4.75% of GDP, a slight increase from the previous year, although not far from the lowest point since the end of World War II. The strategic and defence policy in place, as expressed in the 1979 *Statement of Defence Estimates*, was based on collective defence through NATO and the concentration of efforts on areas where UK resources would 'most effectively aid collective Alliance defence: the defence of the United Kingdom base and its immediate approaches; the Eastern Atlantic and Channel; the Central Region of Europe; and the nuclear forces' (Secretary Defence, 1979: 18). Although the vast bulk of UK military forces was assigned to NATO, the UK also retained interests in the more general promotion of international security, in peacekeeping, and in some foreign locations such as Belize, Gibraltar, Hong Kong, and the Falkland Islands. The period under review concludes with the end of Margaret Thatcher's time as

British Prime Minister, an event sandwiched between the fall of the Berlin Wall in 1989 and the end of the Cold War in 1991.

Policy

Four themes with relevance to the examination of defence policy under the Thatcher Government persist throughout the period, namely: the relationship with the Soviet Union, the importance and implementation of Britain's nuclear deterrent, the military's utility in supporting British interests outside the NATO area, and the preservation of defence industry sovereignty. The first theme, the relationship with the Soviet Union, had been a determinant of British defence policy for decades but was significantly altered during this period by the adoption of a more uncompromising security position. Whereas previous governments had attempted to balance the ends/ways/means challenge by consistently reducing the percentage of GDP allocated to defence, the Thatcher Government undertook to initially increase defence spending. This development had been foreshadowed by Thatcher in a 1976 speech that advocated increases in defence spending, but was amplified following the Soviet invasion of Afghanistan on 25 December 1979. In the 1980 *Statement of Defence Estimates* the UK Government stated that 'we believe that this is the time for giving higher, not lower, priority to defence' (Secretary Defence, 1980: 3). Under Thatcher the defence budget increased to 5.4% in 1983/84 before declining again as the relationship with the Soviet Union improved, to be approximately 3.5% when the government changed in 1990.

In mid-1981, the Government released a new defence white paper, *The United Kingdom Defence Programme: The Way Forward* (Secretary Defence, 1981c), that aimed to reshape the UK military forces (Secretary Defence, 1981a) and reset the approach to defence spending and capabilities. In one sense *The Way Forward* maintained the broad approach of previous governments as Britain's defence roles were emphasised as:

> an independent element of strategic and theatre nuclear forces committed to the Alliance; the direct defence of the United Kingdom homeland; a major land and air contribution on the European mainland; and a major maritime effort in the Eastern Atlantic and Channel. We also commit home-based forces to the Alliance for specialist reinforcement contingencies, particularly on NATO's European flanks. Finally, we exploit the flexibility of our forces beyond the NATO area so far as our resources permit, to meet both specific British responsibilities and the growing importance to the West of supporting our friends and contributing to world stability more widely (Secretary Defence: 1981c: 5)

The principal change in *The Way Forward* was not in ends, but in the ways and means. As noted above the means were to be increased, at a time of economic recession and overall hardship within the British economy (Chancellor Exchequer, 1980; Rogers, 2013). The ways involved a substantial restructuring and overall reduction in the surface elements of the RN, primarily as it was argued during the development of the review that submarines were more efficient and effective in countering Soviet submarines in the likely operational areas than warships (Dorman, 2001). The sub-surface capabilities were therefore to be maintained and expanded, with the ongoing commitment to the submarine-launched nuclear deterrent and the introduction of additional numbers and classes of submarine.

The second theme for defence policy was the maintenance of the United Kingdom's nuclear deterrent. Following the upgrade to the Polaris system through the *Chevaline* project to harden missiles against Soviet defence systems, and the Duff-Mason Report in 1978 that investigated options for the nuclear deterrent, the UK made the decision to replace *Polaris* with *Trident* (Ministry Defence, 1978; Baylis, 2005). The *Trident* decision also included the decision to continue to use nuclear-powered submarines as the launch vehicle (Secretary Defence, 1981b; Pym, 1980a), with the then Secretary of State for Defence Francis Pym stating to the House of Commons that:

> (w)e shall design and build our own submarines and nuclear warheads here in the United Kingdom, and buy the Trident missile system, complete with its MIRV capability, from the United States. Once bought, it will be entirely in our ownership and operational control, but we shall commit the whole force to NATO in the same way as the Polaris force is committed today (Pym, 1980b: 1235).

The *Trident* decision therefore also had implications for the operational advantage, freedom of action, and defence industrial sovereignty of British submarines, that will be explored later in this section.

The third persistent theme throughout the period of the Thatcher Government was "out of area", or "beyond the NATO area" operations. This was not a new or novel theme, having been a component, albeit steadily decreasing, of British defence policy since the end of World War II (Secretary Defence, 1966, 1972, 1975). At the advent of the period under review, this component had declined to general peace-keeping and training roles, and the provision of a small military presence in British territorial possessions around the globe (Secretary Defence, 1979). From the outset, the Thatcher Government adopted a more forward-leaning policy regarding the ability to deploy and operate "out of area", largely in response to Soviet adventurism in non-European theatres, but also in direct support of British interests (Secretary Defence, 1980). In support of this changed emphasis in policy, the 1981 document *The Way Forward* contained an entire section on the “beyond the NATO area” aspect of defence policy, and included a commitment to ‘resume … the practice of sending a substantial naval group on long detachment in the South Atlantic, Caribbean, Indian Ocean and further east’ (Secretary Defence, 1981c: 11). The British commitment to this aspect of policy was tested in 1982 with the invasion, and subsequent successful recovery, of the Falkland Islands, but the essence of the previously-announced policy and the focus on the provision of support for NATO was maintained (Grove, 2002).

The Falklands experience did however reinforce the fourth theme of defence policy, that is of having sovereignty in defence industry, and highlighted both the costs and the value of this sovereignty. The Argentinian experience in the same conflict, with the withholding of *Exocet* missiles by France, also demonstrated the risks associated with not having guarantees with respect to the supply of critical weapons and systems. Although no specific defence industry policy was published during the time of the Thatcher Government, and *The Way Forward* published in 1981 provided no specific policy coverage for industry, the over-riding focus for the government during this period was to support British defence industry where it was strategically important and cost effective to do so, and to increase the overall value of defence industry through cost reductions and increased efficiency in defence procurement.

The overall UK position with respect to sovereignty in defence industry is illustrated in Figure 29. The diagram is a uniformly deep green as it reflects the position adopted by the UK Government in the 1980 *Statement on the Defence Estimates* that advocated and supported the development, procurement and support of entire military systems through DO-DC entities as evidenced by the statement that:

> (t)he ability to develop and produce arms is thus an important national asset. It ensures supply; it enables British Service requirements to be met in an appropriate and timely way; it provides domestic employment; it can be paid for in our own currency; it enables us to collaborate, where that is our preferred course; and it offers the prospect of securing foreign exchange through sales. Above all, because of its contribution to our defence, it helps maintain our national security. The Government intends therefore to give full support to British industry in providing these benefits. In return, we look to industry to develop and produce equipment of the desired quality, in the quantities required and at the time expected, in a cost-effective way (Secretary Defence, 1980: 30).

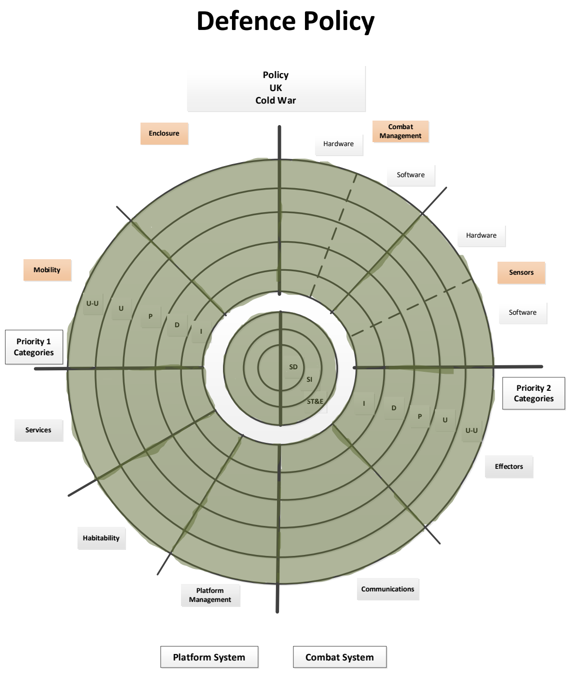


Figure 29. Illustration of intent for control over defence industrial activities during the Cold War

There was, therefore, strong government support for British defence industry, albeit not at any cost. Kirkpatrick (2008:293) has stated that the government 'claimed to have no industrial policy (in the defence sector or in any other) beyond creating a favourable environment for enterprise, and they relied on the market's invisible hand to select which UK companies would prosper or fail', but this does not recognise the importance that the British Government under Thatcher placed on defence industry sovereignty. In *The Way Forward* the government committed to the modernisation of an industry better placed to support the military effort as the overall amount 'spent on procurement with British industry will continue to rise, but with a shift of emphasis towards the more advanced technologies rather than the older labour-intensive areas' (Secretary Defence, 1981: 13).

Two additional aspects of defence industry sovereignty demonstrate the government's simultaneous push for efficiency, but with ongoing recognition of the value of defence industry sovereignty during this period. The first is the de-nationalisation of defence industry companies. In 1981 the government established British Aerospace as a public company and privatised it in 1985 (Tebbitt, 1985). The bulk of British Shipbuilders, comprising Vickers Shipbuilding and Engineering Limited (VSEL) and six other shipyards, was sold in March 1986 (Channon, 1986; Hilditch, 1990; Johnman and Murphy, 2001). Rolls-Royce was re-registered as a public company in 1986 and was privatised in 1987 by selling its shares through tender to private investors (NAO, 1988). Importantly for sovereignty, and in distinct contrast to the sale of ADI in Australia, the UK Government retained a “golden share” in British Aerospace, Rolls-Royce and VSEL which provided it with power to ensure that no change to foreign ownership provisions that restricted any single foreign shareholder to a maximum of 15 percent of the company could be made without Government consent, and that company directors be British nationals (Tebbitt, 1985; Bell, 1994; Heidenkamp, Louth and Taylor, 2013).

The UK Government’s maintenance of control over the future ownership and management structure of key defence companies clearly indicates the ongoing importance of defence industry sovereignty, and therefore of having independence to address both operational advantage and freedom of action. The Thatcher Government deliberately sought to inhibit the ability for foreign interests to take over important defence companies, and thereby also sought indirectly to ensure that British interests, technologies, and military systems could be developed, promoted, and protected. The UK continued to develop and support a defence industry that could deliver systems that addressed any unique operational requirements of the UK military, but it needed to be cost effective. The drive for efficiencies, in both the development and provision of operational advantage and in freedom of action, gave rise to the second aspect with sovereignty implications in this period; collaboration.

Collaboration with European partners for the development of military systems had commenced in the 1960s as a means to spread the overheads and risks associated with the production of small numbers of units, whilst ensuring that British industry maintained ‘a sufficient share of development work on … collaborative projects to maintain its basic capability’ (Secretary Defence, 1980: 7-32). Freedman (1986: 6) has summarised the overall attraction towards collaboration as being essentially driven by economic arguments as ‘(i)n order to bring major equipment projects within reach of the British defence budget, it has been found necessary to collaborate with other countries in design and manufacture’. This explanation can only be partially true. If the key driver was economic, the answer would have been to buy off-the-shelf from the United States. Such a situation was acknowledged by Michael Heseltine, then the Secretary of State for Defence, in a 1986 statement to the House of Commons Defence Committee when he stated that:

> (i)t is quite right that . . . there is practically nothing you cannot buy cheaper from the United States of America because they have huge production runs, huge resources, huge research programmes, funded by the taxpayer, and if we want to cut down Britain’s industrial capability all we have to do is to go to the United States of America and they will enable us to buy the products cheaper, and they are very good products, which would satisfy most of our demands, I might add with defence as well. But it would be, in my view, totally unacceptable as a judgement, both in the strategic concept that you should never allow the strategic

> control of your essential defence requirements to be outside your hands, and, secondly, because the consequences in the acceleration of the brain drain, the loss of jobs, the destruction of the high technology base and the civil implications would be wholly unacceptable (as reported in Freedman, 1986: 6).

Defence industry sovereignty was therefore a critical consideration in collaboration decisions. Although the United Kingdom wanted its defence budget to go as far as possible, it was not prepared to sacrifice its operational sovereignty for purely economic reasons. Collaboration with European and other partners was therefore an acceptable mid-point between a purely pragmatic, economic-driven approach, and the provision of direct support for the maintenance of local industrial activity, whilst negotiating on operational requirements and performance targets to ensure important sovereignty aspects were taken into account (Secretary Defence, 1987, 1988, 1989). The United Kingdom sought the ability to independently achieve operational advantage from its investment in military systems, from domestic industry or from collaborative projects, and it also similarly sought independence in the approach to freedom of action.

Defence Industry

The position with respect to defence industry during the period under review was largely as outlined above in the section concerning defence industry policy. At the commencement of the period the majority of the United Kingdom defence industry comprised DO-DC entities with the government being a major stakeholder and operator through a variety of factories, workshops, dockyards, and nationalised companies. At the end of the period the industry remained as predominantly DO-DC, albeit with some of the government assets having been privatised and other initiatives having been undertaken to improve efficiency. From the perspective of this thesis, the level of sovereignty across the UK defence industry was largely unchanged, particularly as the British Government retained a "golden share" in the privatised companies that ensured a measure of protection against these companies coming under foreign control and the desired independence to achieve both operational advantage and freedom of action from being compromised.

Submarines

This section will consider two classes of submarine operated by the United Kingdom during the period of the Thatcher Government – the diesel-powered *Oberon* SSK and the nuclear-powered *Trafalgar* SSN. Although Britain operated other classes of submarine at this time, the two classes nominated represent the most modern examples of each type, and hence are most illustrative of the approach to operational advantage and freedom of action, and the ability to control related defence industry activities during this period.

A circumplex diagram representing the degree of UK defence industrial sovereignty over the *Oberon* class SSK is shown at Figure 30. The submarine diagram is predominantly dark green as it reflects the independent access to IP and that adequate capability and capacity exists within both industry and the Ministry of Defence, and hence the ability to control activities in both the combat system and the platform system. At the all-of-system level, the UK Government had complete and independent access to the IP associated with design, systems integration and T&E as these submarines were designed and built at four different shipbuilders within the UK (Seaforces, 2021; Hennessy and Jinks, 2015).

In the priority categories for operational advantage, the enclosure category is coloured dark green as the submarine was designed and built in British shipyards. The British Government had independent access to the intellectual property, and a demonstrated capability and capacity to utilise it. The same situation applied to the combat management aspect of the *Oberon*, which was, by contemporary standards, rudimentary, but used a British designed and built fire control system (SIA, 2021; Horobin, 2019a; Hennessy and Jinks, 2015; Parry, 2021a; Toppan, 2004). In the sensors category, the UK had an extensive research and innovation capability, together with the industrial capability to produce, upgrade and maintain sonar systems. The sonars fitted to the *Oberon* during this period were, however, a combination of those designed and manufactured in the UK, and in France (Parry, 2021b). Given that the development of the French sonars was either seeded with earlier British research which was transferred to France, or the result of collaborative projects (Parry, 2021b), the UK retained an ability to control and the industrial activities for the sensor category at Figure 30 are coloured accordingly. The exception is the production activity which is shaded in a lighter colour to reflect the varied routes for sonar production, and the varied industrial capabilities and capacities. The UK also had independent access to IP and the necessary industrial capability and capacity in the mobility category, with the Admiralty-pattern V-16 diesel engine designed and built in the UK (Seaforces , 2021).

The submarine P2 categories were also designed, developed, and produced in the UK, and therefore provided the ability for the British Government to control industrial activities in these areas. The Mk 8 HWT was designed, developed, manufactured and maintained in the UK through Government facilities and Plessey, and the replacement Mk 24 Tigerfish was developed by the British company, Marconi (Chin, 2004; NAO, 1985; History, 2021). In 1974, the UK had also introduced a series of contracting conditions that provided the government with rights to utilise design information that resulted from developmental contracts funded by the MOD and undertaken in Britain (UK MOD, 1974, 2007, 2011). For this reason, all priority two categories are coloured dark green on the circumplex diagram.

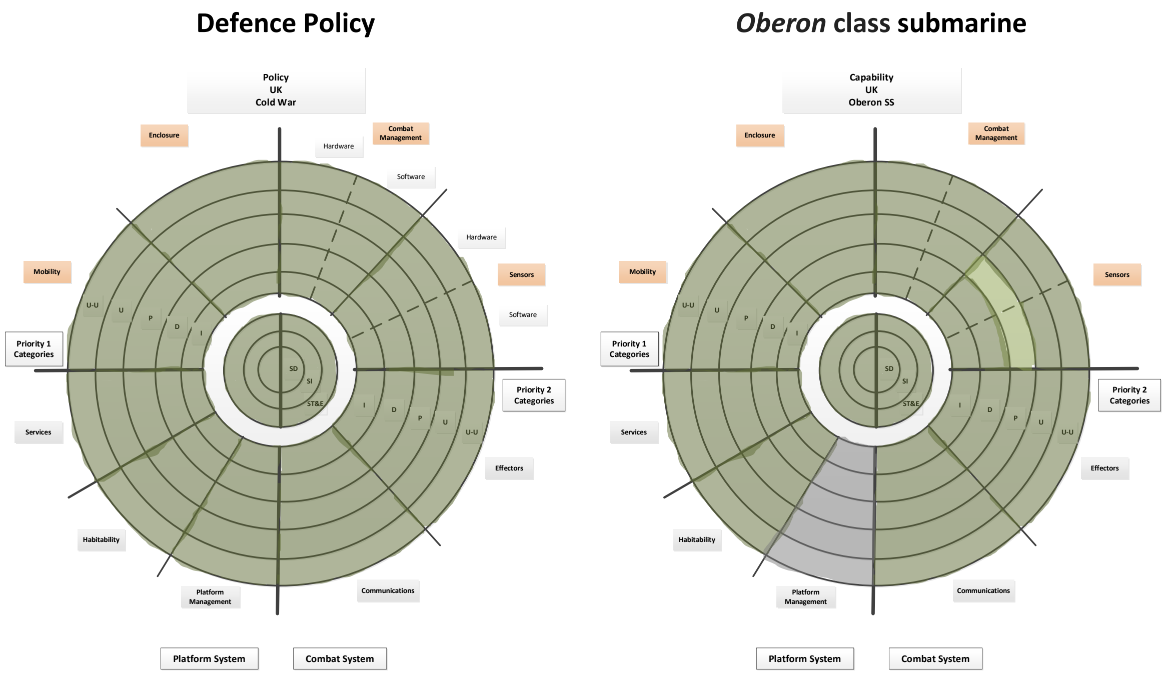


Figure 30. Comparison of intent for control over defence industrial activities for UK Oberon class submarine from *The Way Forward*

In Figure 30, the separate hardware and software labels in the capability diagram have been removed as these are not relevant for this submarine. In addition, as for the Australian *Oberon* submarine in the earlier case study, the platform management system aspect of the submarine is shaded grey as such a system was not fitted and this category is therefore not relevant.

A circumplex diagram representing the ambition for defence industrial sovereignty over the *Trafalgar* class SSN, as determined from *The Way Forward* (Secretary Defence, 1981c), is shown at Figure 31. As a UK designed and manufactured submarine, all system level activities are shaded dark green to reflect the ability to control industrial activities. In the categories deemed as priority for operational advantage, *Trafalgar* was fitted with a UK designed and built combat management system and the Type 2076 sonar suite (Naval Technology, 2020; Parry, 2021a, 2021b). Whilst the 2076 sonar commenced development in Ferranti and was subsequently provided by the local manifestation of the French company Thales, and while the UK Government funded the development but did not own the associated intellectual property, the UK did have independent access to that IP and the industrial capability and capacity to utilise that access (UK MOD, 1974, 2007, 2011; Salzmann, 2018; UK Anon #1, 2018). In comparison to the sensor category for the *Oberon* submarine at Figure 30, therefore, all industrial activities are coloured dark green.

The enclosure category also shows the ability for the UK to control industrial activities as the submarine was designed and constructed in the UK. For mobility, the utilisation of a Rolls-Royce reactor and Paxman diesels (Carr, 2003; Rolls-Royce, 2021; Naval Technology, 2020) also provided the ability to control activities and is coloured accordingly at Figure 31. The only exception to this overall position is in the effectors category where the submarine utilised both the UK-designed and manufactured torpedoes and the US-supplied *Harpoon* anti-ship missiles. The effectors category has therefore been bifurcated to reflect this difference.

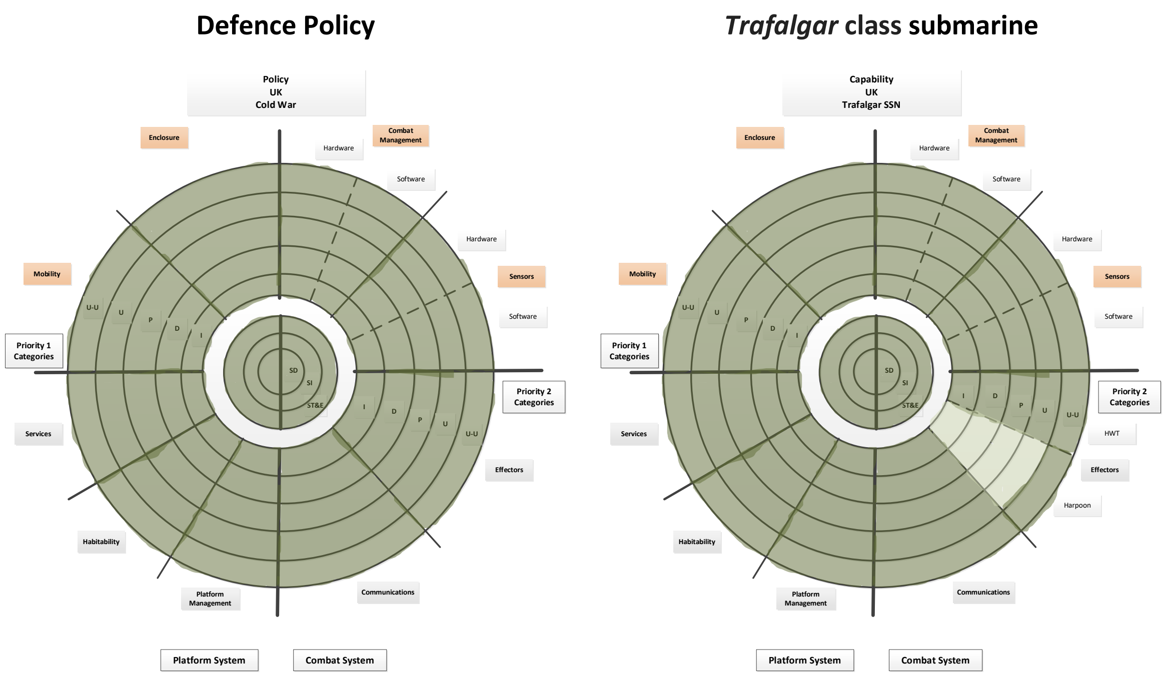


Figure 31. Comparison of intent for control over defence industrial activities for UK Trafalgar class submarine from *The Way Forward*

Figure 30 and Figure 31 show that the policy intent for sovereignty did translate to sovereignty outcomes at the capability level during this period. In all platform and combat system categories the United Kingdom had the domestic capability to innovate for operational advantage, to develop designs to bring those innovations to fruition, and to manufacture, upgrade, and update-upkeep the resultant submarine system. The UK therefore had *full sovereignty*, with the exception of the Harpoon missile, over the *Trafalgar* SSN during this period.

Post-Cold War austerity and change (1990 – 2001)

For decades, the Cold War had provided ‘both enduring principles and some key contingent assumptions around which British defence forces were structured’ (Clarke, 2008: 4). The end of the Cold War therefore ushered in a new reality for the United Kingdom and provided an opportunity for a fundamental rethink of British defence policy. This period of review commences with the end of the Thatcher Government, which broadly coincides with the end of the Cold War, and extends until the strategic shock of the terrorist attacks on New York and Washington DC on 11 September 2001. The period therefore covers the Conservative Government under John Major, and part of the Blair Labour Government. Key documents and reviews during this time were a reassessment of Britain’s military posture in 1990, a White Paper in 1993 and a Strategic Defence Review in 1998.

Policy

The reduction of strategic tension with the Soviet Union at the end of the Cold War provided Britain with another opportunity to reassess the ends, ways, and means applying to the development and maintenance of its military forces. As in most Western nations, the immediate reaction was to reduce the means as a “peace dividend”, driven by a reduction in the assessed threat. This “peace dividend” primarily manifested in the reduction of the percentage of national expenditure devoted to the development and support of military forces (Sabin, 1993; Mills, Brooke-Holland and Walker, 2018). The UK defence policy during this period reflected the increased optimism that developed from the diminishing of an existential threat. The *1998 Strategic Defence Review*, for example, succinctly summarised this assessment in the statement that:

> the collapse of Communism and the emergence of democratic states throughout Eastern Europe and in Russia means that there is today no direct military threat to the United Kingdom or Western Europe. Nor do we foresee the re-emergence of such a threat (Secretary Defence, 1998: 8)

The key underpinnings of British defence strategy did not, however, change during this period: support for NATO, defence of the United Kingdom, maintenance of the nuclear deterrent, and the ability to undertake “out of area” operations.

The primary focus by governments was therefore on restructuring the defence effort within a reduced share of GDP, and in finding efficiencies in the funding of that effort. The economic need, and the ongoing push for improved value for money, was reinforced by successive Secretaries of State for Defence in successive reviews and pronouncements. Tom King (1990: 468), when announcing *Options for Change,* stated that 'our proposals will bring savings and a reduction in the share of GDP taken by defence'. Malcolm Rifkind, in a 1993 speech to the House of Commons when introducing the *Defending our Future* White Paper, noted that 'a major external threat is even more unlikely to re-emerge in the foreseeable future than seemed likely in 1991, and this makes it sensible for us to make some reductions' (Rifkind, 1993: 21). Writing in 1997, George Robertson noted that Britain had 'already reaped a substantial peace dividend (and that) since the mid-1980s defence expenditure has declined by 29 per cent in real terms' (Robertson, 1997: 1).

Whilst the overriding theme of improved efficiency and the maximisation of value for money remained through this period, it was in the approach of the various governments that substantial differences existed. The Conservative Government of John Major in the early part of the period under review preferred market forces to drive industrial developments (Rifkind, 1993b; Bell, 1994). Kirkpatrick (2008: 29) has commented that the lack of focus on defence industry reflected the ideological position of Conservative governments in favour of market forces and that the government's conclusion was that 'the cost of supporting an extended national DIB was no longer sustainable'. This conclusion is consistent with an earlier observation by Taylor and Hayward (1989) that defence costs were to be cut wherever possible and that British goods might be procured only if they were the cheapest available. The focus on market forces during the Conservative part of the period under review, rather than on the government providing guidance and policy direction, was categorically stated by the Secretary of State for Defence in that:

> it must be for the defence industries themselves, as private sector companies, to develop their strategy for dealing with the interests of their companies and of their shareholders. The idea that the Government can somehow take the lead in such a matter goes quite against the whole philosophy that this country has experienced over the years (Rifkind, 1993b: 30).

Whilst the economic challenges remained, the advent of the Blair Labour Government in 1997 saw a change of focus in addressing the domestic defence industry. This change was in collaboration and industrial consolidation. With respect to the former, the collaborative development of weapon systems was seen a means through which to share the cost of development of military systems. Taylor, Waldman and Gick (2008: 41), for example, have noted that:

> the Blair Government displayed a strong commitment to international collaborative procurement arrangements with both the EU and US, primarily in the hope of achieving economies of scale and driving down costs through greater harmonisation of requirements, pooling of capabilities and coordination of research spending.

Collaborative development with EU partners was also seen as a way to both minimise costs and the risks associated with more aggressive export strategies from the US, and the potential US domination of the defence industry landscape in Europe (Commons, 1998). The *Strategic Defence Review* emphasised this overall approach in the statement that the:

> costs of high technology defence research and development and smaller national production runs also make it essential to secure long term competitiveness by achieving economies of scale through international collaboration and industrial restructuring (Secretary Defence, 1998: 57).

Whilst collaboration was an attractive way to fund research and development, and the production of advanced military technologies, it was not without risk. Hartley (2010: 206) has stated that 'national independence is both costly and an illusion when the UK is involved in collaboration' whilst the House of Commons Defence Committee commented on the potential benefits and risks in collaboration and the associated inter-dependence in the statement that:

> (t)he key to retaining access to strategically important technologies and manufacturing capabilities, in an era of an increasingly rationalised industry and collaborative programmes, is to ensure mutual inter-dependence. The risks of dependency are high, however, and the Government must take a hard-nosed and critical look at our ability to keep open such access, and where there are doubts we must still be willing to fund the necessary research and other capabilities single-handed (Commons, 1998b: p.22).

The risks to the UK through collaboration, and by extension to the benefits of having sovereignty in defence industry, were therefore recognised. Moreover, the assessment above highlighted the recognition that sovereignty required investment and that that investment should go to the most critically important capability.

Industrial consolidation, following on from the restructuring of the US defence industry, was also a policy consideration during this period as a means to address the need for economic efficiency and to mitigate the industrial risks posed by a radically altered and aggressive US defence industry. These risks forced the consideration of industrial consolidation, as explained by the House of Commons Defence Committee, in that developments had:

> (made) US defence equipment relatively less expensive for Defence departments in other countries, who were increasingly faced with the dilemma of having to choose between buying US systems for financial imperatives, or domestic products to protect strategically important

> technologies and for 'industrial' reasons; increasing concern in the UK about its ability to continue to supply certain key strategically important products (Commons, 1998b: p.2)

The UK, together with other nations within Europe, therefore similarly sought amalgamations and consolidation within the defence industry as the means through which to compete with the US, both internally and in a pan-European sense. The emphasis on consolidation is evident in the statement by the House of Commons Defence Committee (1998a: p.32) that 'it is regrettable that for the last several years, while the US defence industry has significantly restructured, little has happened in Europe' and that consequently its entire future was at stake. The preference of the British Government to the developing situation at that time is also clear in the responses provided to the HCDC inquiry into defence industry that noted in the Fifth Special Report that 'faster consolidation of the European defence sector would have been preferable … to ensure the industry's continuing viability and competitiveness in the global market' (Commons, 1998a; p.6), and in the Sixth Special Report that 'the consolidation of the European defence sector is vital if it is to remain viable and competitive in the global market' (Commons, 1998c: p.93).

The circumplex diagram at Figure 32 reflects the policy ambition for submarine related industrial sovereignty as discerned from the *1998 Strategic Defence Review*. Whilst McInnes (1998) has suggested that the preservation of key industrial capabilities was implicit within the 1998 SDR, there is little in the document to indicate what those capabilities were. The colouring of Figure 32 is therefore gleaned from both what is stated in, and what might be implied from, the *Strategic Defence Review* with respect to defence industrial sovereignty as it applied to the RN submarines. The colouring of the systems level activities of design, systems integration and T&E reflect the fact that, whilst not specifically called out in policy for submarines, neither is there any deliberate movement to minimise previous policy positions. Indeed, the repeated reference to the *Trident* nuclear deterrent in the *Strategic Defence Review* and related parliamentary debates (Robertson, 1997; Lord Gilbert, 1997; Secretary Defence, 1998) reinforces the position that SSBNs, and by extension SSNs, remained critical to UK defence. In a similar way it can be assumed that the UK would want to maintain control over the update-upkeep of RN submarines, to continue to have independent access to the IP associated with that activity, and to have the relevant in-country industrial capability and capacity.

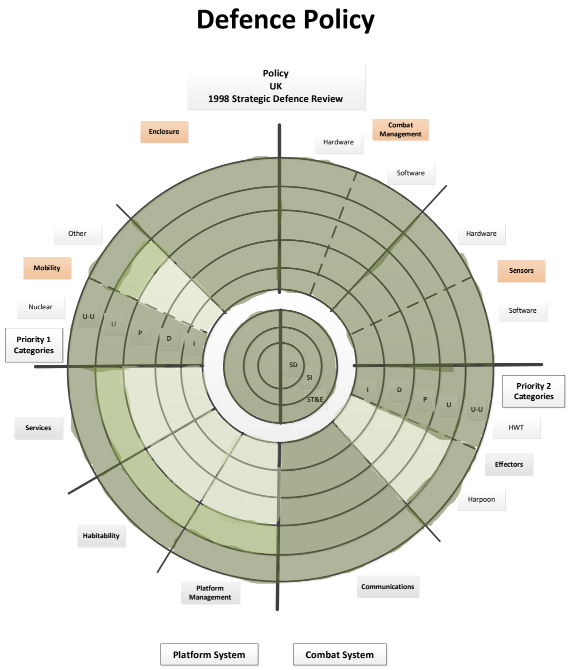


Figure 32. Illustration of intent for control over defence industrial activities from 1998 *Strategic Defence Review*

The dark green colouring for the combat management, sensors and communications categories within the combat system reflects the priority placed on intelligence, surveillance, target acquisition and reconnaissance (ISTAR) within the SDR. The policy emphasis on 'investment in this area not only to maintain a qualitative edge in combat but to facilitate the often rapid decision-making needed in complex political circumstances' (Secretary Defence, 1998: 51) resulted in the development, manufacture and maintenance of these capabilities within Britain, and the associated independent access to IP (Rifkind, 1994; Secretary Defence, 1998). Given the criticality of stealth-related aspects to the successful operation of the submarine an assumption has also been made that the enclosure category of the platform system was also of primary importance at this stage, although not explicitly stated in policy documents. In addition, given the obvious need for nuclear power for the submarine, and the requirements of the 1958 UK-US treaty on atomic energy cooperation that restricted third-country involvement (UK-US Government, 1958; Ludlam, 2006), a similar assumption is made for the nuclear steam-raising aspect of the mobility category.

The pale green reflects those categories that are not supported in policy, or by implication need, and where direct acquisition of sub-systems and components from a FO-FC entity is therefore assumed to be satisfactory. There is an assumption, therefore, that innovation, design, and manufacture may be conducted offshore by FO-FC entities for items within these categories. The bifurcation of the effectors category reflects the design, development, and acquisition of the HWT from entities within the UK, and the *Harpoon* anti-ship missile direct from the United States.

The light green colour applied to the upgrade activity associated with direct off-the-shelf acquisition from FO-FC entities reflects the probable need for such upgrade to occur within Britain, with technology transferred in from abroad. In this case, whilst the relevant IP would be resident within the UK, the government may not have independent access to that intellectual property as the IP contracting regulations would not apply (UK MOD, 1974, 2002, 2007, 2011). The policy position of the UK Government at the time can therefore be assessed as seeking the ability to control defence industrial activities associated with its submarines in the system-level and the higher priority categories, but prepared to accept lesser control in lower priority areas.

Defence Industry

The United Kingdom defence industry underwent a significant restructuring during the period under review. Part of this restructuring was driven by changes in the expected nature of warfare following the end of the Cold War, part was driven by economics and competition from a restructured US industry, and part was a result of the increased interest in international collaboration. The first part resulted from the changed expectation regarding future warfighting away from the Cold War planning for intense, all-encompassing, conflict and towards needing greater flexibility and mobility (Rifkind, 1993a; Secretary Defence, 1995; Robertson, 1997a, 1997b). In the earlier scenario, operational advantage was key. The post-Cold War planning was for potentially prolonged conflict where the requirements to upgrade systems in the face of an evolving threat and an ability to support over a longer term were of increased importance (Taylor, 2018).

The second and third parts of the structural change in defence industry were driven by economics and the threat posed by the restructured US industry. The 1993 “Last Supper” dinner in the United States set in motion a frenzy of industrial mergers and takeovers in US defence companies that resulted in the establishment of a small number of extremely large organisations. The companies that emerged from the US consolidation dwarfed the British and European contemporaries in size, and the economies of scale resulted in vastly improved efficiencies across the industrial activities from research and development, to manufacture and to update-upkeep.

The conflicting pressures in the British defence industry, and the pressure for consolidation in defence industry, is illustrated through the examples of British Aerospace and GEC-Marconi, the two largest UK defence companies. By the late 1990s British Aerospace had acquired multiple private and Government-owned entities, and was in merger negotiations with DaimlerChrysler Aerospace

(DASA) of Germany and Aerospatiale of France for the potential establishment of a European Aerospace and Defence Company (EADC) of sufficient size to match the large US firms (Hartley, 2012; IISS, 1999). GEC-Marconi had also grown substantially through the acquisition of Ferranti, Plessey, and the shipbuilder VSEL, and was the principal shipbuilder in the United Kingdom (Backlund and Sandstrom, 1996). GEC was also investigating its merger options, with Lockheed Martin, with Northrop Grumman, and with Thomson-CSF of France (Muradian, 1998; Cook, Macrae and Szander, 1999; Gow, Milner and Norton-Taylor, 1999). In the end, in 1999, British Aerospace and GEC-Marconi agreed to merge to form BAE. This included the nuclear submarine yards at Barrow-in-Furness, and BAE now assumed the mantle of the premier British shipbuilder.

Whilst the merger of British Aerospace and GEC-Marconi did not satisfy the policy intent of the government in that it did not consolidate defence industry through European collaboration, from a sovereignty perspective the match was very useful. The prospective merger of GEC-Marconi with either Lockheed Martin or Northrop Grumman would have been a merger of vastly unequal partners, with the dependence of the UK party on the US being markedly higher than the reverse. UK shipyards and shipbuilding would have been placed under US control. The HCDC alluded to the potential risks of an unbalanced situation with respect to collaboration with the US in the statement that 'the US had traditionally been reluctant to fully transfer technology abroad (and that) UK companies have been genuinely equal partners in US collaboration in only a relatively limited number of cases' (Commons, 1998b: 18). The potential impact on sovereignty from the proposed arrangement between GEC-Marconi and US industry partners can also be seen in the statement by the HCDC that 'our ability to develop and produce advanced equipment in future would be in doubt' (Commons, 1998b: 18), and from a comment made by Professor Trevor Taylor in an interview with the author that 'mutual dependence is an important factor in minimising risk from industry ownership and control' (Taylor, 2018). The merger of two British companies resulted in the maintenance of high levels of defence industry sovereignty over the activities conducted by the two companies, albeit at the cost of reduced local competition.

The other major industrial change with direct relevance to this thesis occurred in the UK sonar industry. In 1990 a company known as Ferranti Thomson Sonar Systems (FTSS) had been formed through the merger of the sonar systems businesses of Thomson-CSF of France and Ferranti of the United Kingdom. The acquisition of Ferranti by GEC-Marconi in 1990 saw the Ferranti component of FTSS pass to GEC-Marconi but to continue to operate as a separate entity (Backlund and Sandstrom, 1996). In 1996 GEC-Marconi and Thomson-CSF of France established a joint venture company that consolidated Thomson Sintra Activites Sous-Marines (TSASM), GEC-Marconi Sonar Systems and FTSS into a single entity. This company was known as Thomson Marconi Sonar (TMS), with a 49.9 UK/50.1

French ownership structure. The subsequent merger of GEC-Marconi and British Aerospace in 1999 triggered a joint venture clause that allowed Thomson-CSF (now renamed as Thales), in 2001, to acquire that part of the joint venture that it did not own and with it the dominant position in the UK sonar market (Observer, 2001). The “golden share” held by the British Government was somewhat superfluous at this point as the government’s aim was to increase foreign ownership through corporate amalgamation, not to restrict it. The sovereignty implications of the British Aerospace – GEC-Marconi merger are covered in the section below.

Submarines

Apart from the restructuring of the British defence industry, the period under review also saw fundamental change in the submarine force. Successive UK defence policy statements had progressively reorientated the UK military away from its Cold War roles and towards capabilities more aligned with expeditionary warfare (Rifkind, 1993a; Secretary Defence, 1998; Chalmers, 2002), and in 1993 *Defending our Future* announced the withdrawal from service of the four *Upholder* class SSKs that had not been completely introduced. From the mid-1990’s onwards the RN therefore operated a nuclear-only submarine fleet, with the *Swiftsure* SSN, the *Trafalgar* SSN and the *Vanguard* SSBN classes in service.

Figure 33 depicts the level of control that could be exercised over the defence industrial activities associated with over the *Trafalgar* SSN, and the corresponding intent for that control as inferred from the 1998 *Strategic Defence Review* together with that from Cold War defence policy. The circumplex diagram shows that UK control over defence industry for the *Trafalgar* across each of the submarine functional categories was essentially unchanged from the Cold War despite the changes that had occurred within defence industry. The formation of BAE through the merger of British Aerospace and GEC-Marconi had resulted in the preservation of a high degree of industrial control by the UK, and hence of sovereignty, over the large part of the UK submarine capability. Through this new DO-DC entity, and the investment provided by the government, the UK retained the ability to independently access system-level design, systems integration, and T&E IP, and had the industrial capability and capacity to utilise that IP.

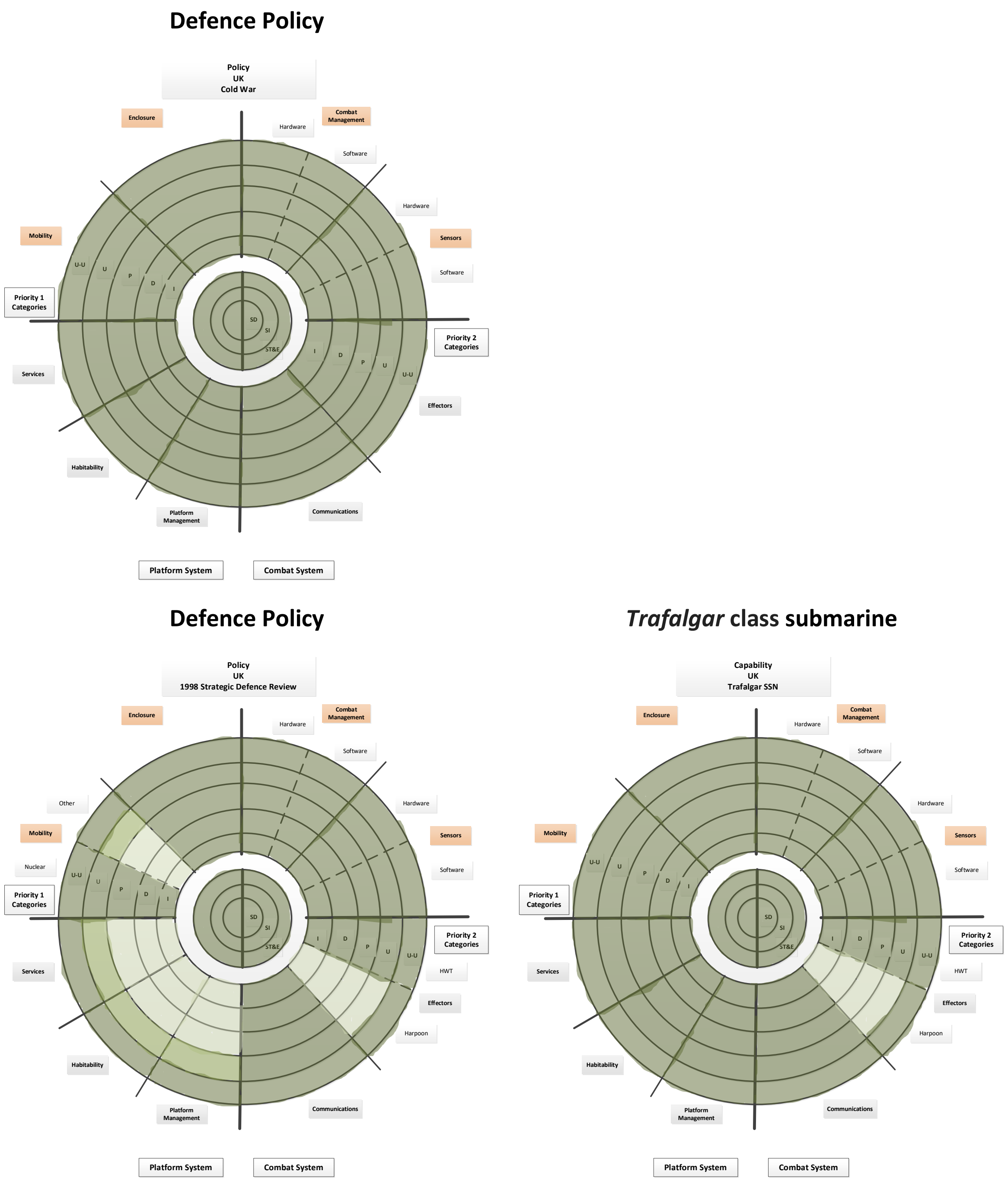


Figure 33. Comparison of intent for control over defence industrial activities *Trafalgar* class submarine in 1998

In the submarine categories determined as highest priority for operational advantage, BAE provided the combat system and, as the shipbuilder, the enclosure. Rolls-Royce continued to provide the nuclear reactor, the steam turbines were manufactured in the UK by the GE Company, and diesel engines were provided by Paxman (Carr, 2003; Rolls-Royce, 2021; Naval Technology, 2020). The later *Defence Industrial Strategy* (MOD UK, 2005: 7) stated that 'for the foreseeable future the UK will retain all of those capabilities unique to submarines and their Nuclear Steam Raising Plant, to enable their design, development, build, (and) support', thereby implying that such capabilities did exist in the UK in 1998. Furthermore, the intent of the UK Government was to retain industrial sovereignty over 'those capabilities unique to submarines' (MOD UK, 2005: 7).

In the important sensors category, although the sonar business of GEC-Marconi had been acquired by the French company Thales, and sonar activities in the UK were therefore moved into a DO-FC company, the development of sonar systems continued to be undertaken in the UK with government funding. Moreover, the capability and capacity for the full range of sonar-related industrial activities was maintained, and independent access to relevant IP also remained available to the UK as a result of UK government contracting regulations (UK MOD, 1974, 2002, 2007, 2011; UK Anon #1, 2018; Salzmann, 2018; Gould, 2018). The British Government, therefore, maintained the ability to control the associated industrial activities, and the relevant section of Figure 33 is coloured dark green.

The ability to control activities pertaining to the P2 categories is unchanged from the earlier iteration of *Trafalgar* depicted in Figure 31. The effectors category also continued to be a combination of UK-designed and manufactured HWT and the US *Harpoon* missile, as the *Tomahawk* Land-Attack Missile (TLAM) was not fitted to a *Trafalgar* class SSN, HMS Torbay, until 2008 (Naval Technology, 2020).

In addition to the ongoing operation of the *Trafalgar* class, a contract for the design, production, and initial support of a follow-on class of SSN, originally known as *Trafalgar Batch 2* and subsequently the *Astute* SSN, was awarded to GEC-Marconi in March 1997 and passed to BAE with the merger of the two companies in 1999. Work on the new submarine design had commenced nearly two decades earlier when the initial requirements had been endorsed, but initial work had been suspended due to cost projections and the tasking of the available naval architects for the development of the replacement SSBN design (Hennessy and Jinks, 2015; Navy Lookout, 2023). The keel for *Astute* was finally laid in January 2001 (Naval Technology, 2020).

In a major deviation from past practices, GEC-Marconi, and therefore ultimately BAE, replaced the MOD UK as the design authority for the first three new submarines and, according to Hennessy and Jinks (2015: 616), 'the MOD … lost its ability to be an informed and intelligent customer'. Schank *et al* (2011b) have also noted that while the Royal Corps of Naval Constructors (RCNC) had previously had the competence to fulfil the role of design authority for all UK submarines, the government push to reduce costs and to downsize the MOD had underpinned the decision to transfer design authority for *Astute* to GEC-Marconi, with the result that this had:

> greatly limited the ability of the MOD to influence the design of the submarine. The MOD had little authority to mandate certain design details or to argue for changes in the design of the

submarine. Any such changes to the design would result in increased risks and contract change costs to the MOD, an outcome that was to be avoided (Schank *et al*, 2011b: 33).

Further complicating the issue for *Astute*, was that, in addition to inadequate government client capability and capacity, a suitable level of capability did not exist in defence industry to undertake the required tasks. As noted by Schank *et al* (2011b: 46):

> (p)rior to *Astute*, the MOD and the Royal Navy had been responsible for testing and commissioning the boat. With *Astute*, this role was transferred to the prime contractor, which was ill prepared to accept it.

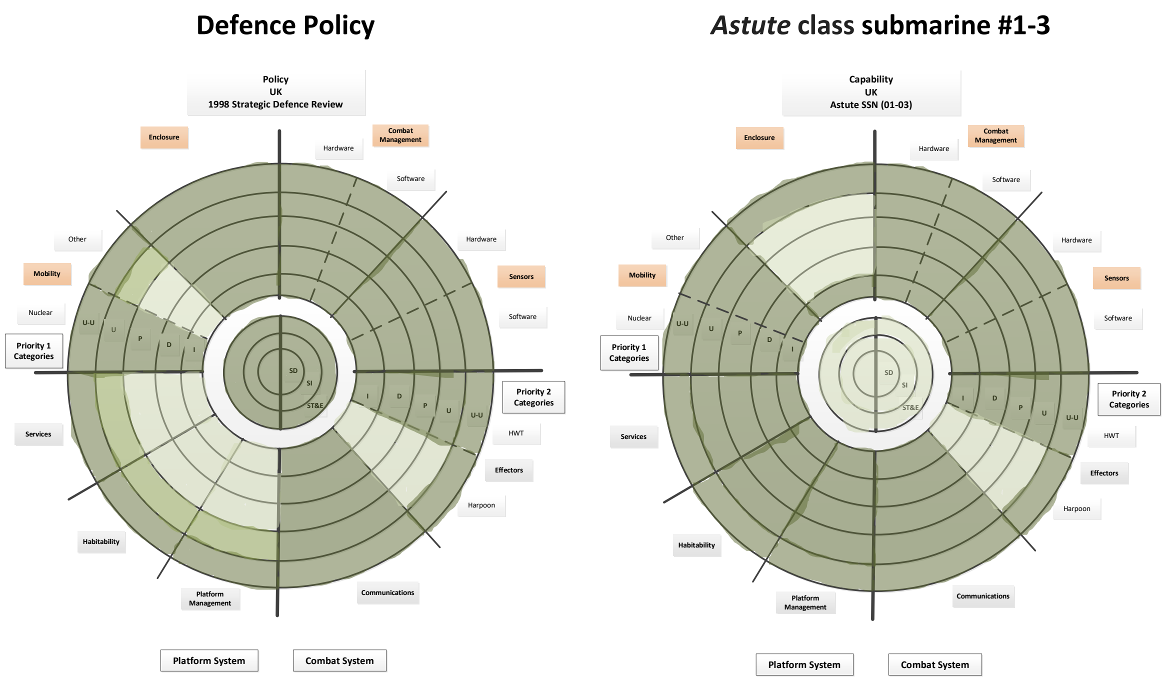


Figure 34. Comparison of intent for control over defence industrial activities for first three *Astute* class submarines

The result of the design authority changes, and empowering the shipbuilder with this responsibility, was that 'the MOD (was left) with no authority or mechanism to challenge the steps taken, or not taken, by the submarine designer and builder' (Shank *et al,* 2011b: 42). Consequently, the British Government had no ability to control industry activities at the system level for the first three boats of the *Astute* class. Figure 34 reflects the areas where MOD UK could potentially exercise control, and those areas where it was unable to. *Astute* was planned to be powered by the Rolls-Royce PWR2 nuclear reactor used in the *Vanguard* SSBN, and equipped with the new UK-developed combat management system in use in *Trafalgar* (Hennessy and Jinks, 2015). In accordance with the Sovereignty Diagnostic developed in Chapter 3, the government had the ability to exercise control over all the functional areas with the exception of the system level design, integration and test, the design, production and upgrade of the submarine hull, and the *Harpoon* missile that was acquired direct from the United States. The enclosure category is included as the government could not, even theoretically, separately procure the hull and provide to the shipbuilder as GFE. The British Government therefore had *focused sovereignty* over the majority of the submarine functional categories, but *no sovereignty* over the complete submarine system.

During the period under review, translation of sovereignty from policy to capability was mixed. Following the end of the Cold War, policy ambitions were relaxed but the ability to control industrial activities relating to submarines continued to be sought at the system level and for the priority functional categories. *Full sovereignty*, with the exception of the *Harpoon* missile was achieved for the *Trafalgar* SSN. The initial position regarding *Astute*, however, fell a long way short of the ambition as the government had no control, and hence no sovereignty, over the design, development, or acceptance of the first three submarines of the class. Throughout it all, however, the government maintained *rudimentary sovereignty*, and *focused sovereignty* over the majority of functional categories and sub-systems.

Increasing uncertainty (2001 – 2016)

The final period under review commenced with the attack on the United States on 11 September 2001 (9/11) and continued until the Brexit referendum on 23 June 2016. The period is extended and includes both Conservative and Labour Governments under Prime Ministers Blair, Brown, and Cameron, but can be categorised as Britain attempting to redefine its place in an increasing uncertain world. Whilst the 9/11 event did not affect the United Kingdom directly, it does serve as a point of policy distinction between the reassessment of the approach to security and defence in the immediate Cold War world and a Britain subsequently wanting to be more assertive across a wider geographical area. The effect of 9/11 is evident in the publication of the *Strategic Defence Review: A New Chapter* in 2002 that specifically addressed the threat of international terrorism and raised the profile of asymmetrical warfare in defence planning considerations.

Across this period the United Kingdom developed four major defence policy statements and an additional three documents that specifically addressed policy for defence industry. In marked contrast to the overall consistency in defence policy, there was significant variability in defence industry policy as the UK attempted to redefine the application and role of the domestic industry in an increasingly uncertain world.

Policy

In the period following 9/11, the United Kingdom maintained the four pillars upon which its defence policy had rested for many decades. The difference was in the importance placed on these individual parts, and in the addition of non-traditional security concerns such as disaster relief. The defence policy documents presented a general consistency across the period, with the main differences appearing in the military force structure as the UK increasingly focused on expeditionary warfare and the need to sustain forces deployed at long distances from the UK over extended periods. Consideration of structural change to the UK's military forces is evident in the statement that 'a manpower-intensive, platform-heavy and predictable doctrine has been replaced by the requirement for sophisticated, rapid and precise military solutions' (MOD UK, 2002: 7).

The development of defence industry policy during this period illustrates a struggle within the UK to balance the pressures created by the significantly different operating and security environment, the consolidated defence industry market, international cooperation, the ongoing need for security of supply, ongoing budgetary pressures, and the wider economic benefits of defence industry activity. Three distinct approaches to defence industry policy are evident throughout this period as illustrated in Figure 35 to Figure 37 below, characterised in turn as value for money, support for key industry capabilities, and market forces.

In 2002, the UK under the Blair Labour Government published *Defence Industry Policy* (MOD UK, 2002b), the first occasion that a separate industry-focused policy had been developed in the UK. However, the policy was little more than a political statement of the need for a 'healthy and globally competitive defence industry' (MOD UK, 2002b: 4), on the general need to generate intellectual property within the UK, on collaboration, and on competition and value for money. Although the document recognised the need for investment in technologies critical for operational advantage, scant, if any, information was provided on what the priority areas for UK defence were, and hence the focal areas for industrial activity.

The combination of the *Defence Industry Policy* and the 2003 *Delivering Security in a Changing World* Defence White Paper (MOD UK, 2003) presented a policy of reduced scope for defence industry in the UK. Apart from the development of systems for export, the expectation from the government was for a markedly less capable industry as 'in the most demanding operations we will be operating alongside the US and other allies' (MOD UK, 2003: 7) and, therefore for industry, 'nationality of ownership or control is much less relevant or strategic than in the past' (MOD UK, 2002b: 10).

Whilst *Defence Industry Policy* did not contain a single reference to the importance of UK industrial activity to support submarines or the nuclear deterrent, it is inconceivable, given that the deterrent was a pillar of UK defence policy, that the UK government would have been content to simply source key elements of the submarine capability direct from foreign suppliers. This assumption is supported by the government's statement that:

> (t)here are a very small number of capabilities which for national security reasons we would place a high priority on retaining within the UK industrial base. Examples exist in the fields of nuclear technology, defence against biological, chemical and radiological warfare, and some counter-terrorist capabilities (MOD UK, 2002b: 11).

As with the earlier version of defence industry policy, independent access to intellectual property for submarine system-level design, integration, and T&E, together with aspects critical to submarine stealth, could be expected, although not stated in policy. Figure 35 has been developed to highlight the ambition for defence industrial sovereignty in a document that did not definitively support UK defence industry activities, but where the total reliance on foreign sources was implicitly unacceptable to address the operational advantage and freedom of action of RN submarines,

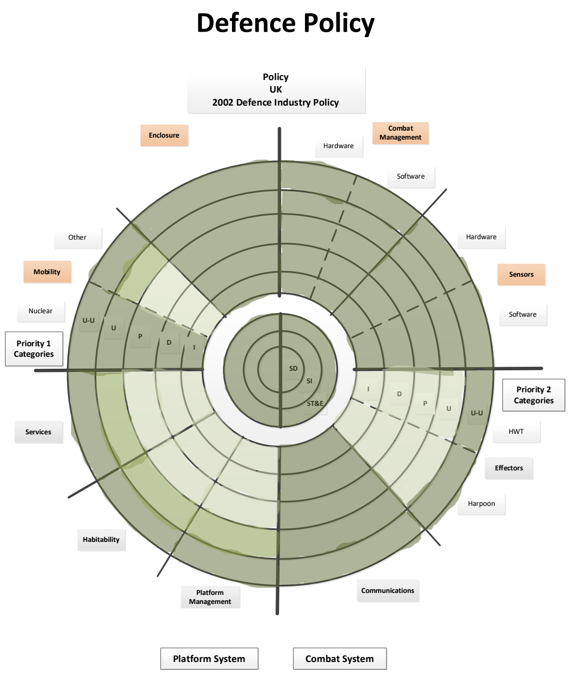


Figure 35. Illustration of intent for control over defence industrial activiities from the 2002 Defence Industry Policy/ 2003 *Delivery Security in a Changing World*

The dark green sections of Figure 35, covering combat management and sensors, arise from the implementation of Defence Technology Centres and Towers of Excellence (ToE) following the publication of the *Defence Industry Policy.* One of the Defence Technology Centres focussed on data and information fusion (Southampton, 2003; Sutton, 2015; Gelenbe, Tilbrook and Vinter, 2007), whilst the ToE covered a range of technologies, including underwater sensors (MOD UK, 2002c, 2002d). Whilst the Technology Centres and the ToE focused on innovation, UK contracting rules provided the government with access rights to the IP generated by that research (Clevstrom and Winnerstig, 2003; UK MOD, 1974, 2002, 2007, 2011). An assumption is made, as a result of the implementation of this policy, that the ambition of the UK Government was to have the ability to control activities within the relevant categories, and therefore to have *focused sovereignty*. The ongoing importance of the nuclear deterrent, and the importance of stealth to that deterrent, means a similar assumption can be made for the platform enclosure and nuclear mobility categories.

In the P2 categories in Figure 35, communications is also coloured for *focused sovereignty* as 2003 *Delivery Security in a Changing World* noted that the UK is 'investing heavily in digitised communications systems' (MOD UK, 2003: 14). This investment, coupled with application of the UK contracting regulations to that investment, implies an ambition for the government to be able to control developments in this category. Other P2 categories are as discussed for Figure 32. Submarine-related weapons are not mentioned in any of the contemporary policy documents, leading to the assumption that direct off-the-shelf procurement from a FO-FC supplier might be acceptable. The effectors category is coloured for no control as missiles and torpedoes would be acquired as complete units from the manufacturer, and upgrade would therefore be undertaken by that FO-FC manufacturer in an offshore location.

The 2005 *Defence Industrial Strategy: Defence White Paper* was a marked change from the somewhat vague approach to defence industry adopted by its 2002 predecessor, and provided more direct support for those 'industrial capabilities we need to retain in the UK to ensure that we can continue to operate our equipment in the way we choose, to maintain appropriate sovereignty and thereby protect our national security' (MOD UK, 2005: 2). The 2005 policy was the first occasion where the UK Government clearly articulated the industrial capabilities that were required for operational advantage and for freedom of action, and the military systems that were considered of highest priority. *Defence Industrial Strategy* therefore highlighted the independent access to IP required and the related contribution expected from industry. The link to sovereignty was explicitly stated:

> (a)s we look to non-British sources of supply, whether at the prime or subsystems level, we need to continue to recognise the extent to which this may constrain the choices we can make about how we use our Armed Forces – in other words, how we maintain our sovereignty and national security (MOD UK, 2005: 6)

Figure 36 provides a representation of submarine-relevant defence industry sovereignty as described in the *Defence Industrial Strategy* policy document, and is framed by the statements that:

> it is a high priority for the UK to retain the suite of capabilities required to design complex ships and submarines, from concept to point of build; and the complementary skills to manage the build, integration, assurance, test, acceptance, support and upgrade of maritime platforms through-life (MOD UK, 2005: 7),

and that:

> (t)he UK's fleet of nuclear powered submarines requires a specialist subset of skills within the maritime industry. … Therefore, it is essential that the UK retains the capability to safely deliver, operate and maintain these platforms, without significant reliance on unpredictable offshore expertise (MOD UK, 2005: 71).

The all-of-system activities in Figure 36, together with the unique stealth elements associated with the enclosure category, are therefore coloured dark green to represent the policy intent for *focused sovereignty*. The combat management category and the sensors category show similar policy intent. The latter is recognised in *Defence Industrial Strategy* as being 'critical to UK defence' (MOD UK, 2005: 123), whilst the importance of maritime combat systems were highlighted in the statement that 'combat system design and integration capabilities are a clear strategic imperative to deliver the required installed performance in maritime combatants' (MOD UK, 2005: 76), although the policy also recognised that:

> (n)ot all elements of a Combat System must be developed and provisioned onshore; but it is strategically important to be capable of developing a single integrated Combat System. Maintaining control of specification, design, integration and acceptance is fundamental to initial procurement and through-life management of the Combat System (MOD UK, 2005: 71).

Two other categories in Figure 36 are of note. The first is the nuclear propulsion element of the mobility category, as evidenced by the unequivocal commitment for the UK to 'retain all of those capabilities unique to submarines and their Nuclear Steam Raising Plant, to enable their design, development, build, support, operation and decommissioning' (MOD UK, 2005: 7). The government therefore sought *focused sovereignty* in this area. The second area is the HWT, where *Defence*

Industrial Strategy (MOD UK, 2005: 9) noted that ‘we would be prepared to source future torpedoes from abroad provided we retain the capability to support the current inventory, write tactical software, and design and integrate homing heads’. Figure 36 therefore reflects the combined situation whereby control was sought over HWT innovation, design, upgrade, and update-upkeep, but with production acceptable from a FO-FC entity. The result from the Sovereignty Diagnostic is therefore that the government was content to have no sovereignty over the HWT employed on UK submarines.

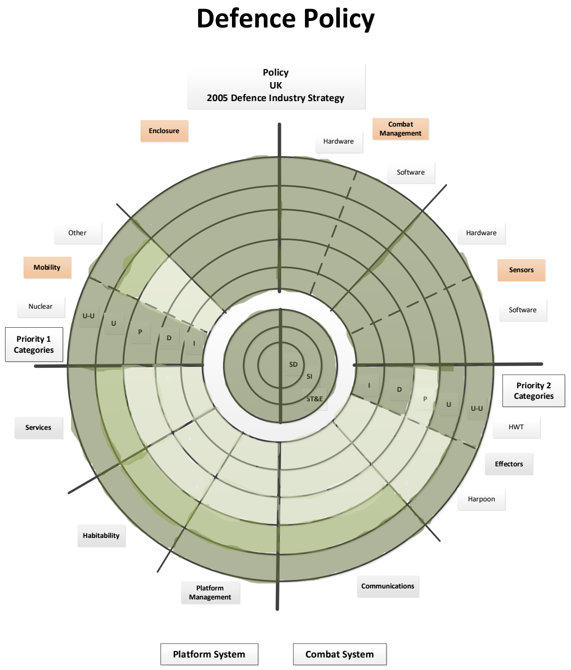


Figure 36. Illustration of intent for control over defence industrial activities as expressed in the 2005 Defence Industry Strategy

The remainder of the Figure 36 is predominantly pale green to reflect a willingness to procure systems from FO-FC suppliers. *Defence Industrial Strategy* notes, for example with respect to communications, that ‘the ability to design and manufacture equipment does not generally need to reside in the UK’ (MOD UK, 2005: 109). In line with previous comments regarding the transfer of technology into the UK for equipment procured from foreign suppliers, the upgrade category depicts a limited ability to control to highlight the probable restriction on the UK Government’s ability to independently access the associated IP.

Whilst *Defence Industrial Strategy* promoted the importance of the UK having control over the important elements of its defence industrial activity and direction, significant policy changes occurred with the replacement of the Brown Labour Government with the Conservatives under David Cameron in 2010, and the release of the *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review* (SDSR) later the same year (HM Government, 2010). The SDSR was developed during a time of significant financial pressure on the UK, and hence on defence procurement, and with the UK engaged in military operations in Iraq and Afghanistan. Somewhat unsurprisingly, the SDSR reiterated the ongoing themes in UK defence policy regarding support for NATO, defence on the UK, maintenance of the nuclear deterrent, and the projection of power.

In a general sense, the SDSR repeatedly reinforced the criticality of the Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) capability to UK security, but simultaneously stated a preference for 'bilateral collaboration on technology, equipment, and support issues, as we believe this offers the best balance of advantages and disadvantages' (HM Government, 2010: 8). Industry-related commentary within the SDSR was scant, highlighted future policy development, and focused on value for money and the intent for open competition for major acquisitions. As stated by Taylor (2010: 11), the SDSR 'accepts, without specifying what they are, that the UK will need some specific industrial capabilities'.

The 2010 SDSR was followed in 2012 by the release of *National Security Through Technology: Technology, Equipment and Support for UK Defence and Security,* but the industrial position adopted in that paper was somewhat pre-empted by the earlier publication of *Equipment, Support, and Technology for UK Defence and Security: A Consultation Paper* that unequivocally stated that the:

> default position is to use open competition in the global market, to buy off-the-shelf where we can, and to promote open markets in defence and security capabilities. We will take action to protect our operational advantages and freedom of action, but only where essential for national security (Secretary Defence, 2010: 5).

National Security Through Technology reiterated this strategy in the statement that:

> (i)n our drive to deliver value-for-money, we will buy off-the-shelf where appropriate, in accordance with the policies set out in this paper, because this generally allows the UK to take full advantage of the cost benefits of buying from a competitive market. This approach applies to systems, sub-systems, and components (MOD UK, 2012: 20).

The 2012 defence industry policy restated the concepts of operational advantage and freedom of action but provided no examples of how or where these were important. Moreover, there were no indications of what capabilities might be important for the United Kingdom to keep or to develop. The House of Commons Defence Committee report into defence acquisition was critical of the lack of specific defence industrial information in *National Security Through Technology*, and hence of specific areas worthy of sovereignty consideration and targeted development, in statements such as ‘it is not intended to be a defence industrial strategy’ (Commons Defence, 2013: 18), and that it ‘does not show a clear grasp of what is needed for the defence of the United Kingdom’ (Commons Defence, 2013: 20).

Market forces, rather than the prioritisation of capabilities, and the investment into and support of those capabilities, was therefore the government’s preferred way ahead. The change between successive defence industry policies was also summarised in an interview conducted by the author with Professor Trevor Taylor in 2018 as:

> (i)n 2005 the default position was to support key industrial sectors in UK. In 2012 the default position was to buy from the global market on a competitiveness basis – unless security concerns dictated otherwise (Taylor, 2018).

Figure 37 provides a pictorial representation of the level of defence industrial control, and hence sovereignty, sought for the UK submarine force from the 2012 *National Security Through Technology* defence industry policy. The system level activities have all been coloured dark green to reflect the ambition to control activities in these areas. In systems integration, *National Security Through Technology* highlighted that:

> the ability to understand a system as a whole and to be able to modify or upgrade it through systems integration can be essential to the performance of the system and to our ability to react to the changing and evolving threat environment (MOD UK, 2012: 28).

System test and evaluation was also emphasised in policy as a critical capability as ‘the ability to understand and validate performance and risks, from component to system-of-systems levels, is also essential’ (MOD UK, 2012: 28).

In the categories determined as priorities for operational advantage, there was a continuation of previous policy positions for independence and national control over all aspects of the propulsion system for the nuclear deterrent, and hence by extension to the Royal Navy’s SSNs (MOD UK, 2012). Whilst the enclosure category for the submarine, with its associated stealth implications, was not specifically mentioned in *National Security Through Technology,* the assumption remains that an independent ability to address associated issues would be a priority.

The combat management category in the circumplex diagram at Figure 37 has been bifurcated to show the policy difference between hardware and software components. The latter was a stated focus for UK industry in the ability to ‘extract value from complex, multiple data sources, media and streams' (MOD UK, 2012: 38). This is essentially a processing function. In contrast to previous defence industry policies, *National Security Through Technology,* did not emphasise the importance of a domestic capability in combat systems. The implication, therefore, was that focused sovereignty over the hardware components was not a national security priority and the involvement of external parties was therefore acceptable. The sensors category, a focus area of the 2005 *Defence Industrial Strategy*, was not mentioned in the 2012 policy, again implying the acceptance of off-the-shelf solutions for submarine acoustic and other sensing sub-systems.

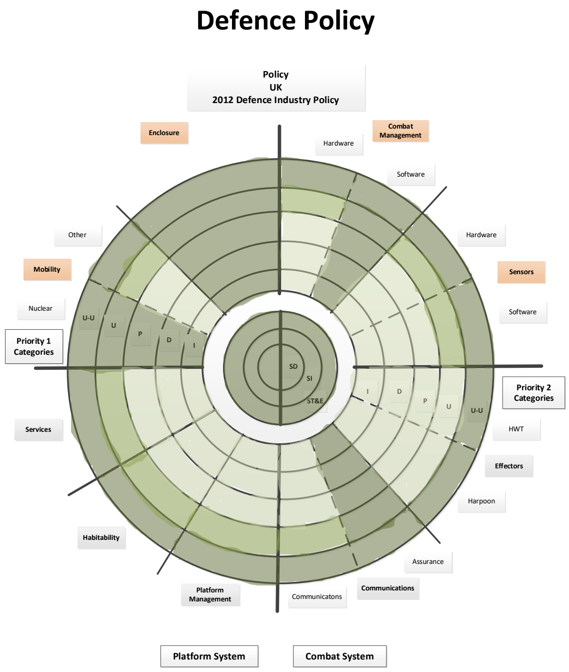


Figure 37. Illustration of intent for control over defence industrial activities as expressed in the 2012 *National Security Through Technology*

Two divergences from the earlier 2005 policy are evident in P2 categories in *National Security Through Technology:* in communications and in effectors. The communications category in Figure 37 has been divided to show the policy differences between communications assurance (cryptography and cyber protection), and the implementation of submarine communications channels through fitted sub-systems and components. The former was nominated as being 'strategically vital across Government' (MOD UK, 2012: 27), whilst the latter was only discussed in general terms.

The final variation is in the effectors category. As in previous diagrams, the acquisition of *Harpoon* and *Tomahawk* missiles was conducted directly with the manufacturer and hence this part of the diagram is shaded pale green. There was no policy ambition to change this situation. Unlike the previous policy there is no commitment to the domestic industry for heavyweight torpedoes. The conclusion therefore is that, in the absence of continuing support for a DO-DC design and production capability, acquisition through a FO-FC entity was considered acceptable, and this section is therefore also coloured pale green.

Although not explicitly stated, as in previous policies and earlier iterations of the sovereignty circumplex diagrams, it is assumed that the UK Government would want to continue to have the independent ability to undertake general update-upkeep of the submarine force, and the outer ring of the diagram is coloured accordingly to reflect a policy ambition for *rudimentary sovereignty*.

The final iteration of defence industry-related policy during this period was the release of the *National Security Strategy and National Security Capability Review 2015: A Secure and Prosperous United Kingdom* (HM Government, 2015). This document reinforced the pillars upon which British security had been built for decades, albeit with further changes of nuance. Whilst NATO remained as a key element of security, the strengthening of the 'rules-based international order and its institutions' (HM Government, 2015: 10) was promoted. Protection of the UK included the re-emergence of state-based threats, the ongoing need to maintain the nuclear deterrent, anti-terrorism, cyber protection, and national crisis management. The projection of global influence reinforced the importance of the rule-based international order and included the application of soft power measures. *A Secure and Prosperous United Kingdom* also emphasised the ongoing need for national prosperity as the means upon which the defence effort could be funded.

With respect to industry, and particularly defence industry, the 2015 policy advocated government and industry collaboration, international collaboration for some key military capabilities such as aerospace and missiles, further development of the national cyber capability, and the overall importance of an ongoing access to an appropriately skilled workforce. The main focus of the document was however on the contribution of the defence industry sector to the national economy, rather than on sovereignty concerns associated with specific, critical military capabilities. One military capability with specific mention was the *Successor* SSBN programme, described as 'a national endeavour' (HM Government, 2015: 35) with British companies BAE Systems, Rolls-Royce and Babcock as the main industrial partners. Although not explicitly described, *A Secure and Prosperous United Kingdom* recognised the importance of sovereignty over the critical SSBN capability and the need for sustained long term effort. Given the key industrial and operational links between the platforms, the SSN was therefore also part of this sovereign approach to capability.

Defence Industry

With respect to the UK defence industry, the period under review did not provide the seismic shifts in ownership and control that had characterised the preceding period. Bekkers *et al* (2009) have commented that in the period to 2006 the majority of mergers and acquisitions in the European arms industry occurred at the national level, a dynamic that served to provide a level of protection for sovereignty across national European defence industries. An analysis of the aerospace and defence industries conducted by the consulting firm PriceWaterhouseCoopers (2009, 2010) has also noted the low level of merger and acquisition activity during this period, and that merger and acquisition deals that were completed tended to be between national entities rather than across international borders. Hartley (2010) has also assessed that the UK defence industry was about 25 per cent foreign-owned in 2005. The ownership structure of the UK defence industry can therefore be considered as largely unchanged across the period under review, although being consistently challenged by government policy to provide improved value for money, and greater competitiveness for exports and the contribution to the overall UK economic situation.

During this period the "golden shares" held by the UK Government in UK defence companies were prominent. The 2002 *Defence Industry Policy* stated the determination of the government to relinquish its rights in BAE Systems and Rolls-Royce (MOD UK, 2002), although this did not happen. In June 2007, the Government used its share in Devonport Management Limited (DML) to influence the consolidation of submarine support services under the UK company Babcock International Group, rather than allow successful bids from either BAE Systems or the US private equity firm Carlyle (NAO, 2007; Boles, 2007; Morgan, 2007). The Government also relinquished its special shareholder rights in QinetiQ in 2012, the company created from the 2001 privatisation of part of the Defence Evaluation and Research Agency (DERA) (Jones, 2012; Straus, 2012).

The developments with the "golden shares" reinforced the intent of the UK government with respect to the submarine enterprise and the wider defence industry during this period. The first observation is the ongoing importance of nuclear submarines to the nuclear deterrent, and the government's desire for independence across critical elements of this enterprise. Although the reasons not to proceed with the divestment of special rights from BAE and Rolls-Royce are not clear, the implication is that the risk from a decreased level in the government's ability to exercise control, and hence the potential increase in foreign involvement, was considered to be too high. The second is that, whilst mindful of the above, the government actively sought to avoid having BAE as a monopoly player across both acquisition and sustainment of the nuclear submarine fleet (Ireland, 2007). To the maximum extent possible, the government therefore aimed to de-risk the overall program by increasing corporate involvement. The third is that the government moves were pragmatic, with the QinetiQ divestment being aligned to increasing the market position of that company, and not associated with potential risks to the nuclear deterrent (Jones, 2012; Straus, 2012).

Submarines

During the period under review the United Kingdom advanced the process of replacing the *Trafalgar* class SSN with the *Astute*. The progression of the *Astute* project was, however, subject to a series of delays driven by capability and capacity considerations, namely the long period between the design and production of the *Vanguard* and the *Astute* submarines, and the rundown in the number of skilled designers, engineers and construction technicians with experience working on submarines (NAO, 2004). The impact of this loss of capability was evident in the previous period with the transfer of design authority responsibility to GEC-Marconi as the designer and producer of the *Astute*. As stated in a RAND report into the *Astute* program, as a result of the gap in nuclear submarine production:

> the Barrow shipyard lacked expertise in its nuclear submarine-builder workforce. Shipyard personnel did not possess a thorough knowledge of the detailed build processes that enable efficient submarine construction. Knowledge about managing the complex build process and ensuring quality construction had evaporated (Schank *et al*, 2011b: 45).

The RAND report also noted that:

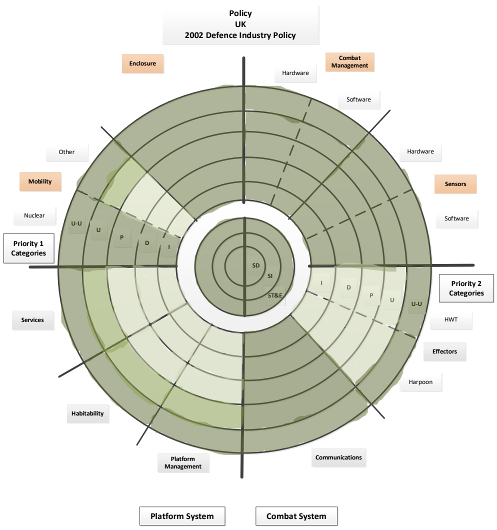
> (t)he issue is not that the gap should have been avoided, but that the MOD neither anticipated the impact of the gap nor factored into the cost and schedule estimates the need to rebuild industrial base capability (Schank *et al,* 2011b: xii).

Ireland (2007: 16) has also commented on the downsizing of the contractor workforce at Barrow-in-Furness in northern England, and that the gap between submarine programs was ‘long enough for the tacit knowledge in the accumulated production workforce to have been lost’. Ireland has also emphasised the overall industrial need for ‘maintaining a workload sufficient to exercise the abilities of engineering and production staff whilst planning for the succession of skilled individuals’ (2007: 17). Pung *et al* (2008) also investigated and highlighted the need for the UK to sustain key technical skills in order to preserve the ability to design, produce and support submarines. The example of the *Astute* therefore highlights the critical role of both industrial capability and capacity if industrial control, and hence defence industry sovereignty, is to be achieved. The HCDC also highlighted the importance of continuity of investment in the preservation of both capability and capacity, as ‘these skills can only be retained by performing "real" work on "real" submarine projects’ (Commons, 2006d).

The RAND study into the *Astute* also highlighted that the impact of the submarine production gap was the ‘atrophy of the supplier base resulting in the need to identify, and certify, many new suppliers’ (Schank *et al*, 2011b: 68). Evidence provided to a House of Commons Defence Committee’s investigation into the strategic nuclear deterrent also emphasised that ongoing work was required if companies with important positions in that supply chain were to remain viable (Morrison, 2006; Ludlam, 2006). Other commentators have expressed similar sentiments regarding the risks to the overall submarine production activity due to the fragility of the supply chain (Schank, 2006; NAO, 2007, Commons, 2006a). The response to these supply chain challenges included the establishment of the *Astute* Key Supplier Forum (KSF) in 2006, a structure comprised of the MOD and the ten largest suppliers to the submarine enterprise. The KSF sought to manage risks to the *Astute* program, both within the members directly and within their supply chains, through transparency and the development of a consistent understanding of submarine program direction and intentions (Foster, 2008; Essentra, 2022, Salzmann, 2018; Moffitt, 2019). The KSF was, therefore, a mechanism to ensure that the UK had an ongoing ability to control developments within its submarine enterprise, and is therefore closely linked to defence industry and operational sovereignty.

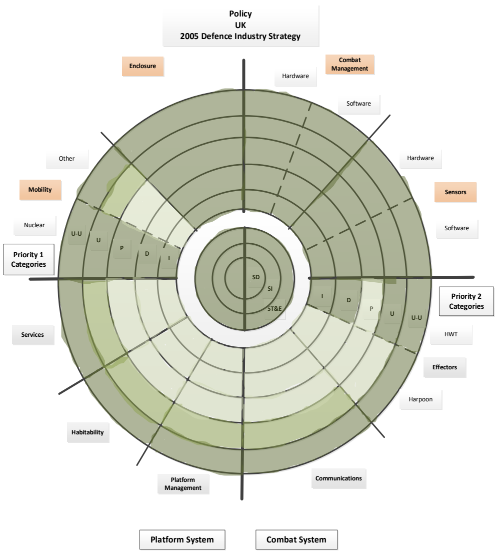
The defence industrial sovereignty applying to the *Astute* SSN, and the comparison of this sovereignty against the positions articulated in the 2002 *Defence Industry Policy*, the 2005 *Defence Industrial Strategy* and the 2012 *National Security Through Technology* is shown in Figure 38. The separate circumplex diagrams show the significant difference in defence industry sovereignty pertaining to the situation where design authority was held by the shipbuilder, and once it was returned to the government. The change back to MOD UK as the design authority therefore reflected the re-institution of the necessary professional skills within the MOD, and that outsourcing the design authority function through an “eyes-on/ hands-off” approach had not provided optimum results (SIA, 2008; (Schank *et al*, 2011b; Schank *et al*, 2007). Figure 38 reflects that, from having no control and hence no defence industry sovereignty over the initial three *Astute* boats, the ability to control industrial activities had been regained. The circumplex diagram for boat #4 onwards is coloured accordingly.

Defence Policy 2002

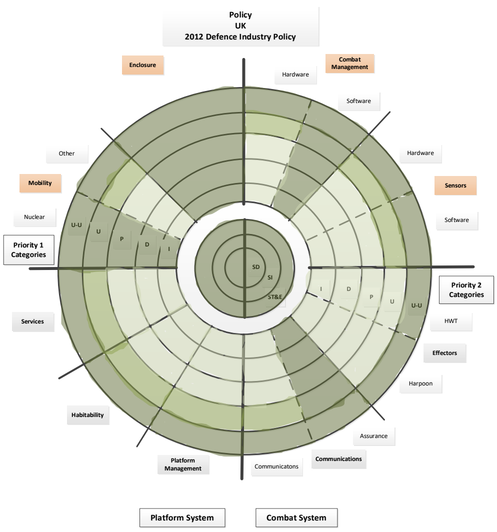


Astute class submarine (01-03)

Defence Policy 2005



Defence Policy 2012



Astute class submarine (04 onwards)

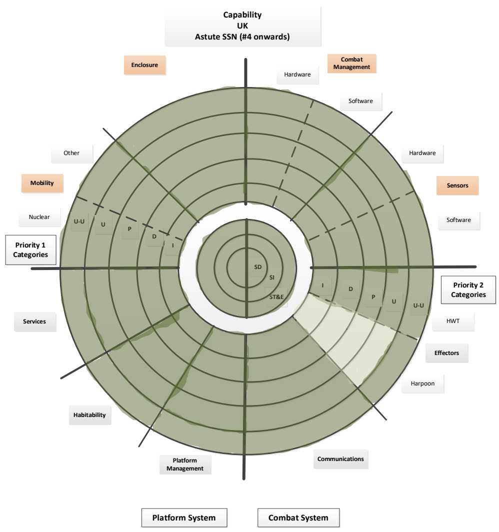


Figure 38. Comparison of intent for control over defence industrial activities for *Astute* in 2012 Defence Industry Policy

The *Astute* Key Supplier Forum covered between 70 and 95 per cent of the overall materiel spend on the submarines (Schank *et al*, 2011b; Ireland, 2007), through either DO-DC or DO-FC entities that manufactured domestically, and ensured that both capability and capacity within UK defence industry was adequate. British contracting regulations for developmental work undertaken within the UK with government funding, covering both sub-systems and components (UK MOD, 1974, 2007, 2011), ensured that the UK maintained independent access to associated IP. Coupled with the rebuild of MOD UK capabilities, the UK therefore had *full sovereignty* over the *Astute* submarine. Examples of domestic industrial activity include BAE as the shipbuilder and the provider of the combat management system, Rolls-Royce for the pressurised water nuclear power plant, Thales UK for the 2076 integrated sonar suite and some external communications, and Alstom for the steam turbines (Morrison, 2007; Ireland, 2007, Naval Technology, 2013, 2021; Northrop Grumman, 2012). Other communications systems were provided by the DO-DC company SEA, and European subsidiaries of EADS (SEA, 2021; Naval Technology 2020).

The platform management system work was undertaken domestically by different companies for different boats of the *Astute* class, including the DO-FC companies Northrop Grumman Sperry Marine and L-3 MAPPS (Naval Technology, 2020, 2021). Large parts of the habitability, services and platform management categories were also provided by the UK activities of US and Canadian-controlled companies (Ireland, 2007; Naval Technology, 2020). Although conducted by DO-FC entities, British contracting rules ensured that a high level of sovereignty was retained for these activities as the government had unrestricted access to the IP that was generated within the UK.

The one category over which the UK was reliant upon on FO-FC entities, and consequently had no independent access to the related IP, continued to be the effectors category, and specifically the sub-surface launched land attack and anti-surface missiles. The effectors category has therefore continued the approach from earlier diagrams that separate these weapons from the UK designed and manufactured HWT. In the case of TLAM, some components of the missile firing system were maintained in the UK whilst the missiles were returned to the US for maintenance by a FO-FC entity.

Conclusion

The UK case study has examined defence industry sovereignty over an extensive period from the Cold War to the UK vote on whether to remain in the European Union in 2016, and over multiple classes of submarines operated by the RN from the *Oberon* SSK to the *Astute* SSN. For the United

Kingdom, the period leading to the end of the Cold War provided a clear, unambiguous, existential threat from the Soviet Union. The UK military response to this threat included the development and maintenance of a submarine-based nuclear deterrent, a policy that continued to underpin defence industrial activities for the nuclear submarine enterprise, and an ongoing commitment to the development of military systems through British companies. In this way, the UK Government was able to exercise *full sovereignty* over those aspects of its industrial activities that it deemed to be critical to submarine operations, and address both operational advantage and freedom of action.

The case study has highlighted the differences between the policy and capability time cycles. Since the end of the Cold War, the intent for sovereignty as expressed in defence and defence industry policy has moved periodically, and occasionally radically. In stark contrast, the level of sovereignty as manifested in the UK submarine capability has barely moved at all. Apart from problems experienced with industrial and related capability and capacity at the commencement of the *Astute* program, the UK has largely maintained the capability and capacity necessary to exercise control over the industrial activities associated with the delivery and support of its submarines. Moreover, the early introduction of contracting regulations that provided the UK government with property rights over the intellectual property generated domestically from the contracts it awarded and the developments it funded, resulted in ongoing independent access to the IP necessary for design, production, upgrade and support of the submarine system, sub-systems, and components.

Although the UK took a “peace dividend” following the end of the Cold War, and whilst it was deemed that ‘a major external threat (was) unlikely to re-emerge in the foreseeable future’ (Rifkind, 1993: 21), the domestic development of the submarine force was maintained on the back of government policy to provide ‘longer term insurance through a credible nuclear deterrent’ (Secretary Defence, 1998: 56). This policy also required the UK to retain an indigenous capacity to ‘deliver, operate and maintain [nuclear submarines] without significant reliance on unpredictable offshore expertise’ (MOD UK, 2005: 71). Whilst the submarine force was not immune from the repeated cuts to the defence budget that accompanied repeated economic crises in the UK, the impact was felt in reductions in the number of submarine platforms rather than the emphasis on off-the-shelf procurement that categorised other elements of the force structure. The result was that, due to the policy priority placed upon the maintenance of the nuclear deterrent, the submarine enterprise, including the hunter-killer submarines, was somewhat shielded from decisions made regarding other elements of the force structure that reduced levels of sovereignty.

During the period under review, defence industry policy in the United Kingdom became formalised, with specific policies being released in support of the broader defence policy. The ideology of the ruling party was reflected in these policies. The combination of the *Defence Industry Policy* and the 2003 *Delivery Security in a Changing World* Defence White Paper (MOD UK, 2002, 2003) presented a policy that relied on market forces, with a reduced scope for defence industry in the UK. *Defence Industrial Strategy* (MOD UK, 2005), released in 2005, identified and promoted sections and activities within British industry as being critical for operational advantage and freedom of action. By 2012, a change of government and a change of outlook overturned this policy for value for money through off-the-shelf procurement. Whilst these frequent, and substantial, changes in policy focus reflected the changing ideology of the governing party, they did not have sufficient time to become embedded into the industrial landscape.

Despite the changes in defence industry policy, the UK did retain a high level of sovereignty over its submarine endeavour. In large part this was due to the establishment of BAE Systems through the merger of British Aerospace and GEC-Marconi in 1999. The merger retained industrial control within the United Kingdom and provided the basis for the continuation of *full sovereignty* in the submarine force. Alternative outcomes, particularly that which might have seen GEC-Marconi as the principal UK submarine builder merge with the much larger Lockheed Martin or Northrop Grumman of the US, were likely to bring key elements of the submarine industry, including the contract for the design and production of *Astute*, under foreign influence (Muradian, 1998; Cook, Macrae and Szander, 1999; Gow, Milner and Norton-Taylor, 1999). Despite the priority placed on the submarine capability as a necessary underpinning of the nuclear deterrent, the maintenance of a high level of sovereignty in the associated defence industry was more an act of good fortune than the outcome of a specific policy.

With respect to United Kingdom and the thesis question *how well do states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level*, the answer is mixed. Following the Cold War period when there was a close reflection of policy and capability, the difference between the two has progressively widened as sovereignty goals in defence industry policy have become less ambitious but sovereignty at the submarine level has remained largely unchanged. As noted above, a key driver for this dynamic has been the government's decision to maintain the nuclear deterrent, and the over-arching impact of this policy on the broader defence industry policy relating to submarines.

7 – Conclusions

Interesting elements occur when two or more rhythmic patterns are combined, and these elements illustrate very aptly the enrichment of information that occurs when one description is combined with another.

- **Gregory Bateson**

People do not like to think. If one thinks one must reach conclusions. Conclusions are not always pleasant.

- **Helen Keller**

Introduction

This thesis has addressed the question *How well do states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level* through case studies in Australia, the United Kingdom and Sweden. The key concepts for consideration for this investigation were distilled from the decomposition of the thesis question in Chapter 1. 'Sovereignty' is an aspect of statehood that has value and may require protection in the presence of a threat. 'Policy' is 'a purposeful synthesis of ends, ways and means' (Wylie, 2007: 54) and is a statement of government ambition. A 'sovereignty outcome' has been considered as the degree to which the state can independently address operational advantage and freedom of action, where the former addresses military operations in the face of an adversary and the latter addresses the ability to operate as, when, where, and for the period required. Collectively the two are considered as operational sovereignty. Given that the countries selected for this research have all manufactured their own submarines, there is an implicit assumption that the outcome sought is greater than zero. 'Capability' for this thesis is the combination of a military system and the supporting defence industry. The military system is the hunter-killer submarine, both the conventional and nuclear versions, but does not include ballistic missile submarines. As noted in Chapter 1 the SSK and SSN have a general consistency in strategic and operational employment across the various jurisdictions that operate them.

The concept of 'translation' as expressed in the question has been investigated through two separate aspects: mechanism and measurement. The mechanism for the translation from policy to capability is the series of industrial activities undertaken within the defence industry that affect the capability life cycle. As western governments typically no longer directly produce the systems upon which their military capability rests, defence industry is critical in the acquisition and sustainment of military systems. The industrial processes involved in the translation and their relationships have been diagrammatically represented at Figure 1. The measurement of the translation has been through investigation of the ability to control activities associated with the design, production and support of the submarine, and through the development of comparable sovereignty-policy and capability control frameworks at Table 1 and Table 2, and the determination of levels of control at Figure 2.

The sovereignty-policy framework has been based on the different levels of ambition that the state might have in operational advantage and freedom of action. This ambition has been discerned from published policy, other related documentation, and from supporting material such as ministerial speeches and press releases. The capability-control framework is based on the decomposition of the submarine into separate functional categories and the consideration of the industrial processes that support the development and sustainment of the submarine.

The thesis has used an innovative use of circumplex diagrams to provide a graphical depiction of the ability of the state to exercise control across the submarine through consideration of the combination of submarine categories and industrial activities. The ability to control has been based upon the level of access to IP, and on having capability and capacity in both industry and in the government client. The level of sovereignty at the capability level is revealed by the patterns within these circumplex diagrams, and ranges from full sovereignty to having none at all. This novel use of a circumplex diagram has been proposed as a Sovereignty Diagnostic.

The final concept from the decomposition of the question, 'wellness', has been investigated from the comparison of various circumplex diagrams. In this regard, it is important to reiterate that policy statements are an intent for something to develop over time, and capability is a manifestation of decisions and actions that have occurred in the past. As the life span of military capabilities often extends into decades, the impact of policy can last for an extended time and a simple side-by-side comparison of policy and capability diagrams at the same point in time may therefore paint a misleading picture. Comparisons have therefore been made against both the extant policy and the preceding one. In addition, as shown in Chapter 3, as some functional categories have greater importance for operational advantage than others, the assessment of wellness has taken this prioritisation into account.

This chapter will provide an answer to the thesis question and draw conclusions that impact on the translation from policy to capability from the examination of the case studies. The conclusions will relate directly to the Sovereignty Diagnostic and to other enabling and constraining factors that have an impact on sovereignty ambitions in policy and sovereignty realisation at the capability level. A short commentary on the Australian decision to acquire nuclear submarines will be included to highlight how the Sovereignty Diagnostic can be applied to contemporary, and other, events. Short sections on the contribution of the thesis to knowledge and the contribution to policy will then follow. The chapter will conclude with proposed areas for further research.

Answering the thesis question

The simple answer to the thesis question *How well do states translate notions of sovereignty in defence policy into sovereignty outcomes at the capability level* is that they largely achieve what they aim to do. In some cases, this is due to having relatively low policy ambitions for operational and defence industry sovereignty. Australia, for example, has typically sought *rudimentary sovereignty* for its submarines and has achieved this. At the time of the initiation of the *Collins* program, the policy ambition for sovereignty was in advance of the situation that existed at the capability level, but the government's position was that industrial capability and capacity would develop over time and *limited sovereignty* over the submarine, with the exception of the effectors, could be achieved, and further extended to the ability to design an indigenous submarine (Beazley, 2019). Successive defence policies, however, incrementally returned the ambition to *rudimentary sovereignty* with *limited sovereignty* over a small number of submarine functional categories.

Somewhat ironically, as the policy ambition in Australia decreased, the industrial capability and capacity within the Australian defence industry pertaining to submarines improved. The local development and production of anechoic tiles reflected the inability of Australia to source this critical element of submarine stealth from overseas partners. The ability to exercise limited control over industrial activities in areas such acoustic sensors and the platform management system has reflected corporate developments and the transfer of technology into Australia, rather than specific policy aims.

One area where sovereignty in capability has consistently lagged the stated policy ambition in Australia has been the combat management system since the change from the planned indigenously-developed system to the US AN/BYG-1 alternative. Since the time of that change in 2001, Australia has been in partnership with the US, and unable to make combat management system changes without US agreement (State Department, 2004). Consequently, Australia has had no sovereignty in this high priority category beyond the ability to conduct local update-upkeep. Policy statements have, however, repeatedly highlighted combat management and signal processing as high priority industrial capabilities that needed to be resident in Australia (Nelson, 2007; Defence, 2010, 2018).

During the Cold War, both Sweden and the UK closely translated policy ambition regarding defence industry sovereignty into capability outcomes. Both nations sought *full sovereignty* over their submarine fleets, and both, with some minor exceptions, achieved this. Divergences between the states appeared following the end of the Cold War in 1991.

The Swedish experience following the end of the Cold War was to significantly scale back the policy ambition to the maintenance of *rudimentary sovereignty*. As a result, the submarine manufacturer Kockums was sold to Germany with the expectation of close cooperation between the countries on submarine design and support issues. Swedish sovereignty at the capability level continued at a high level despite the changed defence policy as access to intellectual property was maintained, and sufficient capability and capacity continued within the Swedish defence industry. Over time, the inability of Sweden to control developments within its submarine enterprise were progressively exposed as Kockums was on-sold, and Swedish options for new submarines narrowed. The Russian invasion of Crimea in 2014 changed policy ambitions dramatically, Sweden returned to an amended version of Total Defence, and *full sovereignty* was again sought for its submarines. This upgraded policy position could be readily realised as industrial capability and capacity, although having declined, continued to be adequate for this task.

In the United Kingdom, following the end of the Cold War, the policy ambition regarding the domestic defence industry also declined, although not as precipitously as in the case of Sweden. In further contrast to the position adopted in Sweden, the UK maintained an ambition for *focused sovereignty* over the most critical submarine categories, including the combat management system, sensors, and the nuclear reactor element of mobility. Given the capability and capacity that had been built during the Cold War, the ongoing UK defence policy for the maintenance of a nuclear deterrent, and the inter-relationship between SSBNs and SSNs, with the exception of a period that encompassed the first three *Astute* submarines, the UK maintained *full sovereignty* over almost all of its submarine capability, a position in advance of the stated policy.

The results of the case studies partially reflect existing literature. As noted in the introduction, commentators on defence industry have typically focused on the research, design and production aspects of the capability life cycle, and the relationship of these activities to self-sufficiency and the associated need for investment. The Swedish and United Kingdom examples are generally consistent with this literature. The Australian case, where the state produces a complex military system but does not design it, is not covered in the existing literature.

The ability to design, not simply access to the design, is a point of differentiation in states' ambitions for operational sovereignty. From the case studies, and the differences between the Australian case and those of Sweden and the United Kingdom, the following observations can be drawn.

First, states that design submarines are more likely to pursue higher levels of defence industry sovereignty than those that do not. This is not a surprising conclusion as the ability to design depends upon the conduct of R&D and innovation, and hence generates the know-why associated with the design. The internal generation of IP therefore leads to the likelihood for independent access to that IP, the ability to control industrial processes, and hence *full* or *focused sovereignty*. Both the United Kingdom and Sweden fit into this category. Australia does not.

Second, states that design do not seek *limited sovereignty* in defence industry policy, or achieve it in capability. The case studies have shown that neither the UK nor Sweden has sought only limited sovereignty in any functional category of the submarine. One possible explanation is that, from a policy perspective, for the functional categories and sub-systems deemed not to be critical, *rudimentary sovereignty* may be considered acceptable as limited sovereignty has minimal impact on overall operational sovereignty; unable to contribute to operational advantage and not required for freedom of action. Moreover, at the capability level, a domestic defence industry capable of submarine system design, integration, and test, also supports the exercising of control over other submarine categories. Both the Swedish experience with the A26 submarine, and the UK with *Astute*, are examples.

Third, design is a necessary component in the pursuit of operational advantage. Design-and-produce states have independent access to the submarine intellectual property and, provided that both industrial capability and capacity are maintained, can control the activities associated with amending the design as knowledge, technology, and the threat change. Both the UK and Sweden are members of this group.

Fourth, *focused sovereignty* is typically sought for the categories nominated as P1 in Table 3 of this thesis. As noted earlier in this thesis, the UK policy regarding defence industry sovereignty has progressively moved from *full sovereignty* to having *focused sovereignty* over select aspects of the submarine. These areas of focused sovereignty have primarily been in the P1 categories. Sweden has not addressed focused sovereignty at any stage and can be disregarded from this discussion. In Australian defence industry policy, the sole instance where focused sovereignty was sought in policy, the handling of sonar systems in the 2010 Defence Industry Policy Statement, has accorded with the P1 categories in Table 3. The Australian experience with focused defence industry sovereignty at the capability level has also been, with the exception of the HAIL through water communications system, in the priority 1 categories; post-SWUP *Oberon* CMS, *Collins* anechoic tiles for stealth, and *Collins* batteries for mobility.

Fifth, states that do not design the complete submarine tend to focus on *limited sovereignty*, with a small number of *focused sovereignty* categories and sub-systems. The only example of this develops from the Australian case study, where an ambition for limited defence industry sovereignty occurs repeatedly in policy documents ranging from the 1987 Defence White Paper through to the 2018 Defence Industry Capability Plan. As noted above, only a single reference to focused sovereignty in defence policy occurs throughout the period of the Australian case study. Given that, as noted above, limited sovereignty does not contribute to operational advantage and is not required for freedom of action, two explanations for the Australian focus on limited sovereignty are possible. The first, as suggested by Beazley (2019), is that limited sovereignty was a deliberate "half-way house" in the quest for an Australian-designed submarine, and full or focused sovereignty. The second is that the effect is a combination of a lack of ambition due to the associated investment, and a by-product of the structure of the Australian defence industry. In this case, the development of domestic capability and capacity is the focus, rather than the ability to take independent action. Further examples are required to specifically address this observation.

Sixth, states that have had policy ambitions aimed at *full sovereignty*, and have achieved the same in capability, tend to retain this full sovereignty long after the policy position has changed to reflect a lesser ambition. Both the UK and Sweden aimed for, and achieved, full sovereignty during the Cold War. In the period following the end of the Cold War, both states lowered their policy ambitions, the UK to one seeking *focused sovereignty* across P1 categories, and Sweden to a position solely at the level of *rudimentary sovereignty*. In both cases, the level of defence industry sovereignty, with an exception for the UK associated with the first three submarines of the *Astute* class, has remained at that of *full sovereignty*. Both states have retained independent access to IP, and have retained, mostly, the domestic capability and capacity to utilise that IP. In Sweden, the government recognised that capability and capacity was declining and took action to maintain full sovereignty. The UK, largely as a result of the relationship between SSNs and the nuclear deterrent, has also maintained the ability to control industrial activities associated with submarines, and full sovereignty. The author recognises that the continuity of an ability to exercise control long after the policy position has changed may be influenced by a range of factors such as the length of time the original position existed, the level of redundancy in the domestic defence industry, or other deliberate actions taken by submarine operators or maintenance authorities to maintain that control outside the published policy position, but these potential explanations cannot be answered in this thesis.

Seventh, all states that operate submarines seek *rudimentary sovereignty*. Each of the states considered in this thesis have sought to maintain control over the update-upkeep activities associated with the submarine. Rudimentary sovereignty therefore appears to be a baseline level for defence industry sovereignty in order for states that produce, or have produced, submarines to minimise potential impacts on freedom of action.

The Sovereignty Diagnostic

At Chapter 3, this thesis has proposed a Sovereignty Diagnostic, a graphic representation of the ability to control industrial activities across the submarine system, as a means of assessing, displaying, and comparing the level of sovereignty sought in policy and manifested at the capability level. This diagnostic has been supported by a description of the elements that influence the ability to control, and the exercise of that control across the capability life cycle. This research has demonstrated the effectiveness of this diagnostic, and has shown that the elements described at Figure 2 add in a Boolean sense with respect to determining the ability to control industrial activities. Conclusions associated with these elements are discussed in the following sections.

Access to intellectual property

The degree to which a state is able to access the intellectual property associated with a military system, or a sub-system, has been posited as a determinant in the level of control that the state can exercise over the industrial processes associated with the development and maintenance of that system or sub-system. Considered in reverse, the level of sovereignty sought in defence policy dictates the level of access required to the intellectual property. Whilst it is somewhat self-evident that no sovereignty can be achieved with no access to IP, the extent to which access to IP is required, and the nature of the IP involved, will also differ between a policy with ambitions for operational advantage and one that only seeks freedom of action. For example, understanding the "know-why" of a design is important for the former, but of lesser importance if the policy focus is on being able to deploy a capability sourced from a foreign supplier as, when, where, and for the period required.

In addition, the policy goal for defence industry sovereignty over a submarine may vary substantially across the functional categories and fitted sub-systems of that submarine, with policy aiming for *focused sovereignty* in some areas, but willing to accept *limited sovereignty* or *no sovereignty* in others. Notions of sovereignty in policy, and sovereignty outcomes in capability, may therefore be a patchwork of levels of sovereignty with the importance, and impact, of independent access to IP varying accordingly.

The hypothesis advanced at Figure 1, that intellectual property, the combination of formal design information, the know-how on the industrial utilisation of that information, and the know-why that informs why the design has been developed in the way that it has, occupies a key position in the realisation of defence industry sovereignty has been supported by the case studies. Although the states considered in the case studies have different experiences with respect to intellectual property, there is an overall alignment with the premise that independent access to intellectual property is necessary for defence industry sovereignty.

For Sweden and the United Kingdom, the long history of indigenous submarine design and manufacture, and an industrial structure comprised primarily of DO-DC entities, provided both nations with independent access to associated intellectual property. During the Cold War, this situation also extended to most of the functional categories and associated sub-systems of their respective submarines.

Following the end of the Cold War, both nations opened up their respective defence industries to foreign players and increased the number of DO-FC entities involved in providing support to their military forces. In the UK, ongoing independent access to IP generated in the UK through government-funded research and technology contracts was guaranteed by the series of defence contracting conditions that addressed this issue and provided such access for the government. This access extended across all classes of submarine, and included the period when the design authority function was transferred to GEC-Marconi and subsequently to BAE Systems. Whilst the policy ambitions for sovereignty, as shown at Figure 38, have progressively reduced into a small number of key areas, the ability to realise sovereignty at the capability level has remained high.

The Swedish example has also shown that the level of control that the state is able to exercise over industrial activities, and hence the level of sovereignty that it possesses, is dependent upon the extent to which it can access relevant intellectual property. In the decision to sell Kockums to

Germany in 1999, the Swedish Government reduced the policy intent from *full sovereignty* to *rudimentary sovereignty*. The Government, however, maintained full access to the IP and, therefore was theoretically able to continue to exercise control over industrial activities associated with its submarines, even though that activity was then being provided by a DO-FC entity.

The importance of having independent access to intellectual property for defence industry sovereignty is also evident in the Australian case study. During the *Oberon* SWUP project, Australia developed a capability in submarine combat systems, with independent access to the associated IP. Through the SWSC, the RAN was able to independently augment and test CMS software, and to upgrade the combat system, and had *focused sovereignty* over that aspect of the submarine. Having independent access to the CMS software was also the goal at the commencement of the *Collins* project, but developmental problems and the subsequent transition to the US AN/BYG-1 system, required changes that restricted independent access to the IP. As a consequence, the ability for Australia to exercise control over the industrial activities associated with this functional category was lost, and the level of defence industry sovereignty reduced accordingly.

A similar situation, albeit in reverse, existed with the *Collins* platform IP. For an extended period during the life of the program, the Australian Government had limited, but not independent, access to the design. Conclusion of the deal in 2013 for Australia to acquire Collins system-level IP therefore provided the potential for Australia to independently apply that IP, and to make system-level changes as deemed necessary. In the majority of cases, however, Australia did not have similar access to key sub-systems, and therefore continued to be limited in its ability to control related industrial activities.

Capability and capacity

In industry

Access to intellectual property is of limited, if any, value with respect to sovereignty without the means to utilise it. The case studies have shown that, not only is industrial capability and capacity required in defence industry, but that existing capabilities need to be regularly exercised lest they diminish. Capacity also needs to be maintained at a level aligned with the rate of production required. That is, ongoing investment is necessary.

Figure 2 has proposed that industrial capability and capacity is a binary consideration: adequate or not. The case studies have shown that this description is only partially correct, and that the scale and scope of the industrial capability and capacity required to utilise the IP varies according to the sovereignty objective. *Full sovereignty*, or *focused sovereignty* in priority functional categories, is required for operational advantage, as this requires the ability to innovate and to understand the know-why. A state that aims for *rudimentary sovereignty* does not require the industrial skills, the facilities and the manufacturing infrastructure associated with the development and production of a system or sub-system. Consideration of adequacy is therefore matched to the policy ambition of the state, and will change as that ambition changes. A change in policy ambition to a higher level of sovereignty will take time to materialise as capability and capacity are increased to an adequate state commensurate with the new increased ambition.

The Australian experience has highlighted the critical nature of industrial capability and capacity for sovereignty. In the acquisition of the *Collins* IP, Australia was theoretically able to evolve the *Collins* design but did not have the in-country ability to do so. Whilst the development of an indigenous submarine design had been advanced through the ASC subsidiary Deep Blue Tech, the capability to achieve a complete design had not been developed. The ability to fully use the *Collins* platform IP was therefore inhibited. Importantly, in Australia's case, even though independent access to the *Collins* platform IP was available, policy had not established independent development of that IP as an objective, and the investment had not been made to develop industry appropriately.

In the United Kingdom, the critical importance of capability and capacity in industry is evident in the decline in submarine design and manufacture capability as a result of the extended period between the *Vanguard* and *Astute* classes of SSN. This decline was instrumental in the initial delays incurred in the *Astute* project as capability, in both the shipbuilder and in the supply chain, needed to be re-established. Both capability and capacity had to be rebuilt in order to reach the policy objective to design and produce a new class of submarine.

The UK case study has also highlighted that the exercising of domestic industrial capability needs to be undertaken on real projects, thereby implying that, for critical capabilities, work may need to be created, adjusted, or advanced to ensure the availability of skills when required. Continuity of capability may therefore require additional investment. Extra costs may also be incurred to maintain excess capacity if government assessments are that the rate of production may need to be increased at short notice. Whilst the maintenance of excess capacity is unlikely to be required for a complete submarine, it may be deemed appropriate for consumables such as weapons.

The Swedish experience also demonstrates the link between domestic defence industrial capability and capacity, and the ability to exercise control, and hence to have sovereignty. In Sweden's case, the assessed rundown of in-country shipbuilding facilities was a factor in the decision to re-acquire Kockums from Germany. In the period prior to the re-acquisition, Swedish authorities became increasingly concerned that its domestic capability and capacity in the critical area of undersea warfare was being eroded as the German owner of Kockums increasingly focused on German submarine designs, and industrial activities through German facilities. The decline in Swedish capabilities coincided with the policy objective for increased sovereignty in submarine matters, and hence an increasing challenge to attain those policy objectives. The Swedish maintenance of a submarine-related innovation and design function provided the basis for a rapid return to the full sovereignty sought in policy once the production and support capability and capacity was reacquired and updated.

In the government client

In addition to the need for capability and capacity in industry, both are also required in the client organisation. For the development of submarines, the client is typically a government organisation which also undertakes the role of design authority to ensure that the government, as the client, is able to:

> systematically ensure the fitness for purpose of (the) design through life and to make design decisions, or approve changes to the design intent, or material state (UK Defence Maritime Regulator, 2013: v).

The assignment of design authority to the *Astute* builder, as the required professional skills had been lost within the Ministry of Defence, resulted in the UK Government losing control over the direction of the *Astute* design. The subsequent move of design authority responsibility back to MOD UK once the skills had been rebuilt was therefore necessary to correct a sub-optimal situation impacting both the design and the assurance of that design. The maintenance of capability and capacity within the government client organisation to ensure that operational requirements are met is therefore as important as having that capability and capacity within the wider industry to undertake the industrial processes involved.

Other examples of lack of client-side capability and capacity issues impacting on submarine system outcomes also exist in the Australian *Collins* experience. With respect to the development of the combat management and sonar processing functions with the initial *Collins* combat system, the Australian Department of Defence had limited ability to technically oversee developments and relied heavily on the claims and report of contractors. This reportedly resulted in contractor's claims regarding performance being accepted with limited oversight. As in the case of *Astute* as outlined above, such reliance on industrial partners without the ability to closely monitor developments, did not provide the optimal outcome in that system problems were not identified early, and early corrective measures were not implemented.

In an additional example, *Collins* required significant changes to originally planned in-service equipment, including diesel engines, main motors, and generators. These changes were made in Australia without either the technical oversight of the original system designer or having the requisite technical expertise resident within the Department of Defence to provide assurance for the changes. The altered designs then encountered a variety of performance, reliability, and supportability issues that impacted on the ability to put submarines to sea and hence on operational sovereignty. The later problems that were experienced with the availability of the *Collins* class, and which therefore impacted on freedom of action, were also partly due to the lack of suitably qualified and experienced personnel within the DMO and the RAN (Coles, Greenfield and Fisher, 2012; Coles, Greenfield, Fisher and Davies, 2014).

Enabling and constraining factors

As noted in Chapter 2, public policy is developed by governments to influence, change, or frame political issues. Policy is therefore framed in the present, with an expectation that the future state that develops will exhibit characteristics in line with the stimuli provided. Those aspirations, however, are influenced by the nature of what already exists, and by what the impact of a new policy might have on that existing capability. The inclusion of wrong assumptions and drivers in the policy development process can therefore lead to policy failure, or a lesser form of success. The quality of the decision-making is therefore likely to be instrumental in whether policy ambitions are achieved. With respect to the sovereignty aspects of defence and defence industry policy, the assessment of the threat and associated risks, the depth of understanding of the domestic defence industry, and the assessed importance of related issues such as alliance relationships, will have an impact.

Threat and risk considerations

The case studies have shown that the willingness to invest in defence capability, and where to invest, is fundamentally influenced by the assessed threat and associated risks. During the Cold War, with an assessed existential threat, both Sweden and the United Kingdom sought independent industrial ability with respect to the pursuit of both operational advantage and freedom of action. During this period both countries invested in the domestic development, production, and support of their submarines, and, with a small number of exceptions, in the systems and weapons that were fitted. At the end of the Cold War, when the threat diminished and the assessed risks reduced, the policy position within Sweden changed dramatically. The defence budget was reduced, and consolidation of defence industry, including the acquisition of defence companies by foreign firms, occurred. When the threat reappeared following Russian actions in Georgia and Ukraine, the assessed need for sovereignty in critical areas again increased.

In the United Kingdom the defence budget was also reduced following the end of the Cold War, the defence industrial base was also consolidated, but the position regarding the maintenance of an independent nuclear deterrent was continued. The continuation of the nuclear deterrent therefore continued to be an important feature in the mitigation of strategic risks, even though these risks were assessed to be at a lower level. Whilst the military force structure, including the overall size of the Royal Navy's submarine fleet, was reduced following the downgrading of the threat, the policy position vis-à-vis the nuclear deterrent as a mitigator of strategic risk saw the defence industry sovereignty associated with that capability maintained. When the assessed risks increased towards the end of the period of the case studies, the UK did not have to rebuild its domestic ability to control the industrial activities associated with its SSN force, as this had largely been maintained on the back of the policy to address risk through the maintenance of the submarine-based nuclear deterrent.

In stark contrast, Australia, which did not face an assessed existential or high-level threat, hedged between the maintenance of a credible force and making commitments to defence that might ultimately not be required (Brabin-Smith, 2012, 2013). This use of warning time extended into defence industry, where regional technological superiority for operational advantage was primarily sought through allies and other advanced partners, and with a domestic defence industry capable of undertaking maintenance for the purpose of freedom of action. The self-reliance that was sought in the 1987 Defence White Paper, and in the initial stages of the *Collins* submarine project, was subsequently diminished in later policy documents and decisions, as the assessed threat remained low. Later governments took the view that the level of effort did not justify the investment required to develop that self-reliance.

In addition to considerations of the threat posed by a potential adversary, there are also risks associated with resupply of materiel sourced from foreign suppliers. Supplies may be delayed, restricted, or denied due to the demands of other customers, or for political purposes by the associated foreign government. The case studies have shown that, with the exception of the *Harpoon* and *Tomahawk* missiles, the UK has avoided these risks by contracting to domestic entities, either DO-DC or DO-FC. For Sweden, the supply risks that would have developed through the

German-supplied Type 214 follow-on to the A19, rather that the locally-developed and produced A26, were deemed to be unacceptable and Sweden took steps to mitigate these risks through the re-acquisition of Kockums.

In Australia, supply risks associated with the platform system were mitigated by production in Australia through the DO-FC subsidiaries of offshore entities, or arrangements for sub-system or component production by DO-DC entities under licence to the offshore OEMs. With respect to the combat management system, the Australian Government accepted the resupply and redevelopment risks associated with the AN/BYG-1, rather than mitigate them through the German alterative, due to the perceived benefits to be obtained through closer engagement with the US and its submarine force.

From the case studies, threat assessments can be seen to impact upon the need for sovereignty in defence industry, but do not determine the scope or the extent of that sovereignty. That is, threat assessment is not a sufficient condition for operational or defence industry sovereignty. The willingness to accept risk, in both operational advantage and in freedom of action, is therefore a driver for the level of sovereignty that is sought by a government in its defence policy, and ultimately in how notions of that sovereignty are translated from policy into capability.

Investment and time

One conclusion to draw from this research is that sovereignty costs. As noted in the introduction, Hartley (2008) has shown that quality of the military equipment is directly related to the amount committed to defence research and development. The rising cost of military systems is such a challenge that, as commented in Chapter 1, some states have ceased production of some elements of their defence equipment and have moved to a reliance on foreign suppliers (Bitzinger, 1994, 2003, 2015a; Caverley and Kapstein, 2012; Hartley, 2007, 2016; Hartley and Sandler, 2003). The pursuit of operational advantage requires an ongoing commitment to the innovation required to remain at the forefront of technological developments, and the ability to upgrade systems or develop replacements in the face of movements by a potential adversary. Ongoing investment in the development of both the know-why and the know-how associated with military capabilities is therefore required. The UK case study has shown that, in the absence of investment into submarine projects, such as the gap that developed between the *Vanguard* and *Astute* programs, capability and capacity diminish, and the ability to control industrial activities is lost.

At the end of the Cold War, Sweden, as in many Western countries, took a peace dividend by reducing its defence expenditure. This peace dividend changed sovereignty considerations with respect to submarines considerably and investment decisions concerning those capabilities altered accordingly. The maintenance of *rudimentary sovereignty* was deemed to be sufficient for the prevailing and foreseeable circumstances. The Russian invasion of Crimea in 2014 resulted in changed threat and risk assessments, increased investment into defence, and the nomination of submarines as a priority area requiring *full sovereignty*. The re-acquisition of Kockums, and the subsequent investment into the upgrade of domestic facilities related to submarine production and maintenance, was undertaken to support the changed policy.

The situation in the United Kingdom during the Cold War also comprised a high level of sovereignty, supported by high levels of investment into the domestic defence industry. This investment extended to the use of nationalisation to protect companies and industry sectors deemed to have strategic importance. As in Sweden, the end of the Cold War saw the UK reduce its military budgets and reduce investment into the national development of military systems. In the UK, however, due to the government decision to maintain a submarine-based nuclear deterrent, investment continued into the domestic defence industry to address both operational advantage and freedom of action for RN submarines.

The translation of sovereignty considerations from policy to capability requires continuity, in policy commitment and in investment. Time is therefore an important factor in the trajectory for defence industry sovereignty. Existing industrial capabilities need to be regularly exercised lest they diminish, and capacity needs to be maintained. Nations that seek to move from one level of sovereignty to a higher one, for example from *limited sovereignty* to *full* or *focused sovereignty*, have an arguably greater task as industrial capability and capacity consistent with that higher level need to be established. Such developments take time and require a continuing focus on the desired end state. Policies that regularly change, that periodically promote and demote the perceived value in having defence industry sovereignty, or that alter the stated priority afforded to capabilities and systems, are unlikely to result in the development of the industrial elements upon which sovereignty ultimately relies.

The Australian experience with the *Collins* program has shown the impact of the above. Whereas the initial policy ambition was for the progressive development towards the domestic capability to produce an indigenously designed submarine, the push towards greater self-reliance and defence industry sovereignty did not last beyond a change of government, replaced by policies that focused primarily on off-the-shelf procurement for military systems. There was not the same commitment to investment in the domestic defence industry. The preference was to minimise direct investment, and to focus on the ability to maintain, sustain and employ foreign-sourced systems rather to develop any such systems in-country. The investment focus, from the domestic viewpoint, was therefore primarily on *rudimentary sovereignty* for freedom of action, and not for operational advantage. Consequently, the capability and the capacity of the local industry developed with a primary focus on limited aspects of the know-how, and not the know-why. In stark contrast, and as discussed above, the ongoing UK commitment to the nuclear deterrent provided the underpinning for the continuity of investment into the RN submarine capability, and the maintenance of a high level of defence industry sovereignty across the submarine system.

Understanding the domestic defence industry

The above section has shown that, in the face of an assessed threat, states may determine a level of sovereignty necessary to address that threat. The more complete an understanding that the government has of the capabilities within that industry, and of its capacity to meet current and projected demands, the higher the potential for sovereignty ambitions in policy to be achieved. Conversely, an incomplete or inaccurate understanding may lead to policy positions that are unambitious, wasteful of resources, or unachievable.

In the UK, the Government has typically maintained a good understanding of the capability and capacity within industry through the repeated design, development, production, and introduction into service, of successive classes of submarine. This situation continued in a largely unbroken fashion until a gap that developed between the *Vanguard* and *Astute* programs. The level of understanding of the UK submarine defence industry diminished during this gap and, coupled with an actual decline in the submarine design and production skills, led to a situation where the 'MOD neither anticipated the impact of the gap nor factored into the cost and schedule estimates the need to rebuild industrial base capability' (Schank *et al*, 2011b: xii). The implementation of UK defence policy with respect to its submarine capability was therefore impacted by a lack of understanding within government of the extant nature of the domestic defence industry.

The Swedish development and operation of successive classes of submarine during the Cold War has also demonstrated the importance of a detailed understanding of the local defence industry by government, driven in part by government ownership of the submarine designer and builder. The understanding of the ongoing industrial capability and capacity within Sweden continued after the sale of Kockums to HDW in 1999, and subsequently to TKMS in 2005, as Swedish officials were able to discern that the Swedish submarine capability had deteriorated to a critical point, and there was risk to the continuity of the domestic submarine design capability. This understanding led to actions to redress this situation and moves to reacquire Kockums (Olsson, Gutensparr and Elofsson, 2018).

The understanding of the capabilities and capacity of the Australian defence industry by government officials was less specific than either the Swedish or the UK cases. At the commencement of the *Collins* program, the Government understood that Australian industry did not exist at the level required to design and build submarines, and therefore needed to be developed over time. Government policy therefore mandated a level of Australian defence industry involvement in the program, which could only be met through technology transfer and the inclusion of DO-DC and DO-FC entities in the production and support of the submarines. In this way the policy intent was to build internal capability and capacity to the position whereby, in time, Australia could design its own conventional submarine (Beazley, 2019).

An appreciation of the domestic defence industry also impacted upon the development of the *Collins* combat system. In this case, the success of the *Oberon* SWUP and the establishment of the SWSC, led to an over-optimistic assessment of the ability of the domestic industry to undertake that development. The policy ambition with respect to the CMS software expected, given the experience with SWUP, that sufficient capability and capacity existed in-country for the new system, but in reality there were insufficient subject matter experts in Australia to address the task within a realistic timeframe (Johnson, 2022).

Industry structure

One element that has been found to be less important than originally envisaged is the structure of the domestic defence industry. The author's initial expectation was that the location of the control of companies would be a defining feature of defence industrial, and hence operational, sovereignty. The initial assumption was that DO-FC entities could be expected to inhibit independent access to IP due to the controls exerted by a foreign parent and the associated foreign government. The case studies have shown, however, that it is the location of the development of military systems, rather than the control of the entity undertaking that development, that is the critical factor for obtaining independent access to the associated intellectual property. The structure of the domestic defence industry does, however, become a contributory factor to sovereignty when the majority of systems or sub-systems fielded by a state are of foreign origin, as independent access to IP is less likely in this situation.

In the UK, the case study has demonstrated that, following the takeover of the GEC Marconi sonar business by the French company Thales, the UK contracting regulations ensured that sonar system intellectual property generated in the UK with government funding could be independently accessed and utilised by the government. An ability to control the industrial activities associated with these systems could therefore be exercised, and *focused sovereignty* in the sensors category was retained. Other examples from the UK *Astute* experience, involving the domestic activities of the DO-FC companies Alstom, EADS, Northrop Grumman Sperry Marine and L-3 MAPPS, also highlight that defence industry structure is not a significant factor in sovereignty considerations, provided that IP generation is undertaken in-country and government regulations are in place to provide independent access to that IP.

Changes in the Swedish domestic industry structure following the end of the Cold War, including the sale of Kockums to HDW of Germany, had no effect on submarine sovereignty until the country was faced with choices regarding the replacement for the A19 submarine. This choice, starkly presented by TKMS as being the German Type 214 and not the preferred A26, then impacted heavily on submarine sovereignty considerations. The lack of DO-DC entities in the Swedish submarine industry, coupled with likely restrictions in the access to IP and diminishing domestic capability and capacity, meant that Sweden was highly unlikely to retain the *full sovereignty* that it had typically enjoyed if the Type 214 was acquired direct from the German supplier.

The Australian case study has also shown that the sale of the largest Australian owned and controlled defence companies to foreign interests in 2006 and 2008 had negligible direct effect on submarine defence industry sovereignty. The platform system continued to be supported by ASC as a DO-DC entity, and the combat system was provided from the US as a direct procurement. The sales of these companies, coupled with the government preference for off-the-shelf procurements, did have a more general impact, as they placed a large proportion of the domestic industry under foreign ownership and control, lessened the potential for DO-DC entities to be involved in system developments, and increased the challenges for the future achievement of full or focused sovereignty should policy come to have such ambitions.

Defence industry structure, therefore, is an important issue when a large part of the domestic industry associated with a capability is controlled from a foreign location, and the majority of system acquisition is through direct foreign purchase and not from domestic development. In this circumstance, the intellectual property associated with those systems is unlikely to be covered by domestic IP access regulations and independent access to that intellectual property for anything more than *rudimentary sovereignty* may be problematic.

Protection of the ability to control

This thesis has repeatedly commented on the fact that, in Western democracies, military systems are typically developed and supported by commercial entities. In some cases, these entities operate domestically, but are controlled from a foreign location. There is a risk, therefore, that the commercial ambitions of a particular entity and the policy ambitions of a government might not align.

The thesis has shown that governments can adopt a range of measures to protect their ability to control submarine-related industrial activities. These measures can include nationalisation to transfer failing entities into GO-GO organisations, close partnership arrangements between industry and government, the use of "golden shares", limitations on the managerial decision-making by mandating national directors and Board structure, and the use of intellectual property contractual arrangements. The thesis has also highlighted that these measures are more likely to be used by states with ambitions for full or focused sovereignty, rather than those that have lesser sovereignty aspirations.

The UK has used almost all of the above mechanisms to protect the government's ability to control the provision of industrial activities related to its submarine force. Forced amalgamations of disparate shipbuilding companies were used to consolidate industry into a smaller number of larger providers. The British Government also nationalised key elements of the defence industry to protect the ability to undertake the development and support of critical systems domestically. When privatised, government retained the ability to exercise control over the previously-nationalised companies through legislation that dictated the level of foreign shareholding, the specification that only UK citizens sit on the relevant boards, and the creation of a "golden share" through which unsatisfactory corporate decisions could be overturned. The inherent value of these shares was demonstrated in that, following the release of the 2002 *Defence Industry Policy* and the stated intent for the government to relinquish its rights in BAE Systems and Rolls-Royce (MOD UK, 2002), this action did not occur. The Government retained its ability to control corporate developments, and used its share in Devonport Management Limited in 2007 to consolidate submarine support services under a UK company that it preferred (NAO, 2007; Boles, 2007; Morgan, 2007). In addition to these actions and safeguards, further protections were introduced in the form of intellectual property contracting regulations to ensure that the government had rights to IP developed in the UK with government funding (UK MOD, 1974). The UK has also used the *Astute* KSF as a vehicle to understand, monitor and manage the *Astute* supply chain.

In Sweden, prior to its sale in 1999, Kockums operated as a GO-GO entity. The re-acquisition of the company from TKMS of Germany was undertaken following a negotiated agreement between the Swedish Government and Saab (Erixon, 2014; Saab, 2014). The Swedish Government also protected its ability to control events in defence industry through the introduction of the 1971 law on defence inventions that provided State access to military-related innovations made in Sweden (Ministry of Justice, 1971). During the Cold War, Sweden also implemented partnerships between the government, private companies and national universities to develop specialist tools and procedures to support its defence industrial ambitions (De Vore, 2015, 2016).

In contrast to the above examples, in Australia, where there has been an ongoing limited ambition for defence industry sovereignty, there have been minimal attempts to impose control over the corporate entities supporting the military. The initial sale of ADI to a combination of Australian and French interests had an embargo of only 18 months placed on the future sale of the Australian component, and a *post-facto* investigation into the sale conducted by a Parliamentary committee. The sale of Tenix contained no ongoing provisions that might enable an ability to exercise control. The nationalisation of ASC following the sale of Kockums to Germany was designed to facilitate the on sale of the company to US commercial interests, rather than to specifically protect any ability to control industrial activities associated with the *Collins* class submarine.

From these examples, it can be concluded that states that design and produce a strategically-important military capability, such as a submarine, wish to have the ability to exercise control over corporate decisions that might negatively impact upon the industrial processes associated with that capability. States that do not design submarines, that utilise a design developed elsewhere and therefore have a lesser ability to influence the development of maintenance of operational advantage, have a corresponding reduced ambition regarding the ability to control.

Other factors

In addition to the consideration of the threat, and the understanding of the ability of the domestic defence industry to achieve government ambitions, policy development is also influenced by the impact of decisions taken under other policies, and other political ambitions that the government may have regarding alliance and other relationships. The UK policy to place the national nuclear deterrent at sea resulted in the maintenance of a domestic submarine design and build capability that included both ballistic missile and attack submarines. Whilst successive UK defence policies steadily reduced the overall military force structure, and progressively limited the industrial capabilities deemed to be strategically important and which therefore needed to be resident domestically, defence industry sovereignty with respect to the submarine force, from design to update-upkeep, was retained as a by-product of the policy for sovereignty over the deterrent. The policy with respect to nuclear deterrence has therefore provided an ongoing foundation to the broader defence industry policy applying to submarines, and has resulted in *full sovereignty*, with some exceptions, for the UK submarine capability.

Alliance and other relationships have also been shown in the case studies to impact upon defence industry policy, and ambitions for related sovereignty. Chapter 2 of this thesis has shown that some states trade aspects of their sovereignty for security benefits by entering into an alliance. A state may, therefore, seek to avoid the costs associated with pursuing high levels of sovereignty by making commitments to an alliance or through the collaborative development of military systems. The Australian decision to forego domestic development, and potential *full sovereignty*, over the *Collins* combat management system software in favour of the AN/BYG-1 alternative, has highlighted that the benefits of closer relations with the United States were considered by the Government as being more important than having defence industry, and operational, sovereignty over the CMS, and that the strength of that relationship mitigated sovereignty risks.

In the UK, the collaborative development of military systems with European partners that commenced in the 1960s, and the potential merger of key British companies, such as British Aerospace, GEC-Maroni and Ferranti Thomson Sonar Systems with potential European and United States partners in the 1990s, highlights that, even in the important area of submarine capability, alternatives to full sovereignty were considered and embraced. In Sweden, a state that had consistently pursued full sovereignty over its submarines, the benefits of closer engagement with the EU following the end of the Cold War were deemed to be more important than the maintenance of that sovereignty. The cost-benefit balance changed following the Russian invasion of Crimea in 2014, with full sovereignty again being sought by policy-makers for Swedish submarines within the constraints of existing international relationships.

Observation on contemporary events

The case studies in this thesis have all concluded in the period between 2016 and 2020. Government policies, submarines, and defence industry have all continued to develop and evolve in the period between these end dates and now. One of the largest developments has been the formation of the Australia United Kingdom United States (AUKUS) partnership, and the related Australian decision to acquire nuclear-powered submarines. This section briefly addresses that decision in light of the Sovereignty Diagnostic developed in this thesis, both to provide an observation on contemporary events and to show the applicability of the approach adopted herein to those events.

At the time of writing, the way ahead for the acquisition of SSNs for Australia has been clarified. The pathway for this acquisition will see an initial three *Virginia* SSNs acquired direct from the United States, followed by the local production of a new class of a submarine, based on a UK design (Prime Minister, 2023; Marles, 2023). Figure 39 highlights the difference between production in a foreign and an Australian shipyard. The diagram is coloured in purple tones, in the same shaded manner as the case studies, to highlight that these diagrams are separate to any earlier considerations. No policy diagram is included as, apart from the initial statement of intent, no policy position has been announced. The final policy and sovereignty assessments for the *Collins* class submarine from the Australian case study are included at the top row of Figure 39 for comparison.

The middle row of Figure 39, depicting the direct foreign acquisition, shows that Australia will have no ability to control industrial activities in the all-of-system design, systems integration, or test and evaluation, and no sovereignty over any of the functional categories of that comprise the submarine. Some aspects of upgrade can be expected through DO-FC entities, and the diagram has been coloured accordingly. As for the current situation with *Collins*, the upgrade of the software component of the combat management category is coloured for no sovereignty on the assumption that the extent arrangements with the US for this sub-system, or a variation therefore, will continue.

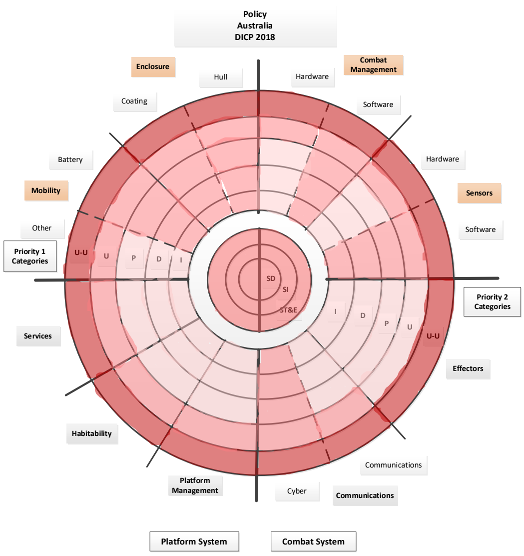
Australian contracting regulations should provide an independent ability to undertake the update-upkeep across the majority of the submarine functional categories, with one exception. Given that Australia is unlikely to have developed adequate capability and capacity in the maintenance of nuclear reactors and their associated components prior to the delivery of the first *Virginia* submarine, it will therefore have to rely upon the foreign OEM for this activity. In the event that such maintenance is undertaken locally, Australia will have limited control over the update-upkeep aspect of the reactor sub-system and will have *limited rudimentary sovereignty*. Should the submarine need to return to the United States for reactor-associated maintenance, then there will be no ability to control, and *no sovereignty*.

The bottom row of Figure 39 shows the situation associated with an Australian build of the SSN. In this case, the all-of-system activities have increased to limited control as the design will be available in-country, and systems integration and T&E are expected to be undertaken by DO-FC entities. Other differences between the offshore and Australian scenarios arise in the production of the enclosure category. As the enclosure will be produced in-country, there will be the ability to exercise limited control over this activity, but innovation with respect to the enclosure and the design is expected to be undertaken in the United Kingdom. In addition, Australia may also be prepared to utilise the domestic capability in anechoic coatings that has been developed for the *Collins*, and this aspect has been coloured for the ability to exercise control. Figure 39 also reflects the hypothetical situation where the sensor and platform management categories reflect the current arrangements for the *Collins* submarine and *limited control* is able to be exercised.

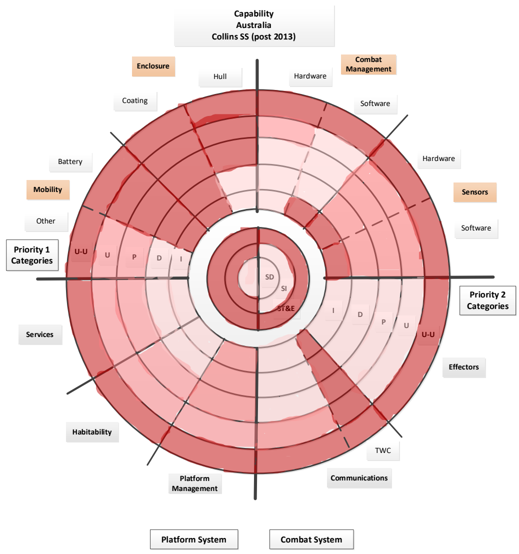
The upgrade activity for the reactor element within the mobility category has been coloured for *no sovereignty* in both diagrams, as the nuclear reactor will be provided to Australia as a sealed unit and no upgrade will be required for the life of the submarine (White House, 2023). As in the case above, update-upkeep activity pertinent to the nuclear reactor is expected to be provided in Australia by a DO-FC entity, and with Australia unlikely to have independent access to reactor design IP for these purposes. The Australian production of SSNs is therefore likely to retain the level of defence industrial sovereignty at the *limited rudimentary* level. In the event that Australia was provided with sufficient reactor IP to enable independent industrial action, and with the development of local defence capability and capacity to undertake the update-upkeep tasks, a level of *rudimentary sovereignty* could be attained.

Overall, the expectation with respect to the Australian acquisition of SSNs is that defence industry sovereignty over the submarine will decrease, with the extent of that decrease reflecting whether the current involvement of DO-FC entities in the sensors and platform management categories is maintained. In the event that this does not occur, the level of sovereignty over the Australian SSN will be similar to the level applying to the *Oberon* submarines prior to the SWUP in the early 1980s. The experience with the *Collins* class has shown, however, that limited sovereignty in some submarine categories is likely to evolve as technical and industrial knowledge is progressively transferred into the DO-FC entities supporting the SSNs in Australia.

Defence Policy (2016 DWP/ DICP 2018)



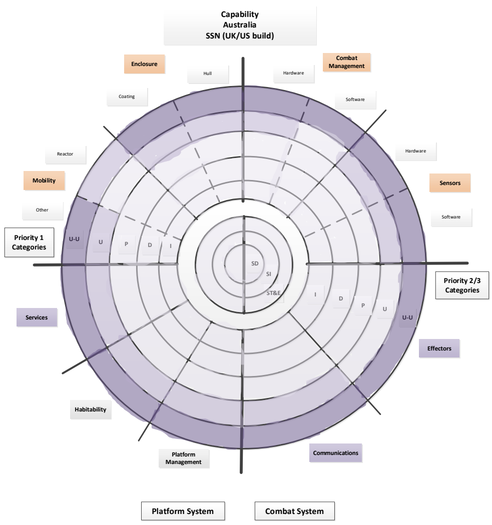
Collins submarine (after IP procurement)



Defence Policy regarding SSN acquisition

?

SSN acquired from US



SSN produced in Australia

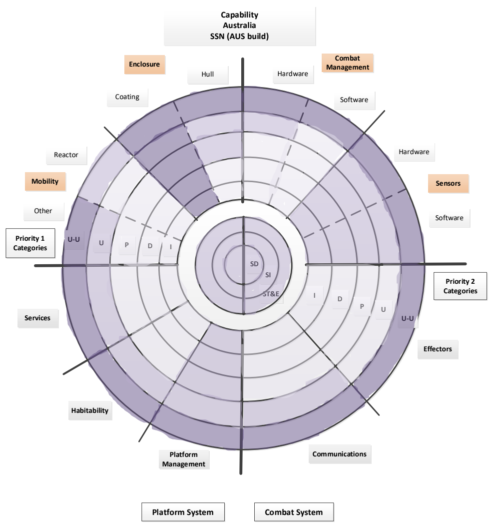


Figure 39. Illustration of defence industrial sovereignty for Australian acquisition of SSNs

Contribution to Knowledge

As noted in the introduction to this thesis, the current literature has paid little attention paid to either operational sovereignty or to defence industry sovereignty. The current literature has typically focused on industrial activity to the point of production and acquisition, or on innovation, and research and development. This thesis makes a significant contribution to knowledge in the following ways.

First, the thesis has highlighted the importance of the ability to control the design activity for operational and defence industrial sovereignty. This ability has been shown to be a point of differentiation in both aspirations for sovereignty, and in the realisations of those aspirations. States that design, aim higher, and achieve higher levels of sovereignty than those that do not.

Second is a stratification of defence industry sovereignty, and the development of a Sovereignty Diagnostic that provides consistent frameworks across both policy and defence industry. This Diagnostic therefore provides a method for the comparison of sovereignty ambitions as expressed in policy to the attainment of those goals at the capability level. Third is the identification of elements associated with defence industry sovereignty and how these separate elements relate to each other, and to the attainment of sovereignty goals. The research has shown that the elements add in a Boolean sense.

Fourth, the thesis has described a military system as separate platform and combat systems, with each comprised of a small number of functional categories. These functional categories have been prioritised according to their importance to the operational employment of the military system, thereby providing a mechanism for the value of an investment into defence industry sovereignty to be considered. The research has shown that higher levels of operational sovereignty are typically sought for categories associated with operational advantage. The thesis has also shown that an ability to control the update-upkeep activity of all categories is required for freedom of action.

Fifth, and related to the determination of functional categories above, the research developed a means to graphically depict the level of sovereignty for both the military system as a whole, and for the functional categories that comprise that system. Moreover, this graphical representation divided each functional category into industrial activities covering innovation, design, production, upgrade, and update-upkeep, thereby proving a more granular view of the ability of the state to control these activities at the functional category level, and hence to determine the overall level of defence industry sovereignty pertaining to the military system.

Sixth, the structure of the domestic defence industry has been found to be important only in the circumstance where the local defence industry is dominated by the DO-FC subsidiaries of foreign companies, and when systems are acquired off-the-shelf rather than developed domestically. The structure of the domestic industry base is less of an issue when developments are undertaken locally, even when DO-FC entities are involved, as IP access clause within contracting arrangements typically provide the ability to access and use the intellectual property so generated.

Seventh, the case studies confirm that there are no sufficient conditions for sovereignty in defence industry, where sufficient means that it is all that is required for an outcome to occur (Walton, 2005). The research has also confirmed that there are elements that are necessary for sovereignty, where necessary means that an outcome will not occur without the condition (Walton, 2005). The necessary conditions are independent access to intellectual property, domestic industrial capability and capacity to utilise that intellectual property, and capability and capacity in the government client organisation to provide governance and design assurance.

One additional contribution to knowledge has been in the consideration of the temporal aspects of policy and capability. The defence industrial capability and capacity may make decades to develop, and the effects of earlier policies may linger in capability for an extended time. That is, earlier policies may cast long shadows. A developed industrial capability may take a similar time to decay. Policy theory, and policy development associated with defence industry, therefore needs to be cognisant of these lags.

Contribution to Policy

This research contributes to policy by providing frameworks for the consideration of the various elements required for the exercise of control over the industrial activities associated with submarines, and the link of this control to different levels of sovereignty. Moreover, due to the Boolean additive nature of these elements, the research shows that these elements need to be considered together if sovereignty outcomes sought in policy are to be achieved at the capability level. That is, states will require to consider the level of access to intellectual property, the capability and capacity in defence industry, and the capability and capacity in the government client organisation as a holistic bundle of policy objectives, with corresponding tools for implementation.

Time and investment are therefore key aspects of a defence industry policy that seeks to raise the level of sovereignty. Moreover, as most states are unlikely to be in a position to meaningfully address sovereignty over each and every aspect of their force structure, prioritisation of capabilities that can realistically be addressed will also be required. Given, also, that the identified elements required for sovereignty may take many years to develop, continuity of policy and focus will be required to move to higher levels of sovereignty. That is, states are unlikely to be successful in moving rapidly to a higher level of sovereignty in the face of a developing threat unless the domestic defence industry already has the majority of the industrial capability and capacity required.

The importance of the ability to design a military system has been shown to be critical if higher levels of sovereignty are sought. The development of policies that may have ambition for focused, and particularly for full, sovereignty need to be pay particular attention to the ability of the defence industry to undertake the generation of intellectual property, and of the capability and the capacity in the government client organisation to oversee, assure and test the design and the system produced from that design.

The research has also shown that the structure of defence industry can be, but not necessarily is, a factor in the ability of a state to exercise control over defence industry activities, and hence a factor in the realisation of defence industry sovereignty ambitions. The potential impact from the structure of the defence industry increases if that industry consists primarily of DO-FC entities, and the state does not have independent access to intellectual property for those elements over which focused sovereignty is required.

The approach to defence industry sovereignty developed within this thesis may therefore be useful to illuminate the differences in any current position and intended future position regarding that sovereignty. In this way, the frameworks and graphical representations can be used to determine where gaps might exist with respect to the future state, and hence what policy developments are required to fill those gaps.

Further research

This thesis has developed the limited previous research in an area of increasing importance to national governments as the strategic situation deteriorates. The research is of increasing importance to Western states as their governments typically rely upon industry to provide and maintain the military forces upon which security rests. The research has not focused on the benefits, or otherwise, of higher levels of sovereignty over lower levels, and further work may therefore illuminate whether such advantages exist, and whether such advantages, if they do exist, are constrained to any particular type of military system.

The submarine is one of many military systems within a state's force structure. The simplest extension of this research would be to examine additional states from the list at Appendix 1 to determine whether the results of this research are consistent across all states, or whether the selection as in this thesis has provided a unique outcome. Research into other major systems, such as surface warships or jet aircraft or space-based surveillance systems, would provide a point of comparison to the results of this research and the importance of the various elements identified herein. As noted in the introduction to this thesis, the challenge for such research will be in bounding the scope of the problem to be investigated.

One area of useful research associated with defence industry sovereignty is in rate of development and decay or defence industry capability and capacity. This thesis has shown that capability and capacity in both industry and the government client is required if full or focused sovereignty is to be achieved and maintained. Research into rates of growth and decay in both these types of organisations would be an important consideration for policy-makers.

The determination of the level of control as explored herein has been based on the adequacy of capability and capacity in industry, and within the client organisation. Adequacy, itself, has not been explored. Further research into the concept of adequacy, and whether there are relationships to factors such as the design and production experience of the state, or the structure of the defence industry, or the continuity of defence industry policy, would be useful.

In addition to capability and capacity in industry, the research has also shown that capability and capacity is required in the government client. As many states, including Australia, procure both capability and capacity from commercial sources rather than retain this within their respective public services, it could be interesting to observe whether there are differences in outcomes that are influenced by the way that such capability and capacity is provided.

The Australian case study has shown that the ability to control industrial processes in some submarine functional categories increased without any policy ambition to do so. Further research could be conducted into whether this growth is a typical phenomenon of a long-lasting, developmental project, or an aberration for the *Collins* class submarine. Research into this topic would be particularly useful for policy makers when considering the approach to, and the benefits of, such projects.

Sovereignty at a more detailed level than the functional category description adopted in this thesis is also a potential area for further research. Such an investigation could potentially be undertaken into a single area such as sensors or combat management in order to forensically examine defence industry sovereignty across the various sub-systems that comprise the functional categories, for example, acoustics, radar, and electro-optics in the sensor domain. Alternatively, a similar research approach could focus on a single sensor of critical importance, such as acoustic sensors for submarines, in order to examine sovereignty, and supply chains, at the component level.

Other potential areas for further research include the following: (1) the potential link between approaches to sovereignty and strategic culture to investigate whether some states are more or less inclined towards defence industry sovereignty as their default position; (2) the potential sovereignty impact of US ITAR rules for states with a high reliance on access to US weapon systems; and (3) whether some policy drivers have more impact than others on the intent for defence industry sovereignty at the policy level.

The research undertaken in this thesis will be of increasing importance to governments as the geo-strategic situation deteriorates and states increasingly need to consider their various assessed risks, both threat-facing risks in the form of operational advantage and supplier-facing risks as freedom of action. Consideration of these risks will comprise an input for the consideration of defence industry sovereignty.

Acronyms and glossary

9/11	11 September 2001. The date of the terrorist attack on the World Trade Centre, New York City and the Pentagon, Washington DC
ABDI	Australian Business Defence Industry
ADF	Australian Defence Force
ADI	Australian Defence Industries
AIC	Australian Industry Capability
AII	Australian Industry Involvement
AIP	Air Independent Propulsion
Anechoic tiles	Anechoic tiles are typically used to reduce the reflectivity index through the absorption of active sonar energy, but the effectiveness of these tiles is related to frequency, and therefore needs to be optimised against the perceived threat.
ANAO	Australian National Audit Office
ANU	Australian National University
APACT	Automated Plotting and Chart Table
APB	Advanced Processing Build
ASC	Australian Submarine Corporation, also just ASC Pty Ltd
ASW	Anti-Submarine Warfare
AUKUS	Australia United Kingdom United States
BDM	Battle Damage Repair
CAD	Computer Aided Design
Capability Category	A description used within the thesis to depict the functional decomposition of the Platform System and the Combat System into constituent elements. Each Capability Category is comprised of one or more sub-systems.
Cavitation	Cavitation is the formation and abrupt collapse of vapour-filled bubbles.

	The collapsing bubbles generate significant noise. This process takes place on propeller edges or along propeller blades where the pressure falls below the vapour pressure of the seawater.
CASG	Capability Acquisition and Sustainment Group
CDF	Chief of the Defence Force
CDS	Combat Data System (also known as a Combat Management System)
CEO	Chief Executive Officer
CMS	Combat Management System
CFSP	Common Foreign and Security Policy
COTS	Commercial-Off-The-Shelf
CSC	Computer Sciences Corporation (of Australia)
DA	Design Authority The Submarine Institute of Australia (SIA) (2008: 36) has stated that: 'The Submarine Design Authority has a crucial role every stage in the life of a submarine: from concept, detailed design, production, through life support to disposal. Having managed the production of the detailed design it oversees the construction, much as an architect does in a large construction project. Prior to the submarine going into service and throughout its life a named individual within the design authority certifies that the vessel: a. meets the customer's requirements b. is fit for its intended purpose c. is safe to operate d. complies with relevant legislation and regulations'
DASA	DaimlerChrysler Aerospace
DBT	Deep Blue Tech Pty Ltd, a subsidiary of ASC.
DER	Defence Efficiency Review
DERA	Defence Evaluation and Research Agency
DIB	Defence Industrial Base

DICP	Defence Industrial Capability Plan
DIPS	Defence Industry Policy Statement
DML	Devonport Management Limited
DMO	Defence Materiel Organisation
DO-DC	Domestically Operating, Domestically Controlled
DoD	Department of Defence / Department of Defense
DRP	Defence Reform Program
DSTG	Defence Science and Technology Group
DSTO	Defence Science and Technology Organisation
DTI	Department of Trade and Industry (UK)
DWP	Defence White Paper
EADC	European Aerospace and Defence Company
EDA	European Defence Agency
EU	European Union
DO-FC	Domestically Operating, Foreign Controlled
FIC	Fundamental Inputs to Capability
FFG	Frigate – Guided Missile
FFH	Frigate – Helicopter
FIRB	Foreign Investment Review Board
FMV	*Försvarets materielverk*; the Swedish Defence Materiel Administration
FO-FC	Foreign Operating, Foreign Controlled
FOI	*Totalförsvarets forskningsinstitut*; the Swedish Defence Research Agency
FSM	Future Submarine
FTSS	Ferranti Thomson Sonar Systems
GAO	Government Accountability Office, also previously General Accounting Office

GEC	General Electric Company
GDP	Gross Domestic Product
GID	Garden Island Dockyard
GO-GO	Government Owned, Government Operated
HCDC	House of Commons Defence Committee
HDW	Howaldtsweke-Deutsche Weft
HMAS	Her Majesty's Australian Ship
HMS	Her Majesty's Ship
HAS	Hollandse Signaal Apparatin
HWT	Heavyweight Torpedo
Hydrodynamic noise	Hydrodynamic noise is generated by water passing across the structure of the submarine. The hydrodynamic noise signature is a combination of the noise radiated by the fluctuation in the pressure in the turbulent boundary layer (created by vortices around discontinuities in the hull structure), and the excitation of the structure itself. The level of the noise is therefore fundamentally affected by the speed of the submarine through the water column, the density of the fluid passing across the surface of the submarine (therefore the depth at which the submarine is operating), and the structure of the submarine hull.
IEEE	Institute of Electrical and Electronics Engineers
INCOSE	International Committee on Systems Engineering
Indiscretion ratio	The indiscretion ratio for a submarine refers to the amount of time masts and other equipment may be exposed above the surface of the ocean, and hence the time that the submarine is more vulnerable to detection. The indiscretion ratio for a conventional submarine will typically be higher than that for a nuclear submarine due to the requirement to snort to recharge batteries.
IP	Intellectual Property
ISCMMS	Integrated Ship Control Management and Monitoring System

ISO	International Standards Organisation
ISR	Intelligence Surveillance Reconnaissance
ISTAR	Intelligence Surveillance Target Acquisition and Reconnaissance
ITAR	International Trade in Arms Regulations – the United States regulation that controls the manufacture, sale, and distribution of defence and space-related articles and services as defined in the United States Munitions List (USML).
JCFAD	Joint Committee on Foreign Affairs and Defence
KSF	Key Supplier Forum
LOVENTP	The Swedish acronym LOVENTP could be translated as Command and Control (C2), Situation awareness, Engagement, External cooperation, Net infrastructure, Transmission and Platforms.
Major System	The description of the various categories in the decomposition of a major system is as follows: • Platform System Capability Categories o Enclosure – that which keeps the constituent parts protected from the environment o Mobility – that which enables the major system to move from place to place o Services – that which generated and manages the power upon which the platform requires for operation o Habitability – that which enables humans to exist within the platform o Platform management system – that which provides the ability for the platform to management other platform layers. • Combat System Capability Categories o Sensor – that which enables the major system to determine the actions of external actors within the operating environment

	- Combat management – that which enables the major system to process and display information, and undertake associated command and control - Communications – that which enables the major system to communicate and exchange information with other major systems - Effectors – that which enables the major system to provide effects external to the platform, and to protect itself from, and to take action against, adversaries.
MOAS	Mine and Obstacle Avoidance Sonar
MOD	Ministry of Defence
MOD UK	Ministry of Defence United Kingdom
MOTS	Military Off-the-Shelf
MP	Member of Parliament
NAO	National Audit Office, United Kingdom
NAVSEA	Naval Sea Systems Command
NATO	North Atlantic Treaty Organisation
OEM	Original Equipment Manufacturer
OTS	Off-the-Shelf
Parent Navy	The term ‘parent navy’ encapsulates the full responsibility and burden for all elements of integrated logistics and technical support through the capability life cycle of a platform (cradle to grave approximately 40 years). It requires commitment of considerable resources and a broad range of specialist skills, knowledge and experience. In the past, the RAN was provided this support by the RN and, more latterly the USN, as they were ‘parent navies’ for most of the ships in service with the RAN’. (Navy, 2016: 41)
PDS	Preliminary Design Studies
PfP	Partnership for Peace

PIC	Priority Industry Capability Priority Industry Capabilities were defined as ‘those industry capabilities which would confer an essential strategic capability advantage by being resident within Australia, and which, if not available, would significantly undermine defence self-reliance and ADF operational capability’ (DIPS 2010: para 4.9).
PIPRS	Passive Intercept Passive Ranging System
PLIC	Priority Local Industry Capability
PMB	Pacific Marine Batteries
R&D	Research and Development
RADM	Rear Admiral
RAN	Royal Australian Navy
RANTME	RAN Torpedo Maintenance Establishment
RCNC	Royal Corps of Naval Constructors
RD&E	Research, Development and Engineering
RN	Royal Navy
RSwN	Royal Swedish Navy
RUSI	Royal United Services Institute
SCMILE	Sensing, Command and Control, Information Mobility, Physical Mobility, Logistics, Supply, Sustainment and Support, Engagement The SCMILE framework comprises discrete services as follows: • Sensing – the provision of information regarding the battlespace and wider operational environment. • Command and Control – the provision of sense-making, decision-making and instructions for agents and analysis of the battlespace and wider operational environment. • Information Mobility – the provision of information storage and dissemination covering infrastructure, activity and processes. • Physical Mobility – the provision of housing and locomotive ability

	(movement, transport and containment). • Logistics, Supply, Sustainment and Support – the provision of activities, physical materials and information that enable the normal function of a system of agent. • Engagement – the provision of effects, in and on the battlespace and wider operational environment
SFCS	Submarine Fire Control System
SI	Systems Integration
SIA	Submarine Institute of Australia
SIC	Strategic Industry Capability
SICP	Sovereign Industrial Capability Priority Sovereign Industrial Capability Priorities are defined as those that are 'strategically critical (and Australia) must therefore have access to, or control over, the essential skills, technology, intellectual property, financial resources and infrastructure as and when required' (DICP, 2018: 17).
SIPRI	Stockholm International Peace Research Institute
SSK	Conventionally-powered Submarine (also variously SS)
SSBN	Ballistic Missile Nuclear-powered Submarine
SSN	Nuclear-powered Submarine
Submarine signature	The signature of a submerged submarine has the following components: • Acoustic – made up of individual elements, including: o Machinery – noise generated by engines, pumps, etc o Habitation – the noise generated by human activities o Sonar emissions – the noise associated with active sonar emissions o Cavitation – the noise generated by bubbles forming and collapsing due to the turning of the propellers o Hydrodynamic – the noise generated as a result of water flowing against the hull and underwater fittings

	• Electrical – made up of individual components as follows:
	  ○ Static electric – generated due to the electrical interaction of dissimilar metals used in the underwater fittings (also called extremely low frequency electric (ELFE))
	  ○ Alternating electric – generated by shaft rotation
	• Magnetic – develops as a result of ferrous material in the construction, the orientation of that material during build, the stress developed in that material, and the movement of the submarine through the earth's magnetic field
	• Pressure – the result of the submarine's physical form distorting the water column as it moves through it
	• Seismic – the result of acoustic waves propagating through the seabed

SWSC	Submarine Warfare Systems Centre
SWUP	Submarine Weapons Upgrade Program
T&E	Test & Evaluation
TI	Technical Insertion
TKMS	ThyssenKrupp Marine Systems
TLAM	Tomahawk Land Attack Missile
TMS	Thomson Marconi Sonar
ToE	Towers of Excellence
UK	United Kingdom
US / USA	United States / United States of America
USN	United States Navy
VADM	Vice Admiral
VSEL	Vickers Shipbuilding and Engineering Limited
WIPO	World Intellectual Property Organization
WND	Williamstown Naval Dockyard

Appendix 1 – Case study source selection

Table 4 below provides the basis of comparison that served as the basis for the source selection of the cases examined in this thesis (WPR, 2021).

The availability of relevant information in English was added to remove the need for translation.

Information accessibility determinations included early conversations with relevant country representatives at Embassies/ High Commissions in Canberra.

Table 4 – Submarine design and build by country for case study selection

Country	Build	Domestic Design	Western Orientated	Democratic	Medium Power	Information in English	Information Accessible	Comments
Algeria								Russian Kilo class
Argentina				✓	✓			
Australia	✓		✓	✓	✓	✓	✓	
Bangladesh								Chinese Ming class
Brazil	✓			✓	✓			Domestic build, and increasing domestic design with French assistance
Canada			✓	✓	✓	✓	✓	UK Upholder class
Chile								
China	✓	✓						Not a realistic option

Country	Build	Domestic Design	Western Orientated	Democratic	Medium Power	Information in English	Information Accessible	Comments
Colombia								
Ecuador								
Egypt					✓			
France	✓	✓	✓	✓	✓		?	
Germany	✓	✓	✓	✓	✓		?	
Greece	✓		✓	✓	✓		?	Build under license
India	✓	✓		✓	✓	✓		Discussions with Indian Defence Adviser, Indian High Commission, Canberra during 2016/17 indicated access to information was unlikely.
Indonesia				✓	✓			
Iran					✓			
Israel			✓	✓	✓			
Italy	✓		✓	✓	✓		?	Italy has traditionally constructed its own submarines. In 1996 the German and Italian

Country	Build	Domestic Design	Western Orientated	Democratic	Medium Power	Information in English	Information Accessible	Comments
								defence ministries concluded a Memorandum of Understanding initiating cooperation in the construction of a new generation of submarines
Japan	✓	✓	✓	✓	✓		?	
Malaysia				✓	✓			
Myanmar								Ex-Indian Russian Kilo class
Netherlands			✓	✓	✓			The Netherlands has previously had a submarine design and build capability
North Korea					✓			
Norway			✓	✓	✓			German 210 class
Pakistan	✓			✓	✓	✓		Build French submarines under license. Aim to increasing build domestic design capability
Peru					✓			
Poland			✓	✓	✓			
Portugal			✓	✓	✓			

Country	Build	Domestic Design	Western Orientated	Democratic	Medium Power	Information in English	Information Accessible	Comments
Russia	✓	✓						Major naval power. Not a realistic option
Singapore			✓		✓	✓		Information requests to Singapore High Commission, Canberra in 2016 were unanswered
South Africa				✓	✓			
South Korea	✓	✓	✓	✓	✓			Has used domestic build to move progressively towards indigenous design
Spain	✓	✓	✓	✓	✓		?	
Sweden	✓	✓	✓	✓	✓	✓	✓	Discussions with the Defence Attache Australia and New Zealand, Swedish Embassy, Canberra Previous involvement in Australian submarine program
Taiwan			✓	✓	✓			Looking to design and build
Turkey	✓	✓			✓			Domestic design based on German collaboration
United Kingdom	✓	✓	✓	✓	✓	✓	✓	

Country	**Build**	**Domestic Design**	**Western Orientated**	**Democratic**	**Medium Power**	**Information in English**	**Information Accessible**	**Comments**
United States	✓	✓	✓	✓		✓	?	Superpower
Venezuela								
Vietnam					✓			

Appendix 2 – List of interviews conducted

Date	Person/ Position	Location	Case Study
	Initial scoping meetings to test the proposed concept and approach		
Oct 2017	**Hakan Soderstedt,** FMV Sweden	Sydney	
02 Nov 2017	**VADM (ret) Sir Jeremy Blackham KCB,** previously Deputy Chief of Defence Staff (Capability), MOD(UK)	London	
02 Nov 2017	**Professor Trevor Taylor,** Royal United Services Institute, UK **Professor John Louth,** Royal United Services Institute, UK	London	
03 Nov 2017	**Mr Kevin McLoughlin** – Assistant Head of Capability Assurance, FMC-Weapons, Evaluation and Capability Assurance, Ministry of Defence, UK **Mr Oliver Burnham** – Assistant Head of Industrial Policy, Ministry of Defence, UK	London	
Jan 2018	**CAPT (ret) Simon Chelton** – previously RN Submarine Commanding Officer and industry consultant (CCL Int)	Singapore	
	Interviews		
22 Feb 2018 07 Jul 2019 21 Jul 2019	**Mr Peter Horobin, MBE** – ex-RAN Submarine Commanding Officer and industry consultant	Canberra Private Correspondence Private	Australia

Date	Person/ Position	Location	Case Study
03 July 2022		Correspondence Private Correspondence	
06 Sep 2018	**Rear Admiral Andreas Olsson**, Special Advisor, Department of Acquisition, Research and Development, Ministry of Defence, Sweden **Captain Kenth Gutensparr**, Swedish Armed Forces Defense Staff **Mr Mats Elofsson**, Director Naval Procurement and Logistics, FMV Sweden	Adelaide	Sweden
11 Oct 2018 13 Nov 2018	**Professor Trevor Taylor,** Royal United Services Institute, UK	Canberra London	United Kingdom
28 Oct 2018	**BRIG-GEN (ret) Uzi Rabin**, Jerusalem Institute for Strategic Studies, Israel	Telephone	All
30 Oct 2018	**Dr Allan Behm** – ex-Chief of Staff to the Hon Greg Combet, Minister for Defence Materiel and Science	Canberra	Australia
31 Oct 2018	**ADML (ret) Chris Barrie, AC** – previous Chief of the Defence Force.	Canberra	Australia
01 Nov 2018	**AUS Anon #1** [redacted]	Canberra	Australia
12 Nov 2018	**Mr Brinley Salzmann**, Director, Overseas and Exports, ADS Group, UK	London	United Kingdom
12 Nov 2018	**CAPT (ret) Simon Chelton** – previously RN	London	United

Date	Person/ Position	Location	Case Study
08 Oct 2019	Submarine Commanding Officer and industry consultant (CCL Int)	Sydney	Kingdom
14 Nov 2018	**VADM (ret) Sir Jeremy Blackham KCB,** previously Deputy Chief of Defence Staff (Capability), MOD(UK)	London	United Kingdom
15 Nov 2018	**Mr Simon Tenison** – Assistant Head, Capability Assurance (Plans), FMC-Weapons, Evaluation and Capability Assurance. Ministry of Defence UK **Wg Cdr Matthew Wood** (FMC-StratProg-WECA-CA-Coherence1), Ministry of Defence UK	London	United Kingdom
15 Nov 2018	**UK Anon #1** [redacted]	Watchfield, Oxfordshire	United Kingdom
16 Nov 2018	**Mr David Gould CB** – previously Deputy Chief Executive and Chief Operating Officer – Defence Procurement Agency UK; Chief Operating Officer – Defence Equipment and Support UK; General Manager Submarines, DMO, Australia	London	United Kingdom Australia
21 Feb 2019	**Mr Pat Conroy, MP** – previously advisor to Hon Greg Combet, AM as Parliamentary Secretary for Defence Procurement	Canberra	Australia
30 Apr 2019	**Mr Harry Dunstall** – previously Deputy CEO DMO and General Manager Commercial, DMO, Australia	Canberra	Australia

Date	Person/ Position	Location	Case Study
10 May 2019	**Dr Rob Bourke** – previously Director-General Industry Policy and Programs, and Director-General Economic and Commercial Analysis in DMO	Canberra	Australia
15 May 2019	**AUS Anon #2** [redacted]	Canberra	Australia
20 May 2019	**CDRE (ret) Paul Greenfield** – previously RAN Submarine Weapons, Electrical Officer; Secretariat, MacIntosh and Prescott Review; Chief of Staff, Submarine Capability Team; Director General Submarines.	Canberra	Australia
30 May 2019 04 Nov 2021	**Mr Steve Ludlam** – previously CEO ASC, Australia. Also previously President of Submarines, Rolls-Royce plc, UK	Adelaide Private Correspondence	Australia United Kingdom
03 Jun 2019	**Mr Glenn Wahlert** – previously Director General Electronic Warfare, DMO, Australia; Director General Industry Capability, DMO	Canberra	Australia
06 June 2019	**AUS Anon #3** [redacted]	Telephone	Australia

Date	Person/ Position	Location	Case Study
07 Jun 2019	**RADM (ret) Rowan Moffitt, AO** – previously Head, Future Submarines Program	Canberra	Australia
04 Jul 2019	**The Hon Kevin Andrews, MP –** previously Minister for Defence	Canberra	Australia
16 Jul 2019	**His Excellency the Hon Kim Beazley, AC** – previously Minister for Defence, Chancellor of Australian National University, Australian Ambassador to the United States of America	Telephone	Australia
08 Oct 2019	**AUS Anon #4** [redacted]	Sydney	Australia
09 Oct 2019	**Sweden Anon #1** [redacted]	Sydney	Sweden
24 Oct 2019	**VADM (ret) Dr David Shackleton, AO –** previously Chief of Navy.	Canberra	Australia
07 Nov 2019 01 Feb 2022	**AUS Anon #5** [redacted]	Adelaide Private Correspondence	Australia United Kingdom
14 Nov 2019	**Mr Brent Clark** – previously interim CEO of	Canberra	Australia

Date	Person/ Position	Location	Case Study
	Naval Group Australia; Chief Operating Officer (COO) Naval Group Australia; Director of Strategy and Communications DCNS; Head Strategy, Business Development and Communications Maritime BAE Systems Australia, Vice President Naval, Thales; RAN Submariner		
21 Nov 2019 04 Mar 2021	**RADM (ret) Peter Briggs, AO CSC** – previously Head, New Submarine Capability Team; Head, Systems Acquisition (Submarines); Commander RAN Submarine Squadron; Director, Submarine Warfare Systems Centre	Melbourne Private Correspondence	Australia
18 Jun 2020 27 Apr 2021	**Sweden Anon #2** [redacted]	Private Correspondence Private Correspondence	Sweden
04 Nov 2021	**Mr Steve Ludlam** – previously CEO ASC, Australia. Also previously President of Submarines, Rolls-Royce plc, UK	Private Correspondence	Australia
06 July 2022	**Mr Andrew Johnson** – previously Engineering Director of the RAN Submarine Warfare System Centre; previously Director of Computer Science Corporation's Australian and NZ, Defence and Communications Division; previously CEO Tenix Defence Systems.	Private Conversation	Australia

Appendix 3 – Illustration of Australian defence industry through an analysis of contract data

Introduction

An analysis of the contracts placed by the Australian Department of Defence (DoD) and the Defence Materiel Organisation (DMO) has been undertaken in support of this research. This analysis has been undertaken over two separate data sets and the results collated into a single result. The data sets cover the following agencies and periods:

- Department of Defence – from 01 July 2007 to 30 June 2021
- Defence Materiel Organisation – from 01 July 2007 until the disbandment of the DMO on 30 June 2015

The data has been accessed from the official record at www.austender.gov.au, stored on separate spread sheets representing the DoD and the DMO and collated to provide a consolidated result.

The period 01 July 2007 to 30 June 2021 represents a total of 439,106 individual contractual records with a combined value of $352,594,258,997.01. Data covering contracts placed in financial years prior to 01 July 1997 is not available on Austender.

Methodology

Each contract has been assigned as a single line within an Excel spreadsheet and comprises the following information:

- Contract start, end and award dates
- A description of the contracted goods or services
- A category description for those contracted goods or services
- Name of the contracting entity
- The value of the contract in Australian dollars

Data in the spreadsheets have been sorted according to contract start data. Contracts have been analysed by Australian financial year (that is 01 July to 30 June), with each contract assigned as a single data point for the entire value of the contract according to the stated start date.

This type of analysis does not take cash flow associated with each contract into account as that information is not available. Each separate contract does represent a commitment on the part of the Government to spend money and the trends that are evident within this analysis will manifest themselves in some form in any subsequent cash flow analysis.

The primary avenue for categorisation of the contract is the description of contracted goods or services. Where this description may not be conclusive the category description for those goods or services has been used.

The following analyses have been conducted:

- By Acquisition, Sustainment or Other with the following descriptions applying to each:
  - Acquisition –
    - New capabilities
    - Significant upgrades to existing capabilities (for example, the FFG upgrade (FFG UP) project that upgraded sensors, fire control and weapons capabilities)
    - Missile, torpedoes, and other ammunition purchases
    - Facilities associated with the introduction of the above
    - Consulting services associated with the above where these can be identified
  - Sustainment –
    - Maintenance, including the procurement of minor items such as pumps or values, and other maintenance-related consumable items such as paint.
    - Fuels and oils associated with operational platforms, but not when associated with bases and garrisons (for example, the provision of gas supplies for the normal operating of a defence facility).
    - Uniform and other forms of military clothing, but not gym or other sporting clothing
    - Medical supplies and equipment, but not the provision of health services to military personnel
    - Facilities associated with the above where these can be identified
    - Consulting services associated with the above where these can be identified
  - Other – any contract that cannot be categorised as either Acquisition or Sustainment. The Other category may therefore contain contracts for acquisition and/or sustainment but the presentation of contract data in the Austender records does not allow this determination to be made.

- By country/region from where the ultimate control is exercised. In some cases, this has required the tracing of ownership back through multiple jurisdictions. The selected categories are:
    - Australia
    - United States of America
    - Europe
    - United Kingdom
    - Other – as countries that do not fall specifically into any of the above categories.
- Foreign Military Sales:
    - FMS acquisition activities
    - FMS sustainment activities
    - FMS other activities
- By combinations of the above.

Assumptions

The following assumptions have been made in respect of this analysis:

- That the Austender data represents a true and complete account of the contracts placed by the Australian DoD and the DMO for the period under review.

Limitations

The following limitations are stated with respect to this analysis:

- The analysis conducted is for prime contracts placed by the DoD and the DMO and does not show the effects of placement of sub-contracts by any of these Prime Contractors. Any sub-contracts will impact on the flow of Commonwealth money following contract placement and may affect the location of where work is actually undertaken. Sub-contract information would provide additional information on where economic benefits of the DoD and DMO spend are realised but this information is not publicly available across the entire data set.

In spite of the limitations as stated above, the analysis contained herein does provide a valid view of defence industry activity within Australia as:

- This is **A view** of the contracts awarded by the DOD and DMO during the period under analysis. It is not the only view.

- This is a complete data set for contracts placed by the DoD and the DMO during the period July 2007 – June 2021 and as reported at www.austender.gov.au
- The data shows the commitment for the flow of money from the Australian Government into the commercial sector.
- The extended timeframe for the analysis acts to minimise the effects of treating each contract as a single data point as the amount of money being contracted into the industry by the DoD and DMO is finite and fully described within the data used for this analysis.
- The money can only be spent once.
- As the total contracted amounts are finite, and are completely reported and accessed through Austender, underlying trends become visible over time.

Figure 40 below tracks the overall activity within the Australian defence industry by showing how the percentage value of defence contracts placed in Australia has changed since 1970. Three significant aspects of government policy and the domestic defence industry that relate to operational sovereignty can be discerned from this graph. First, the implementation of government policies as stated in the 1987 *Defence of Australia* resulted in a dramatic upturn in the percentage of defence work contracted into Australia. Second, this percentage has steadily declined since 2005, with a corresponding increase in the use of Foreign Military Sales (FMS) and other mechanisms direct to the US Government. The latter trend is consistent with government policies for off-the-shelf procurements and increased interoperability with the US military. Third, there has been a steady widening of the difference between that contracted in Australia and that contracted to DO-DC companies. As Figure 40 highlights, the latest data shows that only 10% is contracted to these entities.

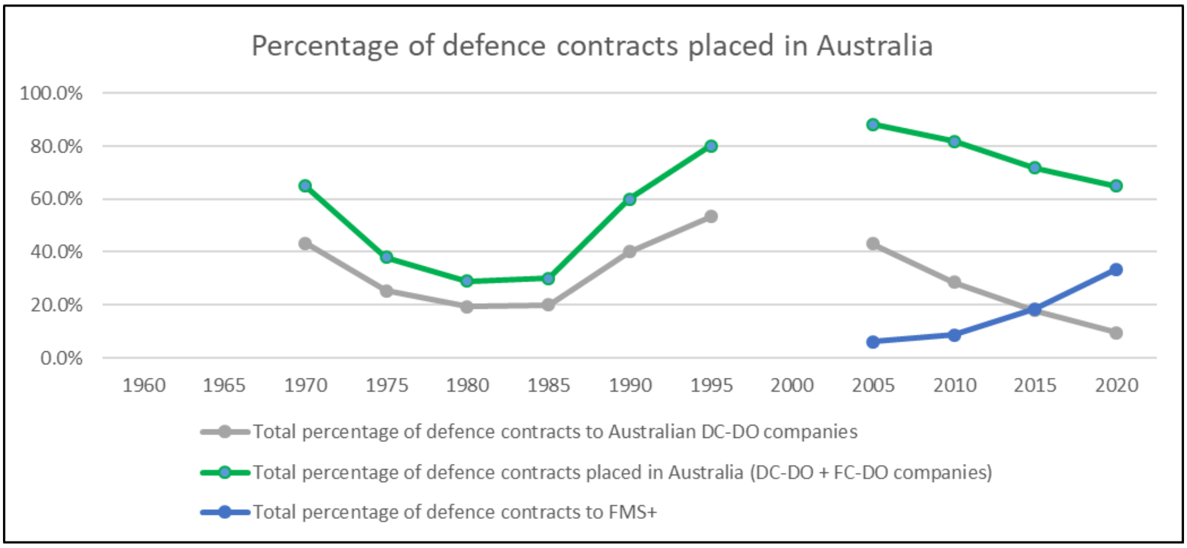


Figure 40. Percentage of defence contracts placed in Australia (and Foreign Military Sales) between 1970 and 2020[12]

The graph at Figure 41 delves more deeply into the domestic defence industry by showing the percentage of the separate acquisition and sustainment activities that has been contracted by the Department of Defence to Australian DO-DC companies. As for the overall defence industry activity undertaken in Australia at Figure 40, the data clearly shows the increase in domestic acquisition activity in the period associated with the build of the *Collins* class submarines and the *ANZAC* frigates. Publicly available government data shows a significant and ongoing decline from the period commencing 2005. The decline from the observed peak in 1995 includes changes in the Australian defence industry landscape, notably the sale of the largest domestic defence industry entities, ADI and Tenix, to foreign companies in 2006 and 2008 respectively, the ongoing acquisition of smaller

[12] The data for the construction of this graph has come from a variety of sources, as follows:

- Defence Annual Reports – as cited in Thomson (2006). Also see 1976 Defence White Paper para 37, and 1994 Defence White Paper para 11.5.
- Dibb (2006: 12) – 'By the mid-1990s, some 80 per cent of Defence's expenditure on facilities, equipment, goods and services was being spent in Australia'.
- Data for the period 2005 to 2020 has been obtained from government data at www.austender.gov.au noting that the data for 2005 is actually for 2007/08 as austender data only commenced in 2007. Data for years 2010 and 2015 are the average of the 2009/10 and 2010/11, and 2014/15 and 2015/16, financial years respectively in order to lessen the year-by-year variability.
- Data for the period 1970-1995 for contracts awarded to Australian-controlled companies has been generated by assuming that, prior to the sale of ADI in 1999, 66.6% of the companies operating within Australia were Australian-owned and controlled. This assessment is supported in that DO-DC companies comprised approximately 66.6% of the total involvement in *Collins* class Australian Industry Involvement. It is acknowledged that this determination may conflate value and volume but, in the absence of any other measure, is considered reasonable.
- FMS+ describes all activity direct to the United States Government, whether through Foreign Military Sales (FMS) or other payment mechanisms (such as for the F-35 Joint Strike Fighter, or the P-8 Poseidon Maritime Patrol Aircraft.

Australia defence companies by offshore interests, and the increasing use of FMS as highlighted in Figure 40.

Figure 41 dramatically captures the changes in the Australian defence activity. The following conclusions can be drawn from this data. First, the peak period in the 1990s coincides with government policy to develop and construct key strategic platforms in Australia, including *Collins*, *Adelaide* and *Anzac* frigates, and the Jindalee Over-the-Horizon Radar Network. With respect to defence industrial sovereignty, and by extension to operational sovereignty, these policies were successful in building both the actual and potential domestic capability within DO-DC companies. Second, the contribution of Australian DO-DC companies in acquisition has dramatically declined in the period since 2005. The ability of Australian industry to 'harness the leading-edge Australian innovation and technological expertise that can provide unique capability advantages for the Australian Defence Force' (Defence, 2016: 10) is therefore questionable.

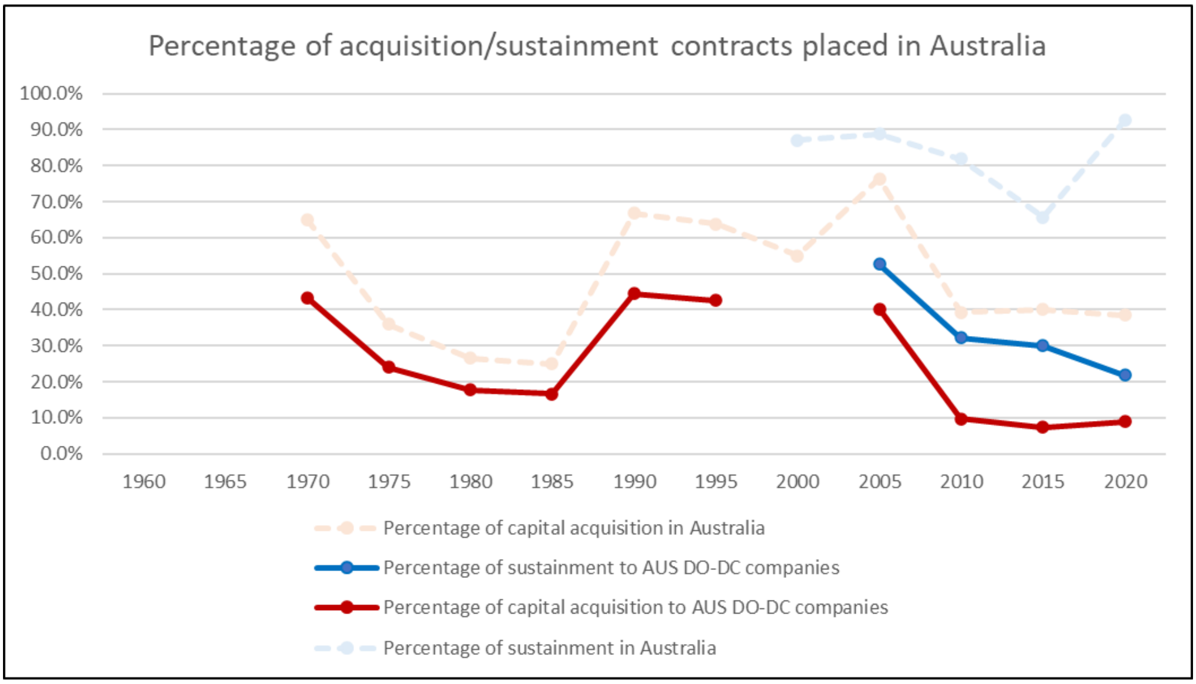


Figure 41. Percentage of acquisition and sustainment contracts placed with Australian owned and controlled companies between 1970 and 2020

Third, the percentage by value of contracts awarded to Australian DO-DC companies for sustainment has also declined in the period from 2005. The vast majority of sustainment contracts are therefore awarded to foreign-controlled companies. Whilst government policy extols the 'vital contribution to defence capability provided by Australian defence industry' (Defence, 2016: 20), it is clear that the progressive transfer of substantial elements of that industry during this period to entities controlled from foreign locations has fundamentally impacted the structure of the domestic industry. Australian companies typically no longer have the size and scope to undertake the prime contractor role for large acquisition or sustainment projects (Kalms and Williams, 2019), and are clearly not preferred for the development or manufacture of systems that might be associated with operational advantage[13], or for the development and maintenance of freedom of action. One final to point to note regarding Figure 41 is that the data represents contracts placed by the Department of Defence and by the DMO, and does not therefore indicate the level of industrial activity that might be conducted by DO-DC firms in a sub-contracting arrangement. However, as sovereignty is associated with authority and control, and as sub-contracted companies have neither, this lack of visibility does not affect any of the conclusions drawn in this thesis.

[13] A small number of exceptions to this general statement do exist. The development of advanced phased array radar capabilities by CEA Technologies is one such example.

References

#1, AUS Anon. 2018a. Interview with anonymous Australian coorporate person – 02 November 2018 at Brindabella Park, Canberra. edited by Graeme Dunk.

#1, Sweden Anon. 2019. Interview with Anonymous Swedish Corporate personnel - 09 October 2019 at Sydney Convention Centre, Sydney. edited by Graeme Dunk.

#1, UK Anon. 2018b. Interview with Anonymous senior, retired British Military Officer - 15 November 2018 at Watchfield, Oxfordshire. edited by Graeme Dunk.

#2, Sweden Anon. 2020. Private correspondence with Anonymous Swedish Corporate person - 18 June 2020. edited by Graeme Dunk.

#3, AUS Anon. 2019. Notes from telephone conversation with anonymous Australian scientific person - 06 June 2019. edited by Graeme Dunk.

#4, AUS Anon. 2019. Interview with anonymous Australian corporate person - 08 October 2019 at Sydney Convention Centre, Sydney. edited by Graeme Dunk.

#5, AUS Anon. 2019. Interview with anonymous Australian corporate person – 07 November 2019 at Hilton Hotel, Adelaide. edited by Graeme Dunk.

#5, AUS Anon. 2022. Private correspondence with Australian corporate person dated 01 February 2022. edited by Graeme Dunk.

(India), Ministry of Commerce & Industry. 2020. Consolidated FDI Policy (Effective from October 15, 2020). edited by Department for Promotion of Industry and Internal Trade. New Delhi: Ministry of Commerce & Industry.

Abramowicz, Dawid, & Malgorzata Stępniewska. 2020. "Public Investment Policy as a Driver of Changes in the Ecosystem Services Delivery by an Urban Green Infrastructure." *Quaestiones Geographicae* 39 (1):5-18. doi: 10.2478/quageo-2020-0001.

Affairs, Ministry for Foreign. 2000. Swedish Arms Exports and Strategic Export Controls in 1999. Stockholm: Ministry for Foreign Affairs.

Affairs, Ministry for Foreign. 2004. Sweden's cooperation in the EuroAtlantic Partnership Council (EAPC) and Partnership for Peace (PfP). Stockholm: Ministry for Foreign Affairs.

Agius, Christine. 2011a. "Transformed beyond recognition? The politics of post-neutrality." *Cooperation and Conflict* 46 (3):370-395.

Agius, Christine, & Christine Agius. 2006. *Social Construction of Swedish Neutrality: Challenges to Swedish Identity and Sovereignty*. ProQuest Ebook Central: Manchester University Press.

Agius, Christine, & Karen Devine. 2011b. "'Neutrality': A really dead concept?' A reprise." *Cooperation and Conflict* 46 (3):265-284.

Albers, Michael J. 2015. "Infographics and Communicating Complex Information." In *Design, User Experience, and Usability: Users and Interactions. DUXU 2015. Lecture Notes in Computer Science, vol 9187*, edited by A Marcus, 267-276. Cham: Springer International Publishing.

Aldred, Ken. 2011. "Defence: Avoiding another Collins-class submarine fiasco." *Newsweekly*, 20 August 2011. http://newsweekly.com.au/article.php?id=4887.

Allison, Melissa. 2002. "Bank One purchase final; Nortrop talks to submaker." *Chicago Tribune*, 08 June 2002. Accessed 02 June 2020. https://www.chicagotribune.com/news/ct-xpm-2002-06-08-0206080392-story.html.

Amao, Olufemi. 2011. *Corporate Social Responsiblity, Human Rights and the Law*. Abingdon, Oxon: Routledge.

Andersson, Jan Joel. 2015. "The Race to the Bottom: Submarine proliferation and international security " *Naval War College Review* 68 (1):12-29.

Andren, Nils. 1976. "The Security and Defence of Sweden." *RUSI* 121 (2):23-32.

Anonymous. 2016. "Sweden - Defense Industry." GlobalSecurity.org, Last Modified 10 June 2016, accessed 02 May 2020. https://www.globalsecurity.org/military/world/europe/industry-se.htm.

Archives, The National. 2019. "Cooperation, competition and testing." https://www.nationalarchives.gov.uk/cabinetpapers/themes/co-operation-competition-testing.htm.

Arena, Mark V., Obaid Younossi, Kevin Brancato, Irv Blickstein, & Clifford A. Grammich. 2008. A Macroscopic Examination of the Trends in U.S. Military Aircraft Costs over the Past Several Decades. Santa Monica, CA: RAND Corporation.

Armstrong, Robert. 1979. Minute from Sir Robert Armstrong to Prime Minister Margaret Thatcher (Ref A0801 dated 29 November 1979) regarding Future United Kingdom Defence Policy. Online: Margaret Thatcher Foundation.

ASC. 2016. "Transitioning Industry to a Multi-Class Submarine Fleet." Submarine Institute of Australia Conference, Canberra.

ASC. 2018. Submission to Senate Foreign Affairs, Defence and Trade Legislation Committee Inquiry into Defence Amendment (Sovereignty Naval Shipbuilding) Bill 2018. Online: Australian Parliament House.

Aselius, Gunnar. 2005. "Swedish Strategic Culture after 1945." *Cooperation and Conflict: Journal of the Nordic International Studies Association* 40 (1):25-44. doi: 10.1177/0010836705049732.

Association, American Psychological. 2023. "APA Dictionary of Psychology: circumplex." American Psychological Association, accessed 28 March 2023. https://dictionary.apa.org/circumplex.

Association, Historic Naval Ships. 2008. "HMS HAJEN." Historic Naval Ships Association, accessed 01 May 2020. https://archive.hnsa.org/ships/hajen.htm.

Augustine, Norman R. 1997. "Reshaping an Industry: Lockheed Martin's Survival Story." *Harvard Business Review* (May-June 1997).

Australia, SAAB. 2018. Saab to Deliver Updated Ship Control System to Collins Class Submarines. Online: SAAB.

Australia, Standards. 2009. AS/NZS ISO 31000:2009. Risk management - Principles and guidelines. Sydney: Standards Australia.

Australia, Submarine Institute of. 2008. Keeping Australia's Option Open in Constrained Strategic Circumstances: The Future Underwater Warfare Capacity. Lyneham, ACT: Submarine Institute of Australia.

Ayson, Robert. 2010. "Australia's defense policy: medium power, even bigger ambitions?" *The Korean Journal of Defense Analysis* 22 (2):183-196. doi: 10.1080/10163271003744447.

Backlund, Karin, & Madelene Sandstrom. 1996. *The Intergation of Acquired Companies Into the Defence Industry. Experiences from Western Europe*. Online: Diane Publishing Company.

Bailes, Alyson J. K. 2012. "The Nordic Countries from War to Cold War - and Today." *Scandinavian Journal of History* 37 (2):156-163. doi: 10.1080/03468755.2012.665665.

Barrie, Chris. 2006. "Defence industry policy." In *Growth 57- The Business of Defence - Sustaining Capability*, edited by CEDA, 20-25. Melbourne: CEDA.

Barrie, Chris. 2018. Interview with Admiral (ret) Chris Barrie, AC – 01 November 2018 at Australian National University, Canberra. edited by Graeme Dunk.

Barrinha, Andre. 2010. "Moving towards a European Defence Industry? The Political Discourse on a Changing Reality and its Implications for the Future of the European Union." *Global Society* 24 (4):467-485. doi: 10.1080/13600826.2010.508340.

Bateman, Sam. 2011. "Perils of the Deep: The Dangers of Submarine Proliferation in the Seas of East Asia." *Asian Security* 7 (1):61-84. doi: 10.1080/14799855.2011.548213.

Baylis, John. 2005. "British Nuclear Doctrine: The 'Moscow Criterion' and the Polaris Improvement Programme." *Contemporary British History* 19 (1):53-65. doi: 10.1080/1361946042000303855.

Beazley, Kim. 1985. Defence Ministerial Statement - 17 September 1985. edited by House of Representatives Official Hansard. Canberra: Commonwealth of Australia.

Beazley, Kim. 1986. Defence Ministerial Statement - 14 October 1986. edited by House of Representatives Official Hansard. Canberra: Commonwealth of Australia.

Beazley, Kim. 1987a. Defence Budget 1987-88 Ministerial Statement - 08 October 1987. edited by House of Representatives Official Hansard. Canberra: Commonwealth of Australia.
Beazley, Kim. 1987b. Defence Policy - Paper and Ministerial Statement - 19 March 1987. edited by House of Representatives Official Hansard. Canberra: Commonwealth of Australia.
Beazley, Kim. 1989a. Ministerial Statement - Defence Industry - Official Hansard No. 166, 10 May 1989. edited by House of Representatives. Canberra: Commonwealth of Australia.
Beazley, Kim. 1989b. Oberon Submarine Refits. Canberra: Office of the Minister for Defence.
Beazley, Kim. 2009. "White Paper Then and Now: Returning to Self-Reliance as a Labor Leit-Motif." *Security Challenges* 5 (4):59-74.
Beazley, Kim. 2018. Kim Beazley on the US alliance and Australia's defence and international security. In *The Strategist Selections*. Canberra: Australian Strategic Policy Institute.
Beazley, Kim. 2019. Telephone Interview with His Excellency the Hon Kim Beazley, AC – 16 July 2019. edited by Graeme Dunk.
Becker, John, Shaun Cookinham, Shawn Goode, David Rhodes, Mark Wasilewski, & Samuel Winograd. 2011. "Submarine combat systems engineering project capstone project." Masters of Science in Systems Engineering, Naval Postgraduate School (NPS-SE-11-005).
Bekkers, F, M. Butter, E. Anders Eriksson, E. Frinking, K. Hartley, D. Hoffmans, M. Leis, M. Lundmark, H. Masson, A. Rensma & G. Willemsen. 2009. Development of a European Defence Technological and Industrial Base. TNO Report: Final. Delft, The Netherlands: TNO.
Belin, Jean, Keith Hartley, Sophie Lefeez, Hilmar Linnenkamp, Martin Lundmark, Helene Masson, Jean-Pierre Maulny, & Alessandro R. Ungaro. 2017. Defence Industrial Links between EU and US. Paris: Armament Industry European Research Group.
Bell, Michael. 1994. "Defence Industry Privatization: The British Case." *Colloquium* 1994.
Bellais, Renaud, & Renelle Guichard. 2006. "Defense Innovation, Technology Transfers and Public Policy." *Defence and Peace Economics* 17 (3):273-286. doi: 10.1080/10242690600645274.
Bennhold, Katrin. 2019. "A European Army? The Germans and Dutch Take a Small Step." *The New York Times (online)*, 20 February 2019. Accessed 16 June 2019. https://www.nytimes.com/2019/02/20/world/europe/germany-defense-spending-european-army.html.
Beraud-Sudreau, Lucie, Alexandra Marksteiner, Diego Lopes Da Silva Nan Tian, Alexandra Kuimova, Pieter D. Wezeman & Siemon T. Wezeman. 2020. Mapping the International Presence of the World's Largest Arms Companies. In *SIPRI Insights on Peace and Security*. Stockholm: Stockholm International Peace Research Institute.
Berg, Eiki, & Ene Kuusk. 2010. "What makes sovereignty a relative concept? Empirical approaches to international society." *Political Geography* 29 (1):40-49.
Bergman, Annika. 2004. "Post-Cold War Shifts in Swedish and Finnish Security Policies: The compatibility of non-alignment and participation in EU led conflict prevention " The European Union and Conflict Resolution, University of Uppsala, 13-18 April 2004.
Bergmann, Kym. 2014. "Subs divide: tale of two companies." *The Australian*, 31 May 2014. Accessed 27 September 2019. https://www.theaustralian.com.au/national-affairs/policy/subs-divide-tale-of-two-companies/story-e6frg8yo-1226936449970.
Besch, Sophia. 2019. The European Commission in EU Defense Industrial Policy. Brussels: Carnegie Europe.
Bieler, Andreas. 2000. *Globalisation and Enlargement of the European Union: Austrian and Swedish Social Forces in the Stuggle over Membership*. ProQuest Ebook Central: Taylor & Francis Group.
Bildt, Carl. 2007. Statement of Government Policy in the Parliamentary Debate on Foreign Affairs, Wednesday 14 February 2007. Stockholm: Government Offices of Sweden.
Bildt, Carl. 2008. Statement of Government Policy in the Parliamentary Debate on Foreign Affairs. Statement by the Minister for Foreign Affairs, 13 February 2008. edited by Ministry for Foreign Affairs. Stockholm: Government Offices of Sweden.

Bildt, Carl. 2010. Statement of Government Policy in the Parliamentary Debate on Foreign Affairs. Statement by the Minister for Foreign Affairs, 17 February 2010. edited by Ministry for Foreign Affairs. Stockholm: Government Offices of Sweden.

Bildt, Carl. 2014. Statement of Government Policy in the Parliamentary Debate on Foreign Affairs. Statement by the Minister for Foreign Affairs, 19 February 2014. edited by Ministry for Foreign Affairs. Stockholm: Government Offices of Sweden.

Bishop, Bronwyn. 1998. Defence and Industry Strategic Policy Statement. Canberra: Department of Defence.

Bisley, Nick. 2018. "Australia's Rules-Based International Order." *Australian Outlook*, 27 July 2018. http://www.internationalaffairs.org.au/australianoutlook/australias-rules-based-international-order/.

Bitzinger, Richard A. 1994. "The Globalization of the Arms Industry: The Next Proliferation Challenge." *International Security* 19 (2):170-198.

Bitzinger, Richard A. 2003a. "Chapter 1: The Rise and Fall of Second-Tier Arms Producers." *The Adelphi Papers* 43 (356):11-38. doi: 10.1080/714027877.

Bitzinger, Richard A. 2003b. "Chapter 3: Towards a Brave New Arms Industry." *The Adelphi Papers* 43 (356):63-79. doi: 10.1080/714027876.

Bitzinger, Richard A. 2009. "The European Defense Industry in the 21st Century: Challenges and Responses." In *The Modern Defense Industry. Political, Economic and Technological Issues*, edited by Richard A. Bitzinger. Santa Barbara, CA: ABC-CLIO.

Bitzinger, Richard A. 2011. "China's Defense technology and Industrial Base in a Regional Context: Arms Manufacturing in Asia." *Journal of Strategic Studies* 34 (3):425-450. doi: 10.1080/01402390.2011.574985.

Bitzinger, Richard A. 2015a. "Comparing Defense Industry Reforms in China and India." *Asian Politics & Policy* 7 (4):531-553.

Bitzinger, Richard A. 2015b. "Defense Industries in Asia and the Technonationalist Impulse." *Contemporary Security Policy* 36 (3):453-472. doi: 10.1080/13523260.2015.1111649.

Bitzinger, Richard A. 2015c. New ways of thinking about the global arms industry: Dealing with 'limited autarky'. In *Strategic Insights*. Canberra, ACT: Australian Strategic Policy Institute.

Bitzinger, Richard A. 2015d. "New ways of thinking about the global arms industry: dealing with 'limited autarky'." *The Strategist*, 05 November 2019. https://www.aspistrategist.org.au/new-ways-of-thinking-about-the-global-arms-industry-dealing-with-limited-autarky/.

Bitzinger, Richard A. 2016. "Reforming China's defense industry." *Journal of Strategic Studies* 39 (5-6):762-789. doi: 10.1080/01402390.2016.1221819.

Bitzinger, Richard A. 2017. "Asian arms industries and impact on military capabilities." *Defence Studies* 17 (3):295-311. doi: 10.1080/14702436.2017.1347871.

Blackham, Jeremy. 2018. Interview with VADM (ret) Sir Jeremy Blackham KCB - 14 November 2018 at Institute of Directors, Pall Mall, London. edited by Graeme Dunk.

Blaikie, Norman. 2010. *Designing Social Research: The Logic of Anticipation*. 2nd ed. Cambridge, UK: Polity Press.

Boles, Tracey. 2007. "Final bids in for Devonport as three vie for subs yard." *Sunday Express*. Accessed 10 January 2022. https://www.pressreader.com/uk/sunday-express-1070/20070429/282548718833748.

Brabin-Smith, Richard. 2006. "Priorities for defence innovation in Australia." In *Growth 57: The Business of Defence - Sustaining Capability*, edited by CEDA, 26-31. Melbourne: CEDA.

Brabin-Smith, Richard. 2012. "Force Expansion and Warning Time." *Security Challenges* 8 (2):33-47.

Brabin-Smith, Richard. 2013. Contingencies and Warning Time. In *The Centre of Gravity Series*. Canberra, ACT: ANU Strategic & Defence Studies Centre.

Brabin-Smith, Richard. 2023. "A framework for assessing Australia's defence strategic review." *The Strategist*, 10 March 2023. https://www.aspistrategist.org.au/a-framework-for-assessing-australias-defence-strategic-review/.
Brauer, Jurgen. 2007. "Arms Industries, Arms Trade, and Developing Countries." In *Handbook of Defense Economics. Defense in a Globalized World*, edited by Todd Sandler, & Keith Hartley, 973-1015. Elsevier.
Braw, Elisabeth. 2017. "Germany Is Quietly Building a European Army Under Its Command." *FP*, 22 May 2017. https://foreignpolicy.com/2017/05/22/germany-is-quietly-building-a-european-army-under-its-command/.
Briggs, Peter. 2012. "Australia's Future Submarine Capability - Research and Development Implications." *Headmark* 143:45-51.
Briggs, Peter. 2015a. "The pros and cons of building the first submarine overseas." *The Strategist*, 09 October 2015. https://www.aspistrategist.org.au/the-pros-and-cons-of-building-the-first-submarine-overseas/.
Briggs, Peter. 2015b. "Submarines: Build them here, and build 12." *the interpreter*, 19 October 2015. https://www.lowyinstitute.org/the-interpreter/submarines-build-them-here-and-build-12.
Briggs, Peter. 2015c. Why Australia should build its own submarines. In *Strategic Insights*. Canberra: Australian Strategic Policy Instittite.
Briggs, Peter. 2019. Interview with RADM (ret) Peter Briggs, AO CSC – 21 November 2019 at RACV Club, Melbourne. edited by Graeme Dunk.
Briggs, Peter. 2021. Private correspondence with RADM (ret) Peter Briggs, AO CSC – 04 March 2021 edited by Graeme Dunk.
Britz, Malena. 2010. "The Role of Marketization in the Europeanization of Defense Industry Policy." *Bulletin of Science, Technology & Society* 30 (3):176-184. doi: 10.1177/0270467610367492.
Broadberry, Stephen, & Nicholas Crafts. 2003. "UK productivity performance from 1950 to 1979: a statement of the Broadberry-Crafts view." *Economic History Review* LVI (4):718-735.
Brodin, Katarina, Kjell Goldmann, & Chistian Lange. 1968. "The Policy of Neutrality: Official Doctrines of Finland and Sweden." *Cooperation and Conflict* 3 (1):18-51. doi: 10.1177/001083676800300102.
Brommesson, Douglas. 2018. "'Nordicness' in Swedish foreign policy – from mid power internationalism to small state balancing?" *Global Affairs* 4 (4-5):391-404. doi: 10.1080/23340460.2018.1516116.
Brookes, Joseph. 2022. "Marles 'open minded' on buying, not building, new subs." *Department of Defence*, 09 August 2022. https://www.innovationaus.com/marles-open-minded-on-buying-not-building-new-subs/.
Bullock, Heather, & John N. Lavis. 2019. "Understanding the supports needed for policy implementation: a comparative analysis of the placement of intermediaries across three mental health systems." *Health Research Policy and Systems* 17. doi: 10.1186/s12961-019-0479-1.
Burns, Alex, & Ben Eltham. 2014. "Australia's Strategic Culture: Constraints and Opportunities in Security Policymaking." *Contemporary Security Policy* 35 (2):187-210. doi: 10.1080/13523260.2014.927672.
Byrd, Peter. 1991. "Defence Policy: An Historical Overview and a 'Regime Analysis'." In *British Defence Policy: Thatcher and Beyond*, edited by Peter Byrd. Hemel Hempstead: Philip Allan.
Cairns, Peter. 2006. "Shipbuilidng and Industrial Preparedness." *Canadian Naval Review* 2 (3):16-23.
Campbell, Kurt M. 2004. "The end of alliances? Not so fast." *The Washington Quarterly* 27 (2):151-163.
Canas, Jesus A., & Miguel Gonzalez. 2016. "British Navy unloading weapons from nuclear submarine in Gibraltar." *El Pais*, 28 July 2016. Accessed 13 January 2020. https://elpais.com/elpais/2016/07/28/inenglish/1469693613_221922.html.

Carolan, Victoria. 2014. "Submarines and the Baltic." In *WW1 at Sea*, 83-98. ProQuest Ebook Central: Oldcastle Books.
Carr, Andrew. 2014. "Is Australia a middle power? A systemic impact approach." *Australian Journal of International Affairs* 68 (1):70-84. doi: 10.1080/10357718.2013.840264.
Carr, Andrew. 2016. "The Politics of the 2016 Defence White Paper." *Security Challenges* 12 (1):1-17.
Carr, Richard. 2003. "Paxman Submarine Engines." Paxmanhistory.org, Last Modified 13 May 2021, accessed 04 December 2021. https://www.paxmanhistory.org.uk/paxsubs.htm.
Cato, Douglas H. 1997. "Ambient Sea Noise in Australian Waters." Fifth International Congress on Sound and Vibration, Adelaide.
Caverley, Jonathon, & Ethan B. Kapstein. 2012. "Arms Away. How Washington Squandered Its Monopoly on Weapon Sales." *Foreign Affairs* 91 (5):125-132.
Cerna, Lucie. 2013. The Nature of Policy Change and Implementation: A Review of Different Theoretical Approaches Geneva: Organisation for Economic Co-operation and Development.
Chalmers, Malcolm. 2002. "The new activism: UK defence policy since 1997." *New Economy* 9 (4):206-211.
Chambers, Margaret. 2000. Cockatoo Island Dockyard. A Guide to the Records. edited by National Archives of Australia. Canberra: National Archives of Australia.
Channon, Paul. 1986. Vickers Shipbuilding and Engineering Ltd. Statement by the Secretary of State for Trade and Industry and President of the Board of Trade (HC Deb 07 March 1986). edited by House of Commons. London: Hansard.
Cheung, Tai Ming. 2016. "Innovation in China's Defense Technology Base: Foreign Technology and Military Capabilities." *Journal of Strategic Studies* 39 (5-6):728-761. doi: 10.1080/01402390.2016.1208612.
Cheung, Tai Ming. 2017. "Commentary on Asian arms industries and impact on military capabilities." *Defence Studies* 17 (3):312-316. doi: 10.1080/14702436.2017.1345279.
Chin, Warren A. 2004. *British Weapons Acquisition Policy and the Futility of Reform*. Aldershot, Hants: Ashgate Publishing Limited.
Christensen, Tommy P. 2019. "If Peace Is under Threat: Sweden's Defence Policy." *European Security & Defence*, 09 May 2019. https://euro-sd.com/2019/05/articles/13190/if-peace-is-under-threat-swedens-defence-policy/.
Christiansson, Magnus. 2010. "Solidarity and Sovereignty: The Two-Dimensional Game of Swedish Security Policy." *Connections : The Quarterly Journal* 10 (1):1-22.
Clark, Brent. 2020. "The IP Paradox." *News*, 08 October 2020. https://www.aidn.org.au/news/9291028.
Clarke, Michael. 2008. "The Overdue Defence Review: Old Questions, New Answers." *The RUSI Journal* 153 (6):4-10. doi: 10.1080/03071840802669991.
Clegg, Will. 2012. "Don’t Get Smart with Me! Sustaining the ADF in the Age of the Strategic Reform Program." *Security Challenges* 8 (2):49-80.
Clevstrom, Jenny, & Mike Winnerstig. 2003. Defence Technology as Security Policy. Defence R&T as a Security Policy Tool in Europe, France, and the United KIngdom. In *Defence Analysis*. Stockhom: FOI Swedish Defence Research Agency.
Coles, John, Paul Greenfield, & Arthur Fisher. 2012. Study into the Business of Sustaining Australia's Strategic Collins Class Submarine Capability. Canberra: Commonwealth of Australia.
Coles, John, Paul Greenfield, Arthur Fisher, & Steve Davies. 2014. Study into the Business of Sustaining Australia's Strategic Collins Class Submarine Capability. Progress review - March 2014. Canberra: Commonwealth of Australia.
Coles, John, Paul Greenfield, Michael Spark, & Heather Savage. 2016. Study into the Business of Sustaining Australia's Strategic Collins Class Submarine Capability. Beyond Benchmark - May 2016. Canberra: Commonwealth of Australia.

Commission, European. 2004. Mergers: Commission clears acquisition of HDW by ThyssenKrupp. Brussels: European Commission.
Commission, European. 2009. Defence industry. Comprehensive sectoral analysis of emerging competences and economic activities in the European Union. Brussels: European Commission.
Commission, Industry. 1994. Defence Procurement. Canberra: Australian Government Publishing Service.
Commission, Swedish Defence. 2017. Resilience - the total defence concept and the development of civil defence 2021-2025. edited by Ministry of Defence. Stockholm: Ministry of Defence, Sweden.
Commission, Swedish Defence. 2018. The Swedish Defence Commission's white book on Sweden's Security Policy and the Development of the Military Defence 2021-2025. Stockholm: Swedish Defence Commission.
Committee, Defence Review. 1982. A Minister and Department of Defence Support. Interim Report of the Defence Review Committee (Utz Review). Canberra: Australian Government Publishing Service.
Committee, House of Commons Defence. 1987. Implementing the Lessons of the Falklands Campaigm, Fourth Report in Session 1986-87; 6 May 1987. London: Her Majesty's Stationery Office.
Committee, House of Commons Defence. 1998a. Defence - Fifth Special Report of Session 1997-98. London: House of Commons.
Committee, House of Commons Defence. 1998b. Defence - Seventh Report of Session 1997-98. Aspects of Defence Procurement and Industrial Policy. London: House of Commons.
Committee, House of Commons Defence. 1998c. Defence - Sixth Special Report of Session 1997-98. Government Response to the Eight Report from the Committee, Session 1997-98. London: House of Commons.
Committee, House of Commons Defence. 2006a. Defence - Fourth Report of Session 2006-07. London: www.parliament.uk.
Committee, House of Commons Defence. 2006b. The Defence Industrial Strategy. Seventh Report of Session 2005-06. London: The Stationery Office Limited.
Committee, House of Commons Defence. 2006c. The Defence Industrial Strategy: Government Response to the Committee's Seventh Report of Session 2005-06. Eighth Special Report of Session 2005-06. London: The Stationery Office Limited.
Committee, House of Commons Defence. 2006d. Memorandum from BAE Systems. Defence - Fourth Report of Session 2006-07. London: House of Commons.
Committee, House of Commons Defence. 2010. Defence Equipment 2010. Sixth Report of Session 2009-10. London: House of Commons.
Committee, House of Commons Defence. 2013. Defence Acquisition. Seventh Report of Session 2012-13. London: House of Commons.
Committee, National Security. 1997. Memorandum JH97/0130 - Progress Report on the New Submarine Project. Online: National Archives of Australia.
Committee, Senate Economics References. 2014. Future of Australia's naval shipbuilding industry. Future submarines. Canberra: Commonwealth of Australia.
Communities, Council of the European. 1992. Treaty on European Union. Luxembourg: Office for Official Publication of the European Communities.
Components, Essentra. 2022. "Under analysis: the Astute-class submarine." Essentra PLC, accessed 12 April 2022. https://www.essentracomponents.com/en-gb/news/news-articles/under-analysis-the-astute-class-submarine.
Conroy, Pat. 2019. Interview with Pat Conroy, MP – 21 February 2019 at Parliament House, Canberra. edited by Graeme Dunk.

Cook, Nick, Duncan Macrae, & Alexander Szander. 1999. "BAe-Marconi merger derails European consolidation train." *Interavia*, 10-12.

Cooksey, Robert J. 1986. Review of Australia's Defence Exports and Defence Industry. Canberra: Australian Government Publishing Service.

Cornish, Paul, & Andrew Dorman. 2015. "Complex security and strategic latency: the UK Strategic Dfence and Security Review 2015." *International Affairs* 91 (2):351-370.

Costello, Peter. 1996. Commonwealth Debt - Official Hansard No. 206, 7 May 1996 edited by House of Representatives. Canberra: Commonwealth of Australia.

Costello, Peter. 1997. Budget Strategy - Official Hansard No. 215, 1 September 1997. edited by House of Representatives. Canberra: Commonwealth of Australia.

Costello, Peter. 2006a. "Budget Speech 2006-07." Australian Government, Last Modified 09 May 2006, accessed 09 October 2018. https://www.budget.gov.au/2006-07/speech/html/Speech.htm.

Costello, Peter. 2006b. Foreign Investment Proposal: Thales Australia Holdings Pty Ltd - Acquisition of Remaining 50 Per Cent Interest in ADI Limited. Canberra: Foreign Investment Review Board.

Council, National Research. 2008. *Managing Materials for a Twenty-first Century Military*. Washington, DC: The National Academies Press.

Crowe, David. 2022. "Marles to prioritise strategic need over local construction in boat decisions." *The Sydney Morning Herald*, 08 August 2022. Accessed 03 April 2023. https://www.smh.com.au/politics/federal/marles-to-prioritise-strategic-need-over-local-construction-in-boat-decisions-20220807-p5b7v7.html.

CSS. 2013. The Stuggle for Sweden's Defence Policy. In *CSS Analysis in Security Policy*. Zurich: Center for Security Studies.

Curran, Robert. 2013. "RAN Torpedo Factory Neutral Bay." borclaud @ tpg.com.au, Last Modified 30 April 2013, accessed 06 May 2021. http://users.tpg.com.au/borclaud/ranad/about_rantf.html.

Dalsjö, Robert. 2013. "From Self-Sufficiency to Solidarity: The Transformation of Sweden's Defence and Security Policies." NIDS International Symposium on Security Affairs. Strategic management of military capabilities : seeking ways to foster military innovation, Tokyo.

Dalsjö, Robert. 2014. "The hidden rationality of Sweden's policy of neutrality during the Cold War." *Cold War History* 14 (2):175-194. doi: 10.1080/14682745.2013.765865.

Dalsjö, Robert, & Michael Jonsson. 2017. National Defence and the Baltic Sea Region: Sweden's New Focus edited by Swedish Defence Research Agency. Stockholm: Swedish Defence Research Agency.

Davies, Andrew. 2014a. "Graph of the week: learning about learning." *The Strategist*, 07 August 2014. https://www.aspistrategist.org.au/graph-of-the-week-learning-about-learning/.

Davies, Andrew & Ian Mackenzie. 2014b. "Project complexity and systems integration: constructing the London 2012 Olympics and Paralympics games." *International Journal of Project Management* 32 (5):773-790.

De Spiegeleire, Stephan, Karlijn Jans, Mischa Sibbel, Khrystyna Holynska & Deborah Lassche. 2019. "Implementing defence policy: a benchmark-“lite”." *Defence & Security Analysis* 35 (1):59-81.

Dean, Peter J. 2020. "The internal risks to Australias' new defence strategy." *The Strategist*, 14 August 2020. https://www.aspistrategist.org.au/the-internal-risks-to-australias-new-defence-strategy/.

Defence, Department of. 1972a. Australian Defence Review. Canberra: Australian Government Publishing Service.

Defence, Department of. 1976a. Australian Defence. Canberra: Australian Government Publishing Service.

Defence, Department of. 1987a. The Defence of Australia 1987. Canberra: Australian Government Publishing Service.
Defence, Department of. 1988a. Cabinet Memorandum No. 5528 - Progress Report on the New Submarine - 14 March 1988. Online: National Archives of Australia.
Defence, Department of. 1988b. Cabinet Memorandum No. 5962 - Progress Report on the New Submarine - June 1988. Online: National Archives of Australia.
Defence, Department of. 1989a. Cabinet Memorandum 6742 - Progress Report on the New Submarine Project - June 1989. Online: National Archives of Australia.
Defence, Department of. 1989b. Cabinet Memorandum No. 6200 - Progress Report on the New Submarine Project - December 1988. Online: National Archives of Australia.
Defence, Department of. 1990. Cabinet Memorandum 7442 - Progress Report on the New Submarine Project - June 1990. Online: National Archives of Auustralia.
Defence, Department of. 1991a. Cabinet Memorandum 7820 - Progress Report on the New Submarine Project - December 1990. Online: National Archives of Australia.
Defence, Department of. 1991b. Cabinet Memorandum 8254 - Progress Report on the New Submarine Project to 30 June 1991. Online: National Archives of Australia.
Defence, Department of. 1991c. Force Structure Review. Canberra: Department of Defence.
Defence, Department of. 1992. Cabinet Memorandum 685 - Progress Report on the New Submarine Project to 30 June 1992. Online: National Archives of Australia.
Defence, Department of. 1993a. Cabinet Memorandum 1027 - Progress Report on the New Submarine Project to 31 December 1992 - 25 May 1993. Canberra: National Archives of Australia.
Defence, Department of. 1993b. Cabinet Memorandum 1348 - Progress Report on the New Submarine Project to 30 June 1993 - 18 November 1993. Canberra: National Archives of Australia.
Defence, Department of. 1993c. Strategic Review 1993. Canberra: DPUBS.
Defence, Department of. 1994a. Cabinet Memorandum 1832 - Progress Report on the New Submarine Project to 30 June 1994 - 16 November 1994. Canberra: National Archives of Australia.
Defence, Department of. 1994b. Defending Australia. Canberra: Australian Government Publishing Service.
Defence, Department of. 1995a. Cabinet Memorandum 2472 - Progress Report on the New Submarine Project to 30 June 1995 - 29 November 1995. Canberra: National Archives of Australia.
Defence, Department of. 2000. Defence 2000: Our Future Defence Force. Canberra: Commonwealth of Australia.
Defence, Department of. 2009a. ADDP 00.1 Command and Control. Canberra: Commonwealth of Australia.
Defence, Department of. 2009b. Defending Australia in the Asia Pacific Century: Force 2030 (Defence White Paper 2009). Canberra: Commonwealth of Australia.
Defence, Department of. 2010a. Building Defence Capability: A Policy for a Smarter and More Agile Defence Industry Base. Canberra, ACT: Commonwealth of Australia.
Defence, Department of. 2013. Defence White Paper 2013. Canberra: Commonwealth of Australia.
Defence, Department of. 2014. Defence Capability Development Handbook 2014. Canberra: Commonwealth of Australia.
Defence, Department of. 2016a. 2016 Defence Industry Policy Statement. Canberra, ACT: Commonwealth of Australia.
Defence, Department of. 2016b. 2016 Defence White Paper. Canberra, ACT: Commonwealth of Australia.
Defence, Department of. 2016c. Capability Life Cycle Detailed Design - Executive Summary. Canberra: Department of Defence.

Defence, Department of. 2018a. 2018 Defence Industrial Capability Plan. Canberra: Commonwealth of Australia.
Defence, Department of. 2020a. 2020 Defence Strategic Update. Canberra: Department of Defence.
Defence, Department of. 2020b. 2020 Force Structure Plan. Canberra: Department of Defence.
Defence, Department of. 2021a. Defence Test & Evaluation (T&E) Strategy. Canberra: Department of Defence.
Defence, Joint Committee on Foreign Affairs and. 1977a. Industrial support for defence needs and allied matters. edited by The Parliament of the Commonwealth of Australia. Canberra: The Commonwealth Government Printer.
Defence, Minister for. 1979a. Cabinet Minute. Decision No. 10450. Submission No. 3577 - Australia Strategic Analysis and Defence Policy Objectives - 1979 (ASADPO 79). edited by Cabinet. Online: National Archives of Australia.
Defence, Minister for. 1980a. Cabinet Minute. Foreign Affairs and Defence Committee. Decision No. 12644 (FAD). Submission No. 4317 - Australia Strategic Analysis and Defence Policy Objectives - 1979 (Supplementary Submission). edited by Foreign Affairs and Defence Committee. Online: National Archives of Australia.
Defence, Minister for. 1985a. New Construction Submarine. Cabinet Submission No. 2816. edited by Cabinet Office. Canberra: National Archives of Australia.
Defence, Minister for. 1987b. Cabinet Decision No. 9580. Submission No. 4870 - New Submarine Project. Online: National Archives of Australia.
Defence, Minister of. 1958. Defence White Paper, 1958 (draft). 05 February 1958. Cabinet Memorandum CAB/129/91/30. London: The National Archives.
Defence, Ministry of. 2015. Sweden's Defence Policy 2016 to 2020.
Defence, Ministry of. 2018b. Development of modern total defence. Stockholm: Ministry of Defence, Sweden.
Defence, PMB. 2021b. "Superior Battery Systems for World Class Submariners." PMB Defence, accessed 04 September 2021. https://pmbdefence.com.au/.
Defence, Secretary of State for. 1966. Defence Review: The Statement on the Defence Estimates 1966, Part I. 11 February 1966. Cabinet Memorandum CAB129/124/33. London: The National Archives.
Defence, Secretary of State for. 1971a. RB 211. Note by Secretary of State for Defence. (Cabinet Memorandum CAB 129/156 - 01 Mar - 07 Apr 1971). London: The National Archives.
Defence, Secretary of State for. 1971b. Statement on the Defence Estimates 1971. 26 January 1971 (Cabinet Memoranda 129/155, 01 Jan - 26 Feb 1971). London: The National Archives.
Defence, Secretary of State for. 1972b. Statement on the Defence Estimates 1972. 25 January 1972. (Cabinet Memoranda CAB 129/161 - 06 Jan - 29 Feb 1972). London: The National Archives.
Defence, Secretary of State for. 1973. Statement on the Defence Estimates 1973. 16 January 1973. (Cabinet Memoranda CAB 129/167 - 12 Jan - 20 Feb 1973). London: The National Archives.
Defence, Secretary of State for. 1974a. Statement on the Defence Estimates 1974. 21 January 1974. (Cabinet Memoranda CAB 129/174, 15 Jan - 07 Feb 1974). London: The National Archives.
Defence, Secretary of State for. 1975. Statement on the Defence Estimates 1975. 25 February 1975. Cabinet Memorandum C(75) 21. London: The National Archives.
Defence, Secretary of State for. 1976b. Statement on the Defence Estimates 1976. 27 February 1976. Cabinet Memorandum CAB-129-187-22. London: The National Archives.
Defence, Secretary of State for. 1977b. Statement on the Defence Estimates 1977. 31 January 1977. Cabinet Memorandum CAB/129/194/13. London: The National Archives.
Defence, Secretary of State for. 1979b. Statement on the Defence Estimates 1979. 22 January 1979. (Cabinet Memoranda CAB 129/205, . London: The National Archives.
Defence, Secretary of State for. 1980b. Statement on the Defence Estimates 1980. 25 January 1980. (Cabinet Memoranda 129/208, 14 Jan - 25 Apr 1980). London: The National Archives.

Defence, Secretary of State for. 1981a. Introduction to Statement on the Defence Estimates 1981. 16 March 1981. Cabinet Memorandum CAB 129/211/11. London: The National Archives.
Defence, Secretary of State for. 1981b. Statement on the Defence Estimates 1981. 16 March 1981. Cabinet Memorandum CAB 129/211/11. London: The National Archives.
Defence, Secretary of State for. 1981c. The United Kingdom Defence Programme: The Way Forward. London: Her Majesty's Stationery Office.
Defence, Secretary of State for. 1983. Statement on the Defence Estimates 1983. 29 April 1983. Cabinet Memorandum CAB-129-216-11. London: The National Archives.
Defence, Secretary of State for. 1985b. Statement on the Defence Estimates 1985. 25 March 1985. Cabinet Memorandum CAB-129-219-8. London: The National Archives.
Defence, Secretary of State for. 1987c. Statement on the Defence Estimates 1987. 26 March 1987. Cabinet Memorandum CA-129-222-5. London: The National Archives.
Defence, Secretary of State for. 1988c. Statement on the Defence Estimates. 6 April 1988. Cabinet Memorandum CAB-129-224-6. London: The National Archives.
Defence, Secretary of State for. 1989c. Statement on the Defence Estimates 1989. 30 March 1989. (Cabinet Memoranda CAB 129/227 - 30 Mar - 18 Dec 1989). London: The National Archives.
Defence, Secretary of State for. 1994c. Statement on the Defence Estimates 1994. 18 March 1994. Cabinet Memorandum CAB 129-232-4. London The National Archives.
Defence, Secretary of State for. 1995b. Statement on the Defence Estimates 1995. 28 March 1995. Cabinet Memorandum CAB-129-233-6. London: The National Archives.
Defence, Secretary of State for. 1998. Strategic Defence Review. London: Minstry of Defence.
Defence, Secretary of State for. 2002a. The Strategic Defence Review: A New Chapter. London: Ministry of Defence.
Defence, Secretary of State for. 2010b. Equipment, Support and Technology for UK Defence and Security: A Consultation Paper. edited by Ministry of Defence. London: Her Majesty's Stationery Office.
Defence, UK Ministry of. 1974b. DEFCON 15 - Design Rights. Online - Knowledge in Defence Commercial Toolkit: MInistry of Defence.
Defence, UK Ministry of. 1978. Duff Mason Report. London: The National Archives.
Defence, UK Ministry of. 2002b. DEFCON 705 - Intellectual Property Rights - Research and Technology. Online: Ministry of Defence.
Defence, UK Ministry of. 2002c. Defence Industry Policy. London: Ministry of Defence.
Defence, UK Ministry of. 2002d. MoD Launches Defence Technology Centre Initiative. London: UK Ministry of Defence.
Defence, UK Ministry of. 2002e. Towers of Excellence - A MoD Research Initiative. Farnborough: UK Ministry of Defence.
Defence, UK Ministry of. 2003. Delivering Security in a Changing World. Defence White Paper. Norwich: The Stationery Office.
Defence, UK Ministry of. 2005. Defence Industrial Strategy: Defence White Paper. London: Ministry of Defence.
Defence, UK Ministry of. 2007. Intellectual Property - Statement of MOD Policy. Online: Ministry of Defence.
Defence, UK Ministry of. 2011. MOD Defence Conditions Guide. Online - The Commercial Toolkit: Ministry of Defence.
Defence, UK Ministry of. 2012. National Security Through Technology: Technology, Equipment, and Support for UK Defence and Security. London: Her Majesty's Stationery Office.
Defence, UK Ministry of. 2016d. Policy for Assured Capability - DCDS(MilCap)/16/06/10. Whitehall: Ministry of Defence.
Defence, UK Ministry of. 2018c. UK Defence in Numbers. London: Ministry of Defence UK.
Defense, Department of. 1996. Assessing Defense Industrial Capabilities. Washington, D.C.: Department of Defense.

Defense, Department of. 2017. DOD Dictionary of Military and Associated Terms. USA Department of Defense.

Department of State, USA. 2004. Memorandum of Understanding between the Department of Defense of the United States of America and the Department of Defence of Australia for the Cooperative Development, Production, and Support of the Combat System AN/BYG-1 Tactical Subsystem. Washington, DC: Department of State.

Deutch, John. 2001. "Consolidation of the U.S. Defense Industrial Base." *Acquisition Review Quarterly* (Fall 2001):137-150.

Development, Concepts and Doctrine Centre. 2015. Strategic Trends Programme. Future Operating Environment 2035. London: Ministry of Defence.

Development, Concepts and Doctrine Centre. 2018. Global Strategic Trends. The Future Starts Today. London: Ministry of Defence.

Development, Concepts and Doctrine Centre (DCDC). 2014. Joint Doctrine Publication 0-01. UK Defence Doctrine (5th Edition). London: Ministry of Defence.

Devore, Marc R. 2015. "Defying Convergence: Globalisation and Varieties of Defence-Industrial Capitalism." *New Political Economy* 20 (4):569-593. doi: 10.1080/13563467.2014.951612.

DeVore, Marc R. 2016. "Reinventing the Arsenal: Defense-Industrial Adaptation in Small States." *The Korean Journal of Defense Analysis* 28 (1):31-48.

DeVore, Marc R. 2017. "Commentary on the value of domestic arms industries: security of supply or military adaptation?" *Defence Studies* 17 (3):242-259. doi: 10.1080/14702436.2017.1347781.

Dib, Viviane, Marco Aurélio Nalon, Nino Tavares Amazonas, Cristina Yuri Vidal, Iván A. Ortiz-Rodríguez, Jan Daněk, Maíra Formis de Oliveira, Paola Alberti, Rafaela Aparecida da Silva, Raíza Salomão Precinoto, & Taciana Figueiredo Gomes. 2020. "Drivers of change in biodiversity and ecosystem services in the cantareira system protected area: A prospective analysis of the implementation of public policies." *Biota Neotropica* 20:1-12. doi: 10.1590/1676-0611-BN-2019-0915.

Dibb, Paul. 1986. Review of Australia's Defence Capabilities. edited by Department of Defence. Canberra: Australian Government Publishing Service.

Dibb, Paul. 2006. "A defence industry development strategy." In *Growth 57: The Business of Defence -Sustaining Capability*, edited by CEDA, 10-19. Melbourne: CEDA.

Dibb, Paul. 2019. "Australia's strategic risks are changing and so must our defence thinking." *The Australian*, 25 November 2019. Accessed 23 September 2021. https://www.theaustralian.com.au/commentary/australias-strategic-risks-are-changing-and-so-must-our-defence-thinking/news-story/744ebdd806b8ebfa8189d6280c9bb2c6.

Dibb, Paul, & Richard Brabin-Smith. 2017. Australia's management of strategic risk in the new era. In *Strategic Insights*. Canberra: Australian Strategic Policy Institute.

Dictionary, Oxford. 2021. "UK English/capability." Lexico.com, accessed 18 July 2021. https://www.lexico.com/definition/capability.

Dixit, Avinash K. & Robert S. Pindyck. 1995. "The Options Approach to Capital Investment." *Harvard Business Review* (May-June 1995):105-115.

Dodd, Mark. 2010. "No-show by subs slammed." *The Australian*, 06 August 2010. Accessed 06 November 2019. https://www.theaustralian.com.au/national-affairs/no-show-by-subs-slammed/news-story/37f0f8fe02c93bac9ded6412086a31a3.

Dogan, Mattei, & John Higley. 2012. "Elites, Crises, and Regimes in Comparative Analysis." *Historical Social Research* 37 (1):269-291.

Dorman, A. 2001. "John Nott and the Royal Navy: The 1981 Defence Review Revisited." *Contemporary British History* 15 (2):98-120. doi: 10.1080/713999409.

Doyle, Suzanne. 2017. "The United States Sale of Trident to Britain, 1977-1982: Deal Making in the Anglo-American Nuclear Relationship." *Diplomacy & Statecraft* 28 (3):477-493. doi: 10.1080/09592296.2017.1347447.

Doyle, Suzanne. 2018. "Perserving the Global Nuclear Order: The Trident Agreements anf the Arms Control Debate, 1977-1982." *The International History Review* 40 (5):1174-1190. doi: 10.1080/07075332.2018.1430047.
Drezner, Jeffrey A., Giles K. Smith, Lucille E. Horgan, Curt Rogers & Rachel Schmidt. 1992. Maintaining Future Military Aircraft Design Capability. Santa Monica, CA: RAND Corporation.
Dube, Line, & Guy Pare. 2003. "Rigor in Information Systems Positivist Case Research: Current Practices, Trends and Recommendations." *MIS Quarterly* 27 (4):597-636.
Dunk, G. A. 1993. "KARIWARA - Australia at the Leading Edge of Towed Array Development." *Maritime Studies* 68:1-6.
Dunk, G. A. 1997. "KARIWARA: A Complex Little Project." In *Defence Project Management - Pitfalls and Pointers Vol2*, edited by A. Hinge, & S. Markowski. Canberra: Australian Defence Studies Centre.
Dunk, Graeme. 1999. "Applied Stealth for Maritime Platforms." *Asian Military Review* 7 (4):23-27.
Dunk, Graeme. 2001a. "2015 : will the submarine continue to be relevant ?" In *Maritime War in the 21st Century*, edited by David Wilson, 241-248. Canberra: Royal Australian Navy Sea Power Centre.
Dunk, Graeme. 2001b. "The Collins combat system." *Asia Pacific Defence Reporter* December/January 2001:14-15.
Dunk, Graeme. 2014a. Evidence provided to Economics References Committee inquiry into the Future of Australia's naval shipbuilding industry - tender process for new supply ships. 21 July 2014, Canberra. Canberra: Official Committee Hansard.
Dunk, Graeme. 2014b. Evidence provided to Economics References Committee inquiry into the Future of Australia's naval shipbuilding industry. 08 October 2014, Newcastle. Canberra: Official Committee Hansard.
Dunk, Graeme. 2015. "Australian defence industry: where to next?" *The Strategist*, 01 May 2015. https://www.aspistrategist.org.au/australian-defence-industry-where-to-next/.
Dunk, Graeme. 2016a. "Australian Defence Industry - Going, Going, Where?" *Asia Pacific Defence Reporter* 42 (7):42-44.
Dunk, Graeme. 2016b. "Defence Industry Policy 2016 - Well-Intentioned but Conflicted." *Security Challenges* 12 (1):139-150.
Dunk, Graeme. 2021. "A sovereign missile capability for Australia is about more than economics." *The Strategist*, 15 April 2021. https://www.aspistrategist.org.au/a-sovereign-missile-capability-for-australia-is-about-more-than-economics/.
Dunk, Graeme A. 2017. "Sovereignty in a resource-constrained environment." 4th Submarine Science, Technology and Engineering Conference 2017, Adelaide.
Dunstall, Harry. 2019. Interview with Harry Dunstall – 30 April 2019 at Fyshwick, ACT. edited by Graeme Dunk.
Dupont, Alan. 2015. "Full Spectrum Defence: Re-thinking the Fundamentals of Australian Defence Strategy." *Analyses*, 13 March 2015. https://www.lowyinstitute.org/publications/full-spectrum-defence-re-thinking-fundamentals-australian-defence-strategy.
Economics, Insight. 2017. Australia's Future Submarine. Getting This Key Capability Right. Insight Economics.
Economist, The. 2017. "A funny kind of neutrality; Sweden, NATO and Russia." *The Economist* 424:35.
Editors, The. 2014. "Submarines: German - Swedish tensions." *The Strategist*, 14 April 2014. https://www.aspistrategist.org.au/submarines-german-swedish-tensions/.
Edmondson, Amy C., & Stacy E. McManus. 2007. "Methodological Fit in Management Field Research." *Academy of Management Review* 32 (4):1155-1179.
Edwards, Peter. 2016. Defence White Papers at 40. In *Strategy*. Canberra: Australian Strategic Policy Institute.

Eisenhardt, Kathleen M. 1989. "Building Theories from Case Study Research." *The Academy of Management Review* 14 (4):532-550.
Eisenhardt, Kathleen M. 1991. "Better Stories and Better Constructs: The Case for Rigor and Comparative Logic." *The Academy of Management Review* 16 (3):620-627.
Eisenhardt, Kathleen M., and Melissa E. Graebner. 2007. "Theory Building from Cases: Opportunities and Challenges." *The Academy of Management Journal* 50 (1):25-32.
Eliasson, Gunnar. 2017. *Visible Costs and Invisible Benefits: Military Procurement as Innovation Policy*. Cham, Switzerland: Springer Nature.
Ericsson, Jorgen. 2003. "The Swedish Submarine Force Centennial." *Naval Forces* 24:3.
Erixon, Lena. 2014. "Interview. Lena Erixon, Director of FMV." *Defence IQ* October 2014.
Etzioni, Amitai. 2016. "Defining Down Sovereignty: The Rights and Responsibilities of Nations." *Ethics & International Affairs* 30 (1):5-20.
Evans, Gareth. 1984. Strategic Basis of Australian Defence Policy Ministerial Statement 10 May 1984. edited by Senate Official Hansard. Canberra: Commonwealth of Australia.
Exchequer, Chancellor of the. 1946. Balance of Payments for 1946. 8 February 1946. Cabinet Memorandum CAB/129/7/53. London: The National Archives.
Exchequer, Chancellor of the. 1980. Public Expenditure: Economic and Monetary Background. Cabinet Memorandum C(80) 4 dated 22 January 1980. (Cabinet Memoranda 129/208, 14 Jan - 25 Apr 1980). London: The National Archives.
Fagersten, Bjorn, August Danielson & Calle Hakansson. 2018. Sweden and European defence cooperation: interests in search of a strategy. In *UIbrief*. Stockholm: Swedish Instiute of International Affairs.
Fausset, Cara Bailey, Samuel Cheng, Alexandra N. Trani, Clayton J. Hutto, Chris R. Hale, Tom McDermott, Molly Nadolski, & Dennis J. Folds. 2017. "Developing a Model of Team Skill Decay." *Proceedings of the Human Factors and Ergonomics Society 2017 Annual Meeting* 61 (1):735-739.
Fawcett, David. 2018. "Defence exports in Australia's national and economic interests." *The Strategist*, 19 April 2018. https://www.aspistrategist.org.au/defence-exports-australias-national-economic-interests.
Feldman, Jonathon Michael. 2013. "A Model of Swedish Security Policy: Deconstructing "the Swedish Paradox"." 17th Annual Conference on Economics and Security, Stockholm, 14 June 2013.
Ferguson, Greg. 2011. "Air Warfare Destroyer." In *The Cost of Defence: ASPI Defence Budget Brief 2011-2012*, edited by Mark Thomson. Canberra: Australian Strategic Policy Institute.
Ferreira-Pereira, Laura C. 2005. "Swedish military neutrality in the post-cold war: 'old habits die hard'." *Perspectives on European Politics and Society* 6 (3):463-489. doi: 10.1080/15705850508438928.
Ferris, Stephen P. 2009. "Identifying measuring and mitigating risk in theatre-strategic and operational planning." *Australian Defence Force Journal* 178:32-47.
Fevolden, Arne Martin & Kari Tvetbraten. 2016. "Defence industrial policy - a sound security strategy or an economic fallacy?" *Defence Studies* 16 (2):176-192. doi: 10.1080/14702436.2016.1169893.
Finance, Department of. 2016. "Past Sales." Department of Finance, Last Modified 04 January 2018, accessed 08 October 2018. https://www.finance.gov.au/property/asset-sales/past-sales.html.
Finance, Department of. 2019. Commonwealth Procurement Rules - 1 January 2019. Canberra: Department of Finance.
Fisher, Josie, & Ingrid Bonn. 2007. "International strategies and ethics." *Management Decision* 45 (10):1560-1572. doi: 10.1108/00251740710837960.
Fitzgibbon, Joel. 2008. Minister for Defence Congratulates BAE Systems Australia on Acquistion of Tenix Defence. Canberra: Office of the Minister for Defence.

Flyvbjerg, Bent. 2006. "Five Misunderstandings About Case-Study Research." *Qualitative Inquiry* 12 (2):219-245.
FMV. 2020. General Terms and Conditions. The Swedish Defence Materiel Administration. Stockholm: FMV.
FMV. 2022. "Procurement." FMV, accessed 27 March 2022. https://www.fmv.se/english/procurement/.
Fontenoy, Paul E., & Spencer C. Tucker. 2007. "Early Submarines." In *Submarines: An Illustrated History and Their Impact*. ProQuest Ebook Central: ABC-CLIO.
Force, HQ New Zealand Defence. 2017. New Zealand Defence Doctrine (NZDDP-D) (Fourth Edition). Wellington: New Zealand Defence Force.
Fordham, Benjamin O. 2004. "A Very Sharp Sword - The Influence of Military Capabilities on American Decisions to Use Force." *The Journal of Conflict Resolution* 48 (5):632-656.
Forsberg, Tuomas. 2013. "The rise of Nordic defence cooperation: a return to regionalism?" *International Affairs* 89 (5):1161-1181.
Forsberg, Tuomas, & Tapani Vaahtoranta. 2001. "Inside the EU, outside NATO: Paradoxes of Finland's and Sweden's post-neutrality." *European Security* 10 (1):68-93. doi: 10.1080/09662830108407483.
Foster, S. Thomas, & Charles R. Franz. 1995. "Assessing process re-engineering impacts through baselining." *Benchmarking for Quality Management & Technology* 2 (3):4-16.
Foster, Thomas A. 2008. "Keeping Submarine Supply Chain on an Even Keel." *SupplyChainBrain*, 16 December 2008. https://www.supplychainbrain.com/articles/4437-keeping-submarine-supply-chain-on-an-even-keel.
Fox, Bernard, Michael Boito, John C. Graser, & Obaid Younossi. 2004. Test and Evaluation Trends and Costs for Aircraft and Guided Weapons. Santa Monica, CA: RAND Corporation.
Francelino, Josiane de Araujo , Ligia Maria Soto Urbina, Andre´ Tosi Furtado, & Milton de Freitas Chagas Jr. 2019. "How public policies have shaped the technological progress in the Brazilian aeronautics industry: Embraer case." *Science and Public Policy* 46 (6):787-804.
Franchi, Peter La. 2000. "Australian Government Nationalization Strategy for Sub Company to Proceed." *Defense Daily International* 1 (13):1.
Fraser, Malcolm. 1982. Ministry and Department Changes. Canberra: Office of the Prime Minister.
Freedman, Lawrence. 1986. "The Case of Westland and the Bias to Europe." *International Affairs* 63 (1):1-19.
Friedman, Norman. 2004. "World Naval Developments: New System Could Be Key To Network-Centric Undersea Warfare." *Proceedings* 130 (6):1216.
Fruehling, Stephan. 2009. *A History of Australian Strategic Policy since 1945*. Canberra: Defence Publishing Service.
Fruehling, Stephan. 2014a. "Australian defence policy and the concept of self-reliance." *Australian Journal of International Affairs* 68 (5):531-547. doi: 10.1080/10357718.2014.899310.
Fruehling, Stephan. 2014b. *Defence Planning and Uncertainty*. Abingdon, Oxon: Routledge.
Fruehling, Stephan. 2016. "Wrestling with commitment: Geography, alliance institutions and the ANZUS Treaty." In *Australia's American Alliance*, edited by Peter J. Dean, Stephan Fruehling, and Brendan Taylor, 13-35. Carlton: Melbourne University Press.
Fruehling, Stephan. 2017. Sovereign Defence Industry Capabilities, Independent Operations and the Future of Australian Defence Strategy. In *The Centre of Gravity Series*, edited by Andrew Carr. Canberra: Strategic & Defence Studies Centre.
Fullan, Michael. 2011. Choosing the wrong drivers for whole system reform. In *Seminar Series Paper*: Centre for Strategic Education.
Fusil, Eric. 2007. "A Century of Growing Stealth in Submarines." UDT 2007 - Undersea Defense Technology, Naples.
Gaddis, John Lewis. 1998. "History, grand strategy and NATO enlargement." *Survival* 40 (1):145-151.

Garud, Raghu. 1997. "On the Distinction between Know-How, Know-Why, and Know-What." *Advances in Strategic Management* 14:81-101.
Gates, Robert M. 2011. The Security and Defense Agenda (Future of NATO). Online: U.S. Department of Defense.
Gee, Oliver. 2014. "'Baffling' Swedish raid on German sub makers." *The Local.se*, 15 April 2014. Accessed 30 May 2020. https://www.thelocal.se/20140415/defence-expert-baffled-by-kockums-raid.
Gelenbe, Erol, Andrew Tilbrook, & Richard Vinter. 2007. "Editorial: Introduction to the Special Issue." *The Computer Journal* 50 (6):630-631.
Gholz, Eugene, & Harvey M. Sapolsky. 1999a. "Restructuring the American Defense Industry." In *The Changing Dynamics of U.S. Defense Spending*, edited by Leon V. Sigal, 153-176. Westport, CT: Praegar.
Gholz, Eugene, & Harvey M. Sapolsky. 1999b. "Restructuring the U.S. Defense Industry." *International Security* 24 (3):5-51.
Gholz, Eugene, Andrew D. James, & Thomas H. Speller. 2018. "The second face of systems integration: An empircal analysis of support chains to complex product systems." *Research Policy* 47 (8):1478-1494. doi: 10.1016/j.respol.2018.05.001.
Gibbert, Michael, Winfried Ruigrok, & Barbara Wicki. 2008. "What Passes as a Rigorous Case Study?" *Strategic Management Journal* 29 (13):1465-1474.
Gilbert, Lord. 1997. Defence Policy. Statement by The Minister of State, Ministry of Defence to House of Lords debate, 06 November 1997. edited by House of Lords. London: Hansard.
Gilli, Andrea & Mauro Gilli. 2018. "Why China Has Not Caught Up Yet: Military-Technological Superiority and the Limits of Imitation, Reverse Engineering, and Cyber Espionage." *International Security* 43 (3):141-189.
Goldrick, James. 2016. "Why does Australia need submarines at all?" *The Conversation*, 28 April 2016. https://theconversation.com/why-does-australia-need-submarines-at-all-58575.
Gould, David. 2013. Current and future submarines and the significant skilling and workforce challenges. Speech to the ADM Congress 2013, 12 February 2013. Not published.
Gould, David. 2018. Interview with David Gould, CB - 16 November 2018 at Army & Navy Club, St James Square, London. edited by Graeme Dunk.
Government, HM. 1977. Aircraft and Shipbuilding Industries Act 1977. edited by HM Government. Online: http://www.legislation.gov.uk/.
Government, HM. 2010. Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review. London: Her Majesty's Stationery Office.
Government, HM. 2015. National Security Strategy and Strategic Defence and Security Review 2015. A Secure and Prosperous United Kingdom. London: Her Majesty's Stationery Office.
Government, HM Government & USA. 1958. Agreement between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of the United States of America for Co-operation on the Uses of Atomic Energy for Mutual Defence Purposes, Washington, July 3, 1958. London: Her Majesty's Stationery Office.
Gow, David, Mark Milner, & Richard Norton-Taylor. 1999. "The gremlin spoiling a City fairy tale." *The Guardian*, 20 January 1999. Accessed 07 August 2020. https://www.theguardian.com/business/1999/jan/20/22.
Gray, Colin S. 2008. "Coping With Uncertainty: Dilemmas of Defense Planning." *Comparative Strategy* 27 (4):324-331. doi: 10.1080/01495930802358414.
Green, Nicole Forrest. 2017. "French sonar: world-class technology." Australian Naval Institute, Last Modified 18 June 2017, accessed 10 January 2023. https://navalinstitute.com.au/french-sonar-world-class-technology/.
Greer, Jed, & Kavaljit Singh. 2019. "A Brief History of Transnational Corporations." *Empire*. http://dsc.du.ac.in/wp-content/uploads/2020/03/asfdr.pdf.

Group, Defence Science and Technology. 2021. "Ping Intercept Passive Ranging System (PIPRS)." Department of Defence, accessed 10 May 2021. https://www.dst.defence.gov.au/innovation/ping-intercept-passive-ranging-system-piprs.
Grove, Eric. 2002. "The Falklands War and British defense policy." *Defense and Security Analysis* 18 (4):307-317. doi: 10.1080/1475179022000024448.
Grumman, Northrop. 2012. Northrop Grumman to Supply Platform Management System for UK Royal Navy's Next Astute-Class Submarine. Online: Northrop Grumman.
Gustavsson, Per M., Asa Bjork, Christoffer Brax, & Tomas Planstedt. 2004. "Towards Service Orientated Simulations." 2004 Falls Simulation Interoperability Workshop, Orlando, FL.
Haass, Richard. 2017. "World Order 2.0: The Case for Sovereign Obligation." *Foreign Affairs* 96 (1):2-9.
Haass, Richard N. 2006. Sovereignty and globalisation. Accessed 4 April 2016.
Haass, Richard N. 2020. "Rethinking national and global supply chains." *The Strategist*, 15 December 2020. https://www.aspistrategist.org.au/rethinking-national-and-global-supply-chains/.
Hagelin, Bjorn. 1986. "Nordic Armaments and Military Dependencies." *Current Research on Peace and Violence* 9 (1/2):13-27.
Hagelin, Bjorn, & Peter Wallensteen. 1992. "Understanding Swedish Military Expenditures." *Cooperation and Conflict* 27 (4):415-441.
Hall, Peter, & Stefan Markowski. 1994. "Defence Industry and Local Content Requirements." In *Fostering and Indigenous Defence Industry? Defence Industry Policy after the 'Price Review'*, edited by Graeme Cheeseman, 51-76. Canberra: Australian Defence Studies Centre.
Hall, Peter, Stefan Markowski, & Robert Wylie. 2010. "Government policy. Defence procurement and defence industry." In *Defence Procurement and Industry Policy. A small country perspective*, edited by Peter Hall Markowski, & Robert Wylie. London: Routledge.
Hamer. 1982. Advisory Committee on Management and Operation of Williamstown Naval Dockyard. Senate Official Hansard No.93, 18 March 1982. edited by Senate. Canberra: Commonwealth of Australia.
Hansard. 1984. Response by Mr Brian Howe, Minister for Defence Support, to Discussion of Matter of Public Importance brought by Mr John Spender. edited by House of Representatives. Canberra: Commonwealth of Australia.
Hansard, Committee. 1999. Evidence to the Senate Foreign Affairs, Defence and Trade References Committee on the Proposed Sale of Australian Defence Industries by Mr Shepherd, Mr Malcor, Mr Dangleterre, and Vice Admiral Walls, 25 October 1999. edited by Australian Senate. Canberra: Commonwealth of Australia.
Harboe-Hansen, Hans. 1998. "Viking -- The future Nordic submarine?" *Naval Forces*, 30-35.
Harrison, Michael. 1999. "Blair 'furious' over BAe's pounds 7bn takeover of Marconi." *Independent*, 20 January 1999. Accessed 07 August 2020. https://www.independent.co.uk/news/business/blair-furious-over-baes-pounds-7bn-takeover-of-marconi-1075087.html.
Hartley, Keith. 2006. "Defence Industrial Policy in a Military Alliance." *Journal of Peace Research* 43:473-489.
Hartley, Keith. 2007. "The Arms Industry, Procurement and Industrial Policies." In *Handbook of Defense Economics. Defense in a Globalized World*, edited by Todd Sandler, & Keith Hartley, 1139-1176. Elsevier.
Hartley, Keith. 2008. "Collaboration and European Defence Industrial Policy." *Defence and Peace Economics* 19 (4):303-315. doi: 10.1080/10242690802221585.
Hartley, Keith. 2010. "The UK defence industrial base." In *The Economics of Defence Policy: A New Perspective*, edited by Keith Hartley. ProQuest Ebook Central: Routledge.
Hartley, Keith. 2011. "Creating a European Defence Industrial Base." *Security Challenges* 7 (3):95-111.

Hartley, Keith. 2012. "Company Survey Series: 1: BAE Systems PLC." *Defence and Peace Economics* 23 (4):331-342. doi: 10.1080/10242694.2011.593353.

Hartley, Keith. 2016. "UK defence inflation and cost escalation." *Defence and Peace Economics* 27 (2):184-207. doi: 10.1080/10242694.2015.1093757.

Hartley, Keith, & Todd Sandler. 2003. "The Future of the Defence Firm." *KYKLOS* 56 (3):361-380.

Hassel, Anke. 2015. "Public Policy." In *International Encyclopedia of the Social & Behavioral Sciences*, edited by James D. Wright, 569-575. Amsterdam: Elsevier.

Hauschildt, Peter, Lars Larsson, & Ezio Bonsignore. 2003. "Air-Independent Propulsion for submarines." *Military Technology* 27 (8/9):97-103.

Hause, Matthew, & Jon Hallett. 2016. "MB-PLE to Plan and Track Submarine Configurations." 26th Annual INCOSE International Symposium (IS 2016), Edinburgh, Scotland, 18-21 July 2016.

Hawke, Robert J. L. 1984. Changes to the Ministry and Departmental Arrangements. Canberra: Office of the Prime Minister.

Hayward, K. 2001. "The Globalisation of defence industries." *Survival* 43 (2):115-132. doi: 10.1093/survival/43.2.115.

Hayward, Keith. 2009. "The Globalization of Defence Industries." In *The modern defense industry: political, economic and technological issues*, edited by Richard A. Bitzinger. Santa Barbara, CA: Praeger Security International.

Healey, Denis. 1966. Defence Review. Statement by Mr Denis Healey, The Secretary of State for Defence, 22 February 1966. . edited by House of Commons. Online: Hansard Commons.

Heidenkamp, Henrik, John Louth, & Trevor Taylor. 2011. The Defence Industrial Ecosystem. Delivering Security in an Uncertain World. In *Whitehall Report*. London: Royal United Services Institute.

Heidenkamp, Henrik, John Louth, & Trevor Taylor. 2013. *The Defence Industrial Triptych. Government as Customer, Sponsor and Regulator*, *Whitehall Paper 81*. Abingdon: Routledge Journals.

Helleiner, Eric. 2021. "The Return of National Self-Sufficiency? Excavating Autarkic Thought in a De-Globalizing Era." *International Studies Review* viaa092:1-25.

Hellyer, Marcus. 2020. "Supply chain security: lessons from Australia's defence industry." *The Strategist*, 09 April 2020. https://www.aspistrategist.org.au/supply-chain-security-lessons-from-australias-defence-industry/.

Hellyer, Marcus. 2021. Cracking the missile matrix. In *Special Report*. Canberra: Australian Strategic Policy Institute.

Hellyer, Marcus, & Andrew Nicholls. 2022. 'Impactful projection': long-range strike options for Australia. Canberra: Australian Strategic Policy Institute.

Hennessy, Peter, & James Jinks. 2015. *The Silent Deep: The Royal Navy Submarine Service since 1945*. London: Penguin Books.

Hensel, Nayantara. 2010. "Can Industry Consolidation Lead to Frater Efficiencies? Evidence from the U.S. Defense Industry." *Business Economics* 45 (3):187-203. doi: 10.1057/be.2010.15.

Hilditch, Peter J. 1990. "Defence procurement and employment: the case of UK shipbuilding." *Cambridge Journal of Economics* 14:483-496.

Hill, Richard. 2000. Medium Power Strategy Revisited. Canberra: Royal Australian Navy Sea Power Centre.

Hiranandani, G. M. 2004. *Transition to Eminence. The Indian Navy 1976-1990*. New Delhi: Ministry of Defence (Navy).

History, Portland. 2021. "Admiralty Gunnery Establishment." Portlandhistory.co.uk, accessed 05 December 2021. https://www.portlandhistory.co.uk/admiralty-gunnery-establishment.html.

Hitchins, Derek. 2000. "Getting to Grip with Complexity or a Theory of Everything Else." In. http://systems.hitchins.net/index.html: Professor Derek Hitchins. http://systems.hitchins.net/profs-stuff/profs-books/getting-to-grip-with-comple/index.html (accessed 04 March 2018).

Hitchins, Derek. 2007. *Systems Engineering. A 21st Century Systems Methodology*. Edited by Andrew P. Sage, *Wiley Series in Systems Engineering and Management*. Chichester: John Wiley & Sons, Ltd.

Hitchins, Derek. 2009. "What Are the General Principles Applicable to Systems?" *Insight* 12 (4):59-63. doi: 10.1002/inst.200912459.

Hoff, Russell V. 2007. "Analysis of Defense Industry Consolidation Effects on Program Acquisition Costs." Master of Business Administration, Naval Postgraduate School.

Holcomb, James F. 2001. "Strategic Risk." In *Guide to Strategy*, edited by Joseph R. Cerami, & James F. Holcomb, Jr, 187-202. US Army War College.

Holcomb, James F. 2012. "Managing Strategic Risk." In *US Army War College Guide to National Security Issues. Volume 1: Theory of War and Strategy*, edited by Jr J. Boone Bartholomees, 67-78. Carlisle Barracks, PA: US Army War College.

Holland, Peter. 2014. "Reforming and restructuring the Australian workplace: a study of the Williamstown Naval Dockyard 1983–1993." *Labor History* 55 (3):251-270. doi: 10.1080/0023656X.2014.907973.

Horobin, Peter. 2018. Interview with Peter Horobin MBE – 22 February 2018 at Hyatt Hotel, Canberra. edited by Graeme Dunk.

Horobin, Peter. 2019a. "Personal Communication: SWUP and SWSC dated 07 July 2019." 08 July 2019.

Horobin, Peter. 2019b. "Personal Communication: SWUP and SWSC dated 21 July 2019." 21 July 2019.

House, The White. 2021. Remarks by President Biden, Prime Minister Morrison of Australia, and Prime Minister Johnson of the United Kingdom Announcing the Creation of AUKUS. Washington, DC: The White House.

House, The White. 2023. FACT SHEET: Trilateral Australia-UK-US Partnership on Nuclear-Powered Submarines. Washington, D.C: The White House.

Howard, Carl. 2011. "Recent Developments in Submarine Vibration Isolation and Noise Control." 1st Submarine Science Technology and Engineering Conference, Adelaide.

Howard, John. 1996. Ministerial Statements - 1996 Progress report to the People - Official Hansard No. 210, 11 December 1996. edited by House of Representatives. Canberra: Commonwealth of Australia.

Howe, Brian. 1983. Australia's Defence Industries Ministerial Statement. edited by House of Representatives. Canberra: Commonwealth of Australia.

Hultqvist, Peter. 2017a. Speech by Minister for Defence Peter Hultqvist at AFCEA TechNet Europe conference 2017. edited by Ministry of Defence. Stockholm: Ministry of Defence, Sweden.

Hultqvist, Peter. 2017b. Speech by Minister for Defence Peter Hultqvist at Atlantic Council's conference Securing Northern Europe – Bridging the Baltic Sea, North Atlantic and the Arctic. edited by Ministry of Defence. Stockholm: Ministry of Defence, Sweden.

Hultqvist, Peter. 2020. Minister for Defence Peter Hultqvist's keynote speech at Chatham House Security and Defence Conference, 12 March 2020. edited by Ministry of Defence. Stockholm: Ministry of Defence, Sweden.

Hunt, John. 1979. Incoming brief: Cabinet Secretary's incoming brief for the new PM (The Budget). 04 May 1979. Online: Margaret Thatcher Foundation.

IISS. 1999. "British Aerospace and GEC-Marconi. A new armaments giant." *Strategic Comments* 5 (1):1-2.

Ikegami, Masako. 2013. "The end of a 'National' Defence Industry?: Impacts of globalization on the Swedish defence industry." *Scandinavian Journal of History* 38 (4):436-457. doi: 10.1080/03468755.2013.823536.

INCOSE. 2015. *Systems Engineering Handbook. A Guide for System Life Cycle Processes and Activities*. 4th ed. Hoboken, NJ: Wiley.

Indigenisation, Directorate of. 2015. Indian Naval Indigenisation Plan (INIP) (2015-2030). edited by Integrated Headquarters of Ministry of Defence (Navy). New Delhi.
Industry, Australian Business Defence. 2014. ABDI Submission to Senate Economics References Committee Inquiry into the future of Australian Shipbuilding Industry Canberra: Australian Senate.
Industry, Australian Business Defence. 2017. Submission to the Senate Economic References Committee into the Future of Australia's Shipbuilding Industry. Canberra: Australian Senate.
Intelligence, Directorate of. 1970. Intelligence Report. Soviet Policy and the 1967 Arab-Israeli War Langley, VA: Central Intelligence Agency.
Ireland, Gavin. 2007. Beyond Artful: Government and Industry Roles in Britain's Future Submarine Design, Build and Support. In *Whitehall Report*. London: Royal United Services Institute.
ISO/IEC/IEEE. 2015. ISO/IEC/IEEE 15288: Systems and software engineering - System life cycle processes. Geneva: ISO/IEC/IEEE.
ISSAT. 2021. "Security Sector Integrity." Geneva Centre for Security Sector Governance, accessed 19 September 2021. https://securitysectorintegrity.com/defence-management/defence-policy/.
Jancy, Scott. 2018. "Using Patterns to Make Sense of Your World." *ART + marketing*, 07 April 2023. https://artplusmarketing.com/using-patterns-to-make-sense-of-your-world-d8034650bd98.
Jenkins, Tom. 2013. Canada First: Leveraging Defence Procurement Through Key Industrial Capabilities. Report of the Special Adviser to the Minister of Public Works and Government Services.
Jensen, Eric Talbot. 2015. "Cyber Sovereignty: The Way Ahead." *Texas International Law Journal* 50 (2):275-304.
Jermalavičius, Tomas, Piret Pernik & Martin Hurt. 2014. Comprehensive Security and Integrated Defence: Challenges of implementing whole-ofgovernment and whole-of-society approaches. Tallinn, Estonia: International Centre for Defence Studies.
Jing, Shaoling, Xia Mao & Lijiang Chen. 2019. "An automatic speech discrete labels to dimensional emotional values conversion method." *IET Biometrics* 8 (2).
Johnman, Lewis, & Hugh Murphy. 2001. "The rationalisation of warship building in the United Kingdom, 1945-2000." *The Journal of Strategic Studies* 24 (3):107-127. doi: 10.1080/01402390108437847.
Johnson, Andrew. 2010. "Lessons from the Oberon Weapons Update Programme (SWUP)." Submarine Conference, Western Australia, November 2010.
Johnson, Andrew. 2022. "Personal Communication with Andrew Johnson regarding SWSC/SWUP - 06 July 2022." 06 July 2022.
Jones, Ian S.F, Douglas H. Cato, L.J. Hamilton, Sandra Tavener, & B.D. Scott. 1995. Site Survey for an Ocean Engineering Project in Spencer Gulf November 1993. Melbourne: DSTO Aeronautical and Maritime Research Laboratory.
Jones, Rhys. 2012. "Britain relaxes influence over defence firm QinetiQ." *Business News*, 30 March 2010. https://uk.reuters.com/article/uk-qinetiq/britain-relaxes-influence-over-defence-firm-qinetiq-idUKBRE82T0CR20120330.
Jones, Seth G. 2006. "The Rise of a European Defense." *Political Science Quarterly* 121 (2):241-267.
Joubert, P. N. 2006. Some Aspects of Submarine Design Part 2. Shape of a Submarine 2026. Fishermans Bend, VIV: Defence Science and Technology Organisation.
Justice, Ministry of. 1971. Lag (1971:1078) om försvarsuppfinningar (Law (1971: 1078) on Defense Inventions - amended through SFS 2016: 195). Stockholm: Government Offices.
Kalms, Mike, & Chris Williams. 2019. "Why so hollow? Australia's Defence Industry Middle and what to do about it." *KPMG Government and Public Sector*. https://newsroom.kpmg.com.au/hollow-australias-defence-industry-middle/.
Kasdorf, Bruno. 2014. "Military cooperation between the German Army and the Royal Netherlands Army from a German perspective." *Militaire Spectator* 183 (4):199-205.

Kelton, Maryanne. 2005. New Depths in Australia-US Relations? The Collins Class Submarine Project. In *Canberra Papers on Strategy and Defence*. Canberra: Strategic and Defence Studies Centre.

Khan, Anisur Rahman. 2016. "Policy Implementation: Sone Aspects and Issues." *Journal of Community Positive Practices* XVI (3):3-12.

Killen, D. J. 1979a. First Modernised Boat to Rejoin Submarine Fleet. Canberra: Department of Defence.

Killen, D. J. 1979b. New Submarine Systems Centre Unique to RAN. Canberra: Department of Defence.

Killen, D. J. 1982. Defence Minsterial Statement 29 April 1982. edited by House of Representatives. Canberra: Commonwealth of Australia.

Killen, James. 1978. Defence Review. Ministerial Statement 24 October 1978. edited by House of Representatives. Canberra: Commonwealth of Australia.

Kim, Jong Ha. 2014. "A Prerequisite for Resuscitating and Developing Taiwan's Local Defense Industries." *The Korean Journal of Security Affairs* 19 (2):41-69.

King, Tom. 1990. Defence (Options for Change). (HC Deb 25 July 1990 vol 177 cc468-86). Online: Hansard.

King, Warren. 2014. Evidence provided to Economics References Committee inquiry into the Future of Australia's naval shipbuilding industry - tender process for new supply ships. 21 July 2014, Canberra. Canberra: Official Committee Hansard.

Kinnaird, Malcolm, Len Early, & Bill Schofield. 2003. Defence Procurement Review 2003. Canberra: Department of the Prime Minister and Cabinet.

Kirkpatrick, David. 2008. "The UK's Defence Industrial Strategy." *Defence Studies* 8 (3):286-310. doi: 10.1080/14702430802252545.

Kogut, Bruce, & Nalin Kulatilaka. 2001. "Capabilities as Real Options." *Organizational Science* 12 (6):744-758.

Korb, Lawrence J. 1996. "Merger Mania: Should the Pentagon Pay for Defense Industry Restructuring?" *Brookings*, 01 June 1996. https://www.brookings.edu/articles/merger-mania-should-the-pentagon-pay-for-defense-industry-restructuring/.

Kordova, Sigal, & Shimon Fridkin. 2021. "Risk Management for Defense SoS in a Complex, Dynamic Environment." *Sustainability* 13 (4):1789- 1806.

Krasner, Stephen D. 1988. "Sovereignty: "An Institutional Perspective"." *Comparative Political Studies* 21 (1):66-94.

Krasner, Stephen D. 1995. "Compromising Westphalia." *International Security* 20 (3):115-151.

Krasner, Stephen D. 1997. "Pervasive Not Perverse: Semi-Sovereigns as the Global Norm." *Cornell International Law Journal* 30 (3):651-680.

Krasner, Stephen D. 1999. *Sovereignty: Organized Hypocrisy*. Princeton, NJ: Princeton University Press.

Krasner, Stephen D. 2001. "Abiding Sovereignty." *International Political Science Review* 22 (3):229-251.

Krasner, Stephen D. 2004. "Sharing Sovereignty: New Institutions for Collapsed and Failing States." *International Security* 29 (2):85-120.

Krasner, Stephen D. 2011. "The durability of organized hypocrisy." In *Sovereignty in Fragments. The Past, Present and Future of a Contested Concept*, edited by & Quentin Skinner Hent Kalmo, 96-113. Cambridge University Press.

Kuah, Adrian W. J. 2005. "The Political Economy of Defence Industrialisation in Singapore: The Costs, Trade-Offs and Synergies." *Defence Studies* 5 (2):213-227. doi: 10.1080/14702430500336475.

Kumar, K. Ajith., Jomon George, & V.P. Jagathyraj. 2014. "Requirements Analysis of an Integrated Sonar Suite for Surface Ships: Systems Engineering Perspective." *Defence Science Journal* 64 (4):366-370. doi: 10.14429/dsj.64.4486.

Kumar, Sampath. 2020. "FinMin nod for 74% FDI in Defence sector under automatic route." *The Hindu Business Line*, 09 December 2020. Accessed 22 January 2021. https://www.thehindubusinessline.com/news/finmin-nod-for-74-fdi-in-defence-sector-under-automatic-route/article33288079.ece.

Kurç, Çağlar. 2017. "Between defence autarky and dependency: the dynamics of Turkish defence industrialization." *Defence Studies* 17 (3):260-281. doi: 10.1080/14702436.2017.1350107.

Lantis, Jeffrey S., & Andrew A. Charlton. 2011. "Continuity or Change? The Strategic Culture of Australia." *Comparative Strategy* 30 (4):291-315. doi: 10.1080/01495933.2011.605019.

Lee, Bill, & Mark N.K. Saunders. 2017. *Conducting Case Study Research for Business and Management Students*. Online: SAGE Publications.

Lindgren, Fredrik, & Ann Odlund. 2017. Total Defence at the Crossroads. edited by Totalförsvarets forskningsinstitut. Stockholm: Swedish Defence Research Agency.

Lindh, Aras. 2016. Sweden - Mind Rather Than Heart in EU Politics. In *Building Bridges Paper Series*. Paris: French Insitute of International Relations.

Lipka, Rafal. 2018. Poland's 'Orka' submarine programme. Part 3. The A26 submarines - Swedish Offer. In *Pulaski Policy Papers*. Warsaw: The Casimir Pulaski Foundation.

Lofven, Stefan. 2017. National Security Strategy. edited by Prime Minister's Office. Stockholm: Government Offices of Sweden.

Lofven, Stefan. 2019. Statement of Government Policy, 10 September 2019. Statement by the Prime Minister, 10 September 2019. Stockholm: Government Offices of Sweden.

Lookout, Navy. 2023. "The Royal Navy's Astute class submarines: Part 1 – development and delivery." *Analysis*, 09 January 2023. https://www.navylookout.com/the-royal-navys-astute-class-submarines-part-1-development-and-delivery/.

Lorell, Mark A., Julia F. Lowell, & Obaid Younossi. 2006. Evolutionary Acquisition: Implementation Challenges for Defense Space Programs. Santa Monica, CA: RAND Corporation.

Lowe, Donald, & Andrew Flahive. 2017. "Systems thinking in force design." Conference presentation Systems Modelling Conference, Canberra, 28 September 2017.

Lowe, Donald, Jenny Hayward, Jon Bell, & Jenny Clothier. 2006. "The SCMILE Services Framework: A Conceptual tool for designing the NCW force." 11th ICCRTS. Coalition Command and Control in the Networked Era, Cambridge.

Ludlam, Steve. 2006. Defence - Minutes of Evidence. Oral evidence taken by the Defence Committee on 07 November 2006. edited by House of Commons. London: www.parliament.uk.

Ludlam, Steve. 2019. Interview with Steve Ludlam – 30 May 2019 at Adelaide, SA. edited by Graeme Dunk.

Ludlam, Steve. 2021. "Personal Communication: Collins IP acquisition." 03 July 2022.

Lundmark, Martin. 2013. Acquiring and Absorbing New Military Capabilities. Singapore: S. Rajaratnam School of International Studies.

Lundmark, Martin. 2014. "Kockums - the Repatriation of the Swedish Underwater Crown Jewel." *Défense & Industries* 1:7-8.

Lundmark, Martin. 2021. "The Evolution Towards the Partial Strategic Autonomy of Sweden's Essential Security Interests." *Defence and Peace Economics* (Online). doi: 10.1080/10242694.2021.1992713.

MacCormick, Neil. 2016. "Sovereignty and after." In *Sovereignty in Fragments. The Past, Present and Future of a Contested Concept*, edited by Hent Kalmo, & Quentin Skinner, 151-168. Cambridge University Press.

Manne, Robert. 2006. "Little America. How John Howard has changed Australia." *The Monthly* (March 2006).

Maritime, Kongsberg. 2015. "SAAB chooses KONGSBERG sonar and multibeam systems for Swedish submarines." Naval Technology, Last Modified 25 January 2015, accessed 23 November 2021. https://www.naval-technology.com/contractors/sonar/kongsberg-maritime2/pressreleases/presssaab-swedish-submarines/.

Maritime, Kongsberg. 2016. "Kongsberg active sonar suite and bottom navigation package for next generation submarines." Kongsberg, accessed 23 November 2021. https://www.kongsberg.com/maritime/about-us/news-and-media/news-archive/2016/kongsberg-active-sonar-suite-and-bottom-navigation-package-for-next-generation/.

Markowski, Stefan, Peter Hall, & Robert Wylie. 2010. "Procurement and the chain of supply. A general framework." In *Defence Procurement and Industry Policy. A small country perspective*, edited by Stefan Markowski, Peter Hall, & Robert Wylie, 11-44. Abingdon: Routledge.

Markowski, Stephan, & Peter Hall. 2006. "The economic benefits of defence industries." In *Growth 57: The Business of Defence - Sustaining Capability*, edited by CEDA, 40-49. Melbourne: CEDA.

Marksteiner, Alexandra, Lucie Beraud-Sudreau, Nan Tian, Diego Lopes Da Silva, & Alexandra Kuimova. 2021. The SIPRI Top 100 Arms-Producing and Military Services Companies, 2020. In *SIPRI Fact Sheet*. Stockholom: Stockholm International Peace Research Institute.

Marles, Richard. 2023a. AUKUS nuclear-powered submarine pathway. Canberra: Department of Defence.

Marles, Richard. 2023b. Securing Australia's Sovereignty. Canberra: Department of Defence.

Martin, Lockheed. 2021. "Brains of a Ship. Software that manages combat at sea." Lockheed Martin Corporation, accessed 27 September 2021. https://www.lockheedmartin.com/en-us/news/features/2017/the-brains-of-a-ship.html.

Masson, Helene, Christian Mölling, Keith Hartley, Martin Lundmark, & Krzysztof Soloch. 2013. Defining the << European Defence Technological and Industrial Base >>: Debates and Dilemmas (I). edited by Helene Masson. Paris: Fondation pour la Recherche Strategique.

Matthews, David, Martin Burke, Phil Collier, & Stephen Cook. 2001. "Systems Thinking for Joint Force Capability Planning and Management." *INCOSE International Symposium* 11 (1):923-928. doi: 10.1002/j.2334-5837.2001.tb02391.x.

Maye, Diane L. 2017. "Autarky or Interdependence: U.S. vs. European Security and Defense Industries in a Globalized Market." *Journal of Strategic Security* 10 (2):33-47. doi: 10.5038/1944-0472.10.2.1597.

McInnes, Colin. 1998. "Labour's Strategic Defence Review." *International Affairs* 74 (4):823-845.

McIntosh, Malcolm K., & John B. Prescott. 1999. Report to the Minister for Defence on the Collins Class Submarine and Related Matters. Canberra: Commonwealth of Australia.

McLachlan, Ian. 1996. Ministerial Statements - Defence Policy - Official Hansard No. 209, 15 October 1996. Canberra: House of Representatives.

McLachlan, Ian. 1997a. "Australian Defence Policy after the Year 2000." In *Canberra Papers on Strategy and Defence No.120. Australian Defence Planning: Five Views From Policy Makers*, edited by Helen Hookey, & Denny Roy, 1-12. Canberra: Strategic and Defence Studies Centre.

McLachlan, Ian. 1997b. Ministerial Statement. Australia's Strategic Policy. Official Hansard No. 218, 2 December 1997. Canberra: House of Representatives.

McLachlan, Ian. 1997c. Parliamentary statement by Minister for Defence (Ian McLachlan) on Defence Reform Program - Official Hansard No. 216, 30 September 1997. Canberra

Menz, Ronald H. 2018. "Can we Defend the Defense Supply Chain? Lessons Learned from Industry Leaders in Supply Chain Management." Master of Arts in Security Studies (Homeland Security and Defense), Naval Postgraduate School.

Mignon, Ingrid, & Anna Bergek. 2016. "Investments in renewable electricity production: The importance of policy revisited." *Renewable Energy* 88:307-316.

Millar, Andy. 2011. "A Retrospective of the Collins Class Submarines." *Naval Historical Review*, September 2011. https://www.navyhistory.org.au/a-retrospective-of-the-collins-class-submarines/.

Mills, Claire, Louisa Brooke-Holland, & Nigel Walker. 2018. A brief guide to previous British defence reviews. Briefing Paper number 07313. London: House of Commons Library.
Milne, Richard. 2017. "Sweden's return to conscription spells end to naivete." *FT.com*, 02 March 2017. Accessed 11 May 2020. https://search-proquest-com.virtual.anu.edu.au/docview/1882861858?pq-origsite=summon.
Milne, Tom. 2003. "British Nuclear Weapons Policy." In *The British Nuclear Weapons Programme, 1952-2002*, edited by Frank Barnaby, Douglas Holdstock, & Douglas Holdstock, 11-22. ProQuest Ebook Central: Routledge.
Minchin, Nick. 2005. Scoping study into sale of ASC. Media Release by Senator the Hon Nick Minchin Minister for Finance and Administration. Canberra: Office of the Minister for Finance and Administration.
Minister, Prime. 2023. Joint Leaders Statement on AUKUS. 14 March 2023. Prime Minister, President of the United States of America, Prime Minister of the United Kingdom. Canberra: Prime Minister of Australia.
Minister, Prime, & Minister of Defence. 1946. Defence Policy in 1946. 15 February 1946. Cabinet Memorandum CAB/129/7/65. London: The National Archives.
Moffitt, Rowan. 2019. Interview with RADM (ret) Rowan Moffitt, AM – 07 June 2019 at Manuka, ACT. edited by Graeme Dunk.
Möller, Ulrika, & Ulf Bjereld. 2010. "From Nordic neutrals to post-neutral Europeans: Differences in Finnish and Swedish policy transformation." *Cooperation and Conflict* 45 (4):363-386.
Monk, Paul. 2012. "Think of insurance rather than threat." *The Strategist*, 19 July 2012. https://www.aspistrategist.org.au/think-of-insurance-rather-than-threat/.
Moore, John. 1999. Hansard - Matters of Public Importance - Minister of Defence - Speech, 25 August 1999. Canberra: House of Representatives.
Moore, John. 2000a. Media Release The Hon John Moore, MP Minister for Defence. Canberra: Office of the Minister for Defence.
Moore, John, Nick Minchin, and John Fahey. 2000b. Commonwealth Acquires Australian Submarine Corp. Joint Media Release by the Hon. John Moore, MP Minister for Defence, Senator the Hon. Nick Minchin Minister for Industry, Science & Resources, and the Hon. John Fahey Minister for Finance & Administration. Canberra: Commonwealth of Australia.
Moore, Stephen. 2019. "Acoustic Signature Control on Maritime Platforms." AAS 2019: Acoustics 2019 - Sound Decisions: Moving forward with Acoustics, Cape Schanck, Victoria.
Moravcsik, Andrew. 1991. "Arms and Autarky in Modern European History." *Daedalus* 120 (4):23-45.
Morgan, Oliver. 2007. "Carlyle to bid for sub dockyard." *The Guardian*, 06 May 2007. Accessed 10 January 2022. https://www.theguardian.com/business/2007/may/06/privateequity.observerbusiness.
Morrison, Jim. 2006. Defence - Minutes of Evidence. Oral evidence taken by the Defence Committee on 07 November 2006. edited by House of Commons. London: www.parliament.uk.
Morrison, Scott. 2021. Transcript - Press Conference, Canberra, ACT - Thursday 16 September 2021. Canberra: Parliament of Australia.
Morth, Ulrika, & Bengt Sundelius. 1993. "Dealing with a High Technology Vulnerability Trap: The USA, Sweden and Industry." *Cooperation and Conflict* 28 (3):303-328.
Mortimer, David. 2008. Going to the Next Level: the report of the Defence Procurement and Sustainment Review. Canberra, ACT: Commonwealth of Australia.
Muradian, Vago. 1998. "1999 expected to be brisk year for gloabl defense deals." *Defense Daily*, 23 December 1998.
Murphy, Mary E. 1952. "Nationalization of British Industry." *The Canadian Jounral of Economics and Political Science* 18 (2):146-162.
Myddelton, D. R. 2014. "The British Approach to Privatization." *Economic Affairs* 34 (2):129-138.

Nagarajan, R., & R. Prabhu. 2015. "Competence and Capability - A New Look." *International Journal of Management* 6 (6):7-11.
Nair, Sreeja, & Michael Howlett. 2017. "Policy myopia as a source of policy failure: adaptation and policy learning under deep uncertainty." *Policy and Politics* 45 (1):103-118.
NATO. 2014. "Partnership for Peace Planning and Review Process." North Atlantic Treaty Organization, Last Modified 05 November 2014. https://www.nato.int/cps/em/natohq/topics_68277.htm.
NATO. 2018. "Relations with Sweden." North Atlantic Treaty Organization, Last Modified 04 October 2018. https://www.nato.int/cps/en/natohq/topics_52535.htm.
NATO. 2020. "Partnership Interoperability Initiative." North Atlantic Treaty Organization, Last Modified 24 March 2020. https://www.nato.int/cps/em/natohq/topics_132726.htm.
NATO. 2021. "Relations with Sweden." North Atlantic Treaty Organization, Last Modified 02 September 2021, accessed 02 November 2021. https://www.nato.int/cps/en/natohq/topics_52535.htm.
Navy, Royal Australian. 2016. Australian Maritime Logistics Doctrine. Canberra: Department of Defence.
Nelson, Brendan. 2007. Defence and Industry Policy Statement 2007. Canberra: Australian Government.
News, ABC. 2010a. "Navy subs marooned by maintenance." *ABC News*, 10 February 2010. Accessed 06 November 2019. https://www.abc.net.au/news/2010-02-10/navy-subs-marooned-by-maintenance/327140.
News, ABC. 2010b. "Sub fleet dead in the water: Opposition." *ABC News*, 26 January 2010. Accessed 06 November 2019. https://www.abc.net.au/news/2010-01-26/sub-fleet-dead-in-the-water-opposition/308518.
Nicholson, Brendan. 2022. "Marles says ADF must quickly develop greater range and lethality." *The Strategist*, 13 July 2022. https://www.aspistrategist.org.au/marles-says-adf-must-quickly-develop-greater-range-and-lethality/.
Nilsson, Mikael, & Marco Wyss. 2016. "The Armed Neutrality Paradox; Sweden and Switzerland in US Cold War Armaments Policy." *Journal of Contemporary History* 51 (2):335-363.
Njolstad, Olav. 2010. "The collapse of superpower détente, 1975-1980." In *The Cambridge History of the Cold War Volume III: Endings*, edited by Melvyn P. Leffler, & Odd Arne Westad, 135-155. Cambridge: Cambridge University Press.
Nordenfelt, Thorsten. 1886. "On Submarine Boats." *Journal of the Royal United Services Institution* 30:149-173.
Nordlund, Peter. 2016. "Defence-specific inflation - the Swedish perspective." *Defence and Peace Economics* 27 (2):258-279. doi: 10.1080/10242694.2015.1096571.
Nuttall, William J., Matthias Holweg, & Michael E. Leybovich. 2011. "Too big to fail - Lessons for today and the future from British industrial policy, 1960-1990." *Technological Forecasting & Social Change* 78 (8):1286-1298.
O'Connor, Michael. 1997. "Redirecting the defence dollar." *Review - Institute of Public Affairs* 50 (1):7-8.
O'Sullivan, David, & Lawrence Dooley. 2009. *Applying Innovation*. Thousand Oaks, CA: SAGE Publications.
Oakes, Dan. 2010. "Reputation of Collins class subs takes a further dive." *The Sydney Morning Herald*, 11 February 2010. Accessed 06 November 2019. https://www.smh.com.au/national/reputation-of-collins-class-subs-takes-a-further-dive-20100210-nsd0.html.
Observer, The. 2001. "UK sonar falls into French hands." *The Guardian*, 29 July 2001. https://www.theguardian.com/business/2001/jul/29/observerbusiness.baesystemsbusiness.
Office, Australian National Audit. 1997. New Submarine Project. Canberra: Commonwealth of Australia.

Office, Australian National Audit. 2009. Management of the Collins-class Operations Sustainment. Canberra: Commonwealth of Australia.
Office, Australian National Audit. 2010. 2009-10 Major Projects Report - Defence Materiel Organisation. Canberra: Commonwealth of Australia.
Office, Australian National Audit. 2015. Test and Evaluation of Major Defence Equipment Acquisitions. In *Department of Defence*. Canberra: Australian National Audit Office.
Office, Congressional Budget. 2016. The U.S. Military's Force Structure: A Primer. Washington, DC: Congressional Budget Office.
Office, Congressional Budget. 2021. The U.S. Military's Force Structure: A Primer, 2021 Update. Washington, DC: Congressional Budget Office.
Office, Foreign and Commonwealth. 2001. Framework Agreement between the French Republic, the Federal Republic of Germany, the Italian Republic, the Kingdom of Spain, the Kingdom of Sweden, and the United Kingdom of Great Britain and Northern Ireland concerning Measures to Facilitate the Restructuring and Operation of the European Defence Industry (Cm 5185). London: Her Majesty's Stationery Office.
Office, National Audit. 1985. Ministry of Defence: The Torpedo Programme. London: Her Majesty's Stationery Office.
Office, National Audit. 1988. Department of Trade and Industry: Sale of Government Shareholding in Rolls-Royce plc. London: Her Majesty's Stationery Office.
Office, National Audit. 2004. Ministry of Defence: Major Projects Report 2003. London: National Audit Office.
Office, National Audit. 2007. Ministry of Defence. Major Projects Report 2007. London: The Stationery Office.
Office, National Audit. 2017. Investigation into equipment cannibalisation in the Royal Navy. London: National Audit Office.
Office, U.S. General Accounting. 1995. Defense Restructuring Costs. Washington, DC: U.S. General Accounting Office.
Office, United States Government Accountability. 2018. Navy Shipbuilding. Past Performance Provides Valuable Lessons for Future Investments. Washington, DC: United States Government Accountability Office.
Olivier, Jacques P., & Santiago Balestrini-Robinson. 2014. "Capability-Based System-of-Systems Approach in Support of Complex Naval Ship Design." 2014 Complex Systems Design & Management International Conference co-located with 5th International Conference on Complex System Design & Management (CSD&M 2014), Paris, 12 November 2014.
Olson, David, Candyce Smith Russell, & Douglas H. Spenkle. 1989. *Circumplex Model. Systemic Assessment and Treatment of Families*. New York: Routledge.
Olson, David H. 2000. "Circumplex Model of Marital and Family Systems." *Journal of Family Therapy* 22:144-167.
Olsson, Andreas, Kenth Gutensparr, & Mats Elofsson. 2018. Interview with Rear Admiral Andreas Olsson, Captain Kenth Gutensparr, & Mats Elofsson – 06 September 2018 at Ibis Hotel, Adelaide. edited by Graeme Dunk.
online, Seaforces -. 2021. "Oberon class Patrol/Attack Submarine." seaforces.org, accessed 03 December 2021. https://www.seaforces.org/marint/Royal-Navy/Submarine/Oberon-class.htm.
Organization, World Intellectual Property. 2020. What is Intellectual Property? Geneva: World Intellectual Property Organization.
Pardesi, Manjeet S., & Ron Matthews. 2007. "India's Tortuous Road to Defence-Industrial Self-Reliance." *Defence & Security Analysis* 23 (4):419-438. doi: 10.1080/14751790701752451.
Parry, David. 2021a. "The History of British Submarine Command Systems." RN Subs, accessed 04 December 2021. http://rnsubs.co.uk/articles/development/command-systems.html.

Parry, David. 2021b. "The History of British Submarine Sonars." RN Subs, accessed 04 December 2021. http://rnsubs.co.uk/articles/development/sonar.html.
Patrick, Rex. 2014. "Future Submarine Stealth Secret Revealed." *Asia Pacific Defence Reporter* (June 2014):52-57.
Perrett, Bradley. 2021. "Australia should be stockpiling missiles instead of making them." *The Strategist*, 09 April 2021. https://www.aspistrategist.org.au/australia-should-be-stockpiling-missiles-instead-of-making-them/.
Persson, Göran. 2000. Statement of Government Policy presented by the Prime Minister to the Swedish Riksdag on Tuesday, 19 September 2000. Stockholm: Government Offices of Sweden.
Persson, Göran. 2004. Statement of Government Policy presented by the Prime Minister, Mr Göran Persson, to the Swedish Riksdag on Tuesday, 14 September 2004 Stockholm: Government Offices of Sweden.
Persson, Göran. 2005. Statement of Government Policy presented by the Prime Minister, Mr Göran Persson, to the Swedish Riksdag on Tuesday, 13 September 2005. Stockholm: Government Offices of Sweden.
Peruzzi, Luca. 2019. "European developments in conventional submarines." *European Defence Review Magazine*, 5-13.
Petersson, Magnus. 2012. "Sweden and the Scandinavian Defence Dilemma." *Scandinavian Journal of History* 37 (2):221-229. doi: 10.1080/03468755.2012.667311.
Porter, Michael. 2001. "The Value Chain and Competitive Advantage." In *Understanding Business: Processes*, edited by David Barnes. London: Routledge.
Porter. Keshia M. Pollack, Lainie Rutkow, & Emma E. McGinty. 2018. "The Importance of Policy Change for Addressing Public Health Problems." *Public Health Reports* 133:95-145.
Posner, Jonathan, James A. Russell, & Bradley S. Peterson. 2005. "The circumplex model of affect: An integrative approach to affective neuroscience, cognitive development, and psychopathology." *Dev Psychopathol* 17 (3):715-734.
Price, Roger. 1992. Defence Policy and Industry. Report to the Minister of Defence Prepared Under the Direction of the Parliamentary Secretary to the Minister for Defence The Hon Roger Price MP. edited by Department of Defence. Canberra: Australian Government Publishing Service.
PriceWaterhouseCoopers. 2009. Aerospace & Defence Deals*. Online: PriceWaterhouseCoopers LLP.
PriceWaterhouseCoopers. 2010. Mission control. 2009 Annual and fourth-quarter review. Merger and acquisition activity in the global aerospace and defence industry. Online: PriceWaterhouseCoopers LLP.
Puche, Ricardo Albert. 1988. The Malvinas War from the Argentinian Viewpoint. Maxwell Air Force Base: Air University, USAF.
Pung, Hans, Laurence Smallman, Mark V. Arena, James G. Kallimani, Gordon T. Lee, Samir Puri, & John F. Schank. 2008. Sustaining Key Skills in the UK Naval Industry. Santa Monica, CA: RAND Corporation.
Purdy, Grant. 2010. "ISO 31000:2009 - Setting a New Standard for Risk Management." *Risk Analysis* 30 (6):881-886. doi: 10.1111/j.1539-6924.2010.01442.x.
Pym, Francis. 1980a. Nuclear Weapons - Statement by the Secretary of State for Defence - HC Deb 24 January 1980. edited by House of Commons. London: Hansard.
Pym, Francis. 1980b. Pym minute to Margaret Thatcher (Polaris Successor: Memorandum): MO 18/1/1 dated 10 June 1980 Online: Margaret Thatcher Foundation.
Pym, Francis. 1980c. Strategic Nuclear Deterrent - Statement by the Secretary of State for Defence - HC Deb 15 July 1980. edited by House of Commons. London: Hansard.
Rawlinson, M. J. 1989. "Government Defence Factories and Dockyards - The Defence Implications of Privatisation." *Defence Force Journal* 74 (January/February 1989):27-35.

Redeker, Claudia, Jane Wardle, Deborah Wilder, Sara Hiom, & Anne Miles. 2009. "The launch of Cancer Research UK's 'Reduce the Risk' campaign: Baseline measurements of public awareness of cancer risk factors in 2004." *European Journal of Cancer* 45:827-836.
Regulator, Defence Maritime. 2013. Joint Service Publication 430. Management of Ship Safety and Environmental Protection. . UK Ministry of Defence.
Reith, Peter. 2001. The Collins Class Submarines - Beazley's Enduring Legacy. Canberra: Office of the Minister for Defence.
Reuters. 2022. "Sweden's Defence Budget Could Reach 2% of GDP in 2028, Military Says." U.S. News, Last Modified 11 April 2022, accessed 30 August 2022. https://www.usnews.com/news/world/articles/2022-04-11/swedens-defence-budget-could-reach-2-of-gdp-in-2028-military-says#:~:text=This%20year's%20defence%20budget%20is,2%25%20of%20GDP%20by%202033.
Review, World Population. 2021. "Submarines by Country 2021." World Population Review, accessed 14 JUly 2021. https://worldpopulationreview.com/country-rankings/submarines-by-country.
Richard J. Dunn, III. 2014. "Measuring Military Capabilities: An Essential Tool for Rebuilding American Military Strength." *Backgrounder* (2911):1-10.
Ridder, Hans-Gerd. 2017. "The theory contribution of case study research designs." *Business Research* 10 (2):281-305.
Rifkind, Malcolm. 1993a. Defence Estimates, 1993. Statement to Parliament by the Secretary of State for Defence, 5 July 1993. edited by House of Commons. Online: Hansard.
Rifkind, Malcolm. 1993b. Statement on the Defence Estimates. Statement to Parliament by the Secretary of State for Defence, 18 October 1993. edited by House of Commons. Online: Hansard.
Rifkind, Malcolm. 1994. Defence Capabilities for the Future. Speech delivered by the Secretary of State for Defence at the Centre for Defence Studies, 15 February 1994. London: Brasseys.
Roberts, John. 2009. *Safeguarding the Nation: The Story of the Modern Royal Navy*. Annapolis, MD: Naval Insitute Press.
Robertson, George. 1997a. Defence Policy. Statement to the House of Commons by hte Secretary of State for Defence to House of Commons debate, 27 October 1976. edited by House of Commons. London: Hansard.
Robertson, George. 1997b. "The Strategic Defence Review." *The RUSI Journal* 142 (5):1-5.
Rockart, Scott F., & Nilanjana Dutt. 2015. "The rate and potential of capability development trajectories." *Strategic Management Journal* 36 (1):53-75.
Rogers, Simon. 2013. "How Britain changed under Margaret Thatcher. In 15 charts." *The Guardian*, 08 April 2013. Accessed 27 March 2020. https://www.theguardian.com/politics/datablog/2013/apr/08/britain-changed-margaret-thatcher-charts.
Roos, Goran. 2014a. "Dawn raids, international intrigue lie beneath Australia's submarine strategy." *The Conversation Media Group*. https://theconversation.com/dawn-raids-international-intrigue-lie-beneath-australias-submarine-strategy-32890.
Roos, Goran. 2014b. Evidence provided to Economics References Committee inquiry into the Future of Australia's naval shipbuilding industry. 08 October 2014, Newcastle. Canberra: Official Committee Hansard.
Rubin, Uzi. 2017. "Israel's defence industries - an overview." *Defence Studies* 17 (3):228-241. doi: 10.1080/14702436.2017.1350823.
Rubin, Uzi. 2018a. Not published.
Rubin, Uzi. 2018b. Telephone interview with Uzi Rubin - 28 October 2018. edited by Graeme Dunk.
Rudd, Kevin. 2008. National Security Speech Thursday 4 December 2008. Canberra: House of Representatives Hansard.

Rusbridge, Peter. 2014. "Replacing submarines for Australian defence goes beyond operational sovereignty." *The Sydney Morning Herald*, 29 December 2014. Accessed 09 December 2016. http://www.smh.com.au/comment/replacing-submarines-for-australian-defence-goes-beyond-operational-sovereignty-20141219-12ak0b.html.

Ryan, Mick. 2022. "The Task Ahead for Rapid Capability Enhancement in Australian Defense." *Experts*, 04 August 2022. https://www.csis.org/analysis/task-ahead-rapid-capability-enhancement-australian-defense.

SAAB. 2014. Saab completes acquisition of TKMS AB (Kockums). Linköping, Sweden: Saab Group.

SAAB. 2015a. "From the swordfish to world-leading submarine technology." Saab, accessed 01 May 2020. https://history.saab.com/en/themes/products/from-the-swordfish-to-world-leading-submarine-technology/.

SAAB. 2015b. "The secret to the world's most silent submarine." SAAB, Last Modified 24 March 2015, accessed 29 July 2022. https://www.saab.com/newsroom/stories/2015/march/the-secret-to-the-worlds-most-silent-submarine.

Sabin, Philip A. G. 1993. "British Defence Choices beyond 'Options for Change'." *International Affairs* 69 (2):267-287.

Sageder, Martina, & Birgit Feldbauer-Durstmuller. 2019. "Management control in multinational companies: a systematic literature review." *Review of Managerial Science* 13:875-918. doi: 10.1007/s11846-018-0276-1.

Salzmann, Brinley. 2018. Interview with Brinley Salzmann, Director, Overseas and Exports, ADS Group - London 12 November 2018. edited by Graeme Dunk.

Sandvik, Håvard. 2014. "Is There a Swedish Defence Variation? Lessons for Europe." ECPR Annual Conference 2014, Glasgow.

Sapolsky, Harvey M., & Eugene Gholz. 1997. "Eliminating excess defense production." *Issues in Science and Technology* 13 (2):65-70.

Sapolsky, Harvey M., & Eugene Gholz. 1999. "The Defense Monopoly." *Regulation* 22 (3):39-43.

Sapolsky, Harvey M., & Eugene Gholz. 2001. "The Defense Industry's New Cycle." *Regulation* 24 (4):44-49.

Schank, John. 2006. Trends in the United Kingdom's Naval Shipbuilding Industrial Base: Lessons for the United States. Testimony presented before the Senate Armed Services Committee, Subcommittee on Seapower on April 6, 2006. Santa Monica, CA: RAND Corporation.

Schank, John F., Cesse Ip, Kristy N. Kamarck, Robert E. Murphy, Mark V. Arena, Frank W. Lacroix, & Gordon T. Lee. 2011a. Learning from Experience. Vol IV. Lessons from Australia's Collins Submarine Program. Santa Monica, CA: RAND Corporation.

Schank, John F., Frank W. Lacroix, Robert E. Murphy, Cesse Ip, Mark V. Arena, & Gordon T. Lee. 2011b. Learning from Experience. Vol III. Lessons from the United Kingdom's Astute Submarine Program. Santa Monica, CA: RAND Corporation.

Schank, John F., Mark V. Arena, Paul DeLuca, Jessie Riposo, Kimberly Curry, Todd Weeks, & James Chiesa. 2007. Sustaining U.S. Nuclear Submarine Design Capabilities. Santa Monica, CA: RAND Corporation.

Schilde, Kaija. 2017. "European Military Capabilities: Enablers and Constraints on EU Power?" *Journal of Common Market Studies* 55 (1):37-53. doi: 10.1111/jcms.12444.

Scholes, Gordon. 1984. Defence Policy for Australian Industry - Media release by the Minister for Defence Gordon Scholes, MP No.105/84. Canberra: Commonwealth of Australia.

Seawright, Jason, & John Gerring. 2008. "Case Selection Techniques in Case Study Research: A Menu of Qualitative and Quantitative Options." *Political Research Quarterly* 61 (2):294-308.

Security, Global. 2012. "Australian Defence Industries (ADI)." GlobalSecurity.org, Last Modified 27 March 2012, accessed 08 October 2018. https://www.globalsecurity.org/military/world/australia/adi.htm.

Senate Foreign Affairs, Defence and Trade References Committee. 2000. The Sale of ADI Limited. Canberra: The Parliament of the Commonwealth of Australia.

Shackleton, David. 2016. "Australia's future submarines: Why the combat system matters." *the interpreter*, 10 February 2016. https://www.lowyinstitute.org/the-interpreter/australias-future-submarines-why-combat-system-matters.
Shackleton, David. 2019. Interview with VADM (ret) Dr David Shackleton, AO – 24 October 2019 at Manuka, ACT. edited by Graeme Dunk.
Shoebridge, Michael. 2021. "Setting clear priorities for the ADF requires ruthless decisions on the force we build." *The Strategist*, 05 August 2021. https://www.aspistrategist.org.au/setting-clear-priorities-for-the-adf-requires-ruthless-decisions-on-the-force-we-build/.
SIA. 2021. "The RAN Oberon Class." Submarine Institute of Australia, accessed 04 December 2021. https://www.submarineinstitute.com/submarines-in-australia/The-RAN-Oberon-Class.html.
Siegel, Matt. 2014. "Australia cracks opens door to foreign submarine build." *Industrials*, 28 July 2014. https://www.reuters.com/article/australia-military-submarine-idINL4N0Q30HM20140728.
SIPRI. 2022. "SIPRI Military Expenditure Database." Stockholm International Peace Research Institute accessed 02 July 2022. https://milex.sipri.org/sipri.
Skinner, Quentin. 2010. "The sovereign state: a genealogy." In *Sovereignty in Fragments. The Past, Present and Future of a Contested Concept*, edited by Hent Kalmo and Quentin Skinner, 26-46.
Slaughter, Anne-Marie. 2005. "Security, Solidarity, and Sovereignty: The Grand Themes of UN Reform." *The American Journal of International Law* 99 (3):619-631.
Slaughter, Anne-Marie. 2011. "Problems will be Global - and Solutions will be, Too." *Foreign Policy* 188:89.
Slaughter, Anne-Marie, & David Zaring. 2006. "Networking Goes International: An Update." *Annu. Rev. Law Soc. Sci* 2:211-229.
Smallwood, Norm & Dave Ulrich. 2004. "Capitalizing on Capabilities." *Corporate Strategy*, June 2004. https://hbr.org/2004/06/capitalizing-on-capabilities.
Smith, Ric. 2017. "Understanding a rules-based White Paper." *the interpreter*, 30 November 2017. https://www.lowyinstitute.org/the-interpreter/understanding-rules-based-white-paper.
Snyder, Glenn Herald. 1997. *Alliance Politics*. Ithaca, N.Y.: Cornell University Press.
Soderlind, Rolf. 1988. "Disarmanent Champion Cleaning Up Own Act: Stung by New Image as Gunrunner, Sweden Tightens Weapons-Export Laws." *Los Angeles Times*, 17 April 1988. Accessed 06 August 2023. https://www.latimes.com/archives/la-xpm-1988-04-17-mn-1899-story.html.
Southhampton, University of. 2003. Southhampton professor to lead first National Defence Technology Research Centre. Southhampton: University of Southhampton.
Staff, PEI. 2002. "US private equity firm buys German shipyard." *Private Equity News & Analysis*, 08 May 2002. https://www.privateequityinternational.com/us-private-equity-firm-buys-german-shipyard/.
Stamm, Bettina von. 2008. *Managing Innovation, Design and Creativity*. 2nd ed. Chichester: John Wiley and Sons Ltd.
Strategy, The Dwight D. Eisenhower School for National Security and Resource. 2016. Strategic Materials. Washington D.C.: National Defense University.
Straus, Rachel Rickard. 2012. "Ministry of Defence gives up QinetiQ veto right to help firm compete more effectively." *This is Money*, 30 March 2012. https://www.thisismoney.co.uk/money/markets/article-2122735/Ministry-Defence-gives-QinetiQ-veto-right-help-firm-compete-effectively.html.
Studies, Institute for Fiscal. 2015. "Defence spending." *Public spending*. https://www.ifs.org.uk/tools_and_resources/fiscal_facts/public_spending_survey/defence.
Sutton, H. I. 2020. "Nordenfelt-submarines." H. I. Sutton, Last Modified 16 April 2020, accessed 28 March 2021. http://www.hisutton.com/Nordenfelt-submarines.html.

Sutton, Phil. 2015. "The UK Defence Technology Centres: a Model of Collaborative Research." Symposium Honouring Prof Erol Gelenbe Imperial College London.

Svensson, Erland, Maud Angelborg-Thanderz, Jonathon Borgvall, & Martin Castor. 2013. "Skill Decay, Reacquisition Training, and Transfer Studies in the Swedish Air Force." In *Individual and Team Skill Decay : The Science and Implications for Practice*, edited by Winfred Arthur Jr., Eric Anthony Day, Jr., Winston Bennett, and Antoinette M. Portrey. Ebook Central: Taylor & Francis Group.

Sweden, Government Offices of. 2004. Swedish Government Bill 2004/05.5. Our Future Defence - the focus of Swedish defence policy 2005-2007. edited by Ministry of Defence. Stockholm: Government Offices of Sweden.

Sydow, Bjorn von. 2018. "Resilience: Planning for Sweden's "Total Defence"." *NATO Review*.

Tall, Jeff. 2001. "The History of the Royal Navy Submarine Service." *RUSI Journal* 146 (3):41-45.

Taylor, Claire. 2010a. A Brief Guide to Previous British Defence Reviews. London: House of Commons Library.

Taylor, Claire, Tom Waldman, & Sophie Gick. 2008. British defence policy since 1997. London: House of Commons Library.

Taylor, Trevor. 2010b. "What's New? UK Defence Policy Before and After the SDSR." *The RUSI Journal* 155 (6):10-14. doi: 10.1080/03071847.2010.542662.

Taylor, Trevor. 2018. Interview with Professor Trevor Taylor - 11 October 2018 at Realm Hotel, Canberra. edited by Graeme Dunk.

Taylor, Trevor & Keith Hayward. 1989. *The UK Defence Industrial Base. Development and Future Policy Options*. London: Brassey's Defence Publishers.

Tebbitt, Norman. 1985. British Aerospace plc - HC Deb 15 January 1985. Statement by the Secretary of State for Trade and Industry. edited by House of Commons. Online: Hansard.

Technology, Naval. 2013. "Northrop delivers final PMS for Royal Navy's Astute-class submarine." *Naval Technology*, 12 September 2013.

Technology, Naval. 2020a. "SSN Astute Class Nuclear Submarines." Verdict Media Limited, accessed 29 March 2020. https://www.naval-technology.com/projects/astute/.

Technology, Naval. 2020b. "Trafalgar Class Attack Submarines." Verdict Media Limited, accessed 29 March 2020. https://www.naval-technology.com/projects/trafalgarclass/.

Technology, Naval. 2021. "L-3 MAPPS. Integrated Platform Management Systems." Naval Technology, accessed 29 December 2021. https://www.naval-technology.com/contractors/consoles/l-3-mapps2/.

Thales. 2018. Thales sonar upgrades to extend Australia's Collins Class submarine capability. Online: Thales Australia.

Thatcher, Margaret. 1976. Speech at Kensington Town Hall ("Britain Awake") ("The Iron Lady"), 19 January 1976. Online: Margaret Thatcher Foundation.

Thomson, Mark. 2006. "Competition in Australian defence procurement." In *Growth 57 - The Business of Defence - Sustaining Capability*, edited by CEDA, 32-39. Melbourne: CEDA.

Thomson, Mark. 2010. The Cost of Defence. ASPI Defence Budget Brief 2010-11. Canberra: Australian Strategic Policy Institute.

Thomson, Mark. 2012. "Thinking about defence and risk." *The Strategist*, 02 August 2012. https://www.aspistrategist.org.au/thinking-about-defence-and-risk/.

Thorton, David W. 2007. "Consolidating the Defense_Industrial Base in the Post-Cold War Era: Budgetary Priorities & Procurement Policies in the U.S. & Western Europe." *Public Finance and Management* 7 (3):295-339.

Timmermans, Stefan, & Iddo Tavory. 2012. "Theory Construction in Qualitative Research: From Grounded Theory to Abductive Analysis." *Sociological Theory* 30 (3):167-186. doi: 10.1177/0735275112457914.

Toppan, Andrew. 2004. "Oberon Class submarine." hazegray.org, accessed 05 December 2021. http://www.hazegray.org/navhist/rn/submarine/oberon/.

Trade, Department of Foreign Affairs and. 2017. 2017 Foreign Policy White Paper. Canberra: Australian Government.

Tramoundanis, Despina. 1995. Australian Air Power in Joint Operations. Canberra: Air Power Studies Centre.

Tunander, Ola. 2005. "Swedish Geopolitics: From Rudolf Kjellen to a Swedish 'Dual State'." *Geopolitics* 10 (3):546-566. doi: 10.1080/14650040591003552.

Union, European. 1997. Treaty of Amsterdam Amending the Treaty on European Union, The Treaties Establishing the European Communities and Certain Related Acts. In edited by European Union. Brussels: European Union.

Union, European. 2007. Treaty of Lisbon Amending the Treaty on European Union and the Treaty Establishing the European Community. In edited by European Union. Brussels: European Union.

Union, European. 2009. Directive 2009/81/EC of the European Parliament and of The Council of 13 July 2009 on the coordination of procedures for the award of certain works contracts, supply contracts and service contracts by contracting authorities or entities in the fields of defence and security, and amending Directives 2004/17/EC and 2004/18/EC. In *Directive 2009/81/EC*, edited by European Union. Brussels: European Union.

Unwin, Antony. 2020. "Why is Data Visualization Important? What is Important in Data Visualization?" *Harvard Data Science Review* 2.1 (Winter 2020):1-7.

Ureta, Sebastian, Thomas Lekan, & W Graf von Hardenberg. 2020. "Baselining nature: An introduction." *EPE: Nature and Space* 3 (1):3-19. doi: 10.1177/2514848619898092.

Van Schoyck, Stephen R. 2018. "Self-Reliance vs Self-Sufficiency: The Difference Is Critical To Your Happiness." Dr Stephen Van Schoyck, accessed 05 May 2019. https://drvanschoyck.com/self-reliance-vs-self-sufficiency-the-difference-is-critical-to-your-happiness/.

Veugelers, Reinhilde. 2012. "Which policy instruments to induce clean innovating?" *Research Policy* 41:1770-1778.

Vince, Joanna. 2015. "Integrated policy approaches and policy failure: the case of Australia's Oceans Policy." *Policy Sciences* 48 (2):159-180.

Volf, J., & V. Novak. 2018. "Use of Factor Analysis in Pattern Recognition." *Journal of Physics: Conference Series* 1065 (17):1-5.

Wallstrom, Margot. 2016. Statement of Government Policy in the Parliamentary Debate on Foreign Affairs 2016. Statement by the Minister for Foreign Affairs, 24 February 2016. edited by Minstry of Foreign Affairs. Stockholm: Government Offices of Sweden.

Wallstrom, Margot. 2017. Statement of Government Policy in the Parliamentary Debate on Foreign Affairs, Wednesday 15 February 2017. Stockholm: Government of Sweden.

Walsh, James I. 2006. "Policy Failure and Policy Change. British Security Policy After the Cold War." *Comparative Political Studies* 39 (4):490-518. doi: 10.1177/0010414005275562.

Walters, Patrick. 2006a. Cutting Edge: The Collins Experience. In *Strategic Insights*. Canberra: Australian Strategic Policy Institute.

Walters, Patrick. 2006b. "French to complete ADI takeover." *The Australian*, 02 October 2006. Accessed 27 June 2018. https://www.theaustralian.com.au/news/nation/french-to-complete-adi-takeover/news-story/1fcb1214d70691d9b3e8b15f6cf1d1a3?sv=760d350faa367f6dcbe3604239197254.

Walton, Douglas. 2005. *Abductive Reasoning*. ProQuest Ebook Central: University of Alabama Press.

Waltz, Kenneth N. 2010. *Theory of International Politics*. Original 1979 ed. Long Grove, IL: Waveland Press.

Wang, Xiaoqian, Eric Anthony Day, Vanessa Kowollik, Matthew J. Schuelke, & Michael G. Hughes. 2013. "Factors Influencing Knowledge and Skill Decay after Training." In *Individual and Team Skill Decay : The Science and Implications for Practice*, edited by Winfred Arthur Jr., Eric

Anthony Day, Jr., Winston Bennett, and Antoinette M. Portrey. Ebook Central: Taylor & Francis Group.
Ward, Tony, Samuel Clark, & Brian D. Haig. 2016. "The Adbuctive Theory of Method: Scientific Inquiry and Clinical Practice." *Behaviour Change* 33 (4):212-231. doi: 10.1017/bec.2017.1.
Watt, David, & Keith Willey. 2005. "The Complex, Chaotic, and Fractal Nature of Complex Systems." 2005 IEEE International Conference on Systems, Man and Cybernetics, Waikoloa, Hawaii, 10-12 October 2005.
Watts, Barry D., & Todd Harrison. 2011. Sustaining Critical Sectors of the U.S. Defense Industrial Base. Washington: Center for Strategic and Budgetary Assessments.
Wellings, Ben. 2018. Taking Back Control: Parliament, Sovereignty and Brexit. edited by Senate. Canberra: Parliament of Australia.
White, Hugh. 2003. "Mr. Howard Goes to Washington: The U.S. and Australia in the Age of Terror." *Comparative Connections* 5 (2).
White, Hugh. 2008. "Strategic Interests in Australian Defence Policy: Some Historical and Methodological Reflections." *Security Challenges* 4 (2):63-79.
White, Hugh. 2017. "Strategic risk in the new era: a response to Paul Dibb and Richard Brabin-Smith." *The Strategist*, 20 November 2017. https://www.aspistrategist.org.au/strategic-risk-in-the-new-era-a-response-to-paul-dibb-and-richard-brabin-smith/.
White, William, Anders Lunnan, Erland Nybakk, & Biljana Kulisic. 2013. "The role of governments in renewable energy: The importance of policy consistency." *Biomass and Bioenergy* 57:97-105.
Wieslander, Anna. 2018. "Sweden and the CSDP: keen on security and reluctant on defence." *Commentary*, 26 January 2018. https://www.europeanleadershipnetwork.org/commentary/sweden-and-the-csdp-keen-on-security-and-reluctant-on-defence/.
Williams, Sean. 2019. Interview with Sean WIlliams – 07 November 2019 at Adelaide. edited by Graeme Dunk.
Wilson, Harold. 1968. Public Expenditure. Speech to Parliament by the Prime Minister, Mr Harold Wilson 16 January 1968 (Hansard Vol 756 cc 1577-620). London: Hansard.
Wiltshire, Horden. 2001. "Submarines: an Australian view." In *Maritime War in the 21st Century*, edited by David Wilson, 249-257. Canberra: Royal Australian Navy Sea Power Centre.
Woolner, Derek. 2001a. Getting in Early: Lessons of the Collins Submarine Program for Improved Oversight of Defence Procurement. In *Research Paper*. Canberra: Department of the Parliamentary Library.
Woolner, Derek. 2001b. How Kockums was Selected for the Collins Class Submarine. In *Research Paper*. Canberra: Parliament of Australia.
Woolner, Derek. 2009. "Taking the Past to the Future: The Collins Submarine Project and Sea 1000." *Security Challenges* 5 (3):47-71.
Wrigley, Alan K. 1990. The defence force and the community : a partnership in Australia's defence : report to the Minister for Defence. Canberra: Australian Government Publishing Service.
Wunderlich, Carmen. 2013. "Moving beyond neutrality: Sweden's changing attitude towards the military use of force." In *The Militant Face of Democracy: Liberal Forces for Good*, edited by Anna Geis, Harald Muller, & Niklas Schornig, 269-305. Cambridge: Cambridge University Press.
Wylie, Bob. 2006a. "Supplying and supporting Australia's military capability." In *Growth 57: The Business of Defence - Sustaining Capability*, edited by CEDA, 50-63. Melbourne: CEDA.
Wylie, R., S. Markowski, & P. Hall. 2006b. "Big Science, Small Country and the Challenges of Defence System Development: An Australian Case Study " *Defence and Peace Economics* 17 (3):257-272. doi: 10.1080/10242690600645233.
Wylie, Robert. 2007. "A Defence Policy for Australian Industry: Are We There Yet?" *Security Challenges* 3 (2):53-71.

Wylie, Robert. 2010a. "Defence Industry Policy 2010: The Combet Iteration." *Security Challenges* 6 (3):59-77.

Wylie, Robert, & Stefan Markowski. 2010b. "The Australian defence value-adding chain. Evolution and experimentation." In *Defence Procurement And Industry Policy: A Small Country Perspective*, edited by Stefan Markowski, Peter Hall, & Robert Wylie, 187-208. Abingdon: Routledge.

Wylie, Robert Charles. 2014. "Why innovation outcomes differ among defence innovation systems: a comparitive study of radar innovation in Sweden and Australia." Doctor of Philosophy, School of Business UNSW@Canberra.

Xenthos. 2017. A Retrospective of the COLLINS Class Signature Measurement Program and Consideration of the Corresponding Requirements for SEA 1000. Perth: Xenthos.

Yin, Robert K. 2014. *Case Study Research: Design and Methods*. 5th ed. Thousand Oaks, California: SAGE Publications.

Yule, Peter, & Derek Woolner. 2008. *The Collins Class Submarine Story: Steel, Spies and Spin*. Cambridge: Cambridge University Press.

Zandee, Dick, Margriet Drent, & Rob Hendricks. 2016. Defence cooperation models. Lessons learned and usability. In *Clingendael Report*. The Hague: The Clingendael Institute.

Zunneberg, Christel. 2017. "Multilateral Effect of Dutch-German Bilateralism in the EU." *Spectator*, 20 November 2017. https://spectator.clingendael.org/en/publication/multilateral-effect-dutch-german-bilateralism-eu.