Flinders University
Australian Industrial Transformation Institute

The Defence Dividend – *Maximising spillovers from investment in maritime defence projects*

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The Defence Dividend:

Maximising spillovers from investment in maritime defence projects

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Substantial investment in maritime defence projects in Australia provides a pipeline of projects capable of generating significant beneficial economic and employment outcomes for South Australia and the nation. Around $90bn will be invested on the construction of submarines, Future Frigates and Offshore Patrol Vessels. While this activity will have significant direct industry development and employment impacts it will also generate substantial indirect economic benefits. In particular this is due to the complexity (or knowledge-intensity) of the projects, which could be leveraged to help accelerate the uptake and diffusion of advanced technologies, applications of new materials, enterprise knowledge and innovative business models, and high-performance production systems (e.g. the industrial internet) in a wide range of industry sectors. Contributions to increasing the complexity of Australia's industrial structure are of great strategic importance given the loss of the automotive manufacturing industry - an industry that has played a significant role in modernising manufacturing.

> *The spinoffs into the rest of the economy will be immense. The defence industry is at the very cutting edge of technology.*
>
> Prime Minister Malcolm Turnbull, Announcement of Submarine partnership with DCNS, 26 April 2016

The suite of maritime defence projects is among the most sophisticated engineering endeavours ever undertaken in Australia. As well as providing highly desirable and strategically valuable opportunities for Australian industry participation, major defence projects demand highly skilled and qualified people. They also generate a range of spillovers, which are economic and social benefits that cannot be easily captured by the firms directly involved in the delivery of a major project. This includes knowledge, technologies, enterprise capabilities and workforce skills developed or applied during the course of a major defence project that have commercial application. National and international examples of spillovers from past defence projects are summarised in Section 3.

While the combined projects have the potential to accelerate industrial transformation and diversification efforts locally and nationally, this cannot be taken for granted. Steps need be taken to optimise the outcome. The challenge facing industry, government and the research community is to develop and successfully implement strategies capable of maximising the full range of industry and employment opportunities that arise – a challenge that requires all key stakeholders being committed to leveraging the economic benefits that complex defence projects can generate. This briefing is designed to inform discussions on what the key ingredients of a successful strategy of spillover maximisation might be, recognising that a parallel discussion is underway on how to maximise Australian industry participation in defence projects.

> *As a focus for advanced manufacturing, the sector also helps to grow the general economy by developing human capital and generating innovation and spillovers into the broader national industry.*
>
> ASC

1.1 Why spillovers matter

When a prime contractor (PC) supplies a government with a defence product like a submarine, the complexity of the project demands that they require a supply chain of specialist companies to operate as sub-contractors on the delivery of the project. This transaction has economic benefits

to supply chain companies that cannot be easily captured by the PC. Benefits of large projects often spill over to firms in and around the supply chain through formal and informal interaction between individuals and companies. The PC inadvertently transfers commercially valuable knowledge of technology, processes and practices to other firms. These benefits can have application within a firm's existing supply chain, or to 'adjacent' technologies or products in other sectors. They are sometimes called 'positive externalities' but are more commonly known as 'spillovers'. Spillovers describe the way information relating to the prime contractor's research and development (R&D), product specifications and innovative processes become more broadly available through their engagement with other participants in a project. For suppliers to meet the requirements of a prime contractor which is in turn delivering a product to their customer, they must engage in the exchange and sharing of knowledge. The PC creates opportunities for sub-contracting firms to participate in a process of innovation, and these spillovers are the inevitable and unintentional (yet often beneficial) result of this process.

Spillovers give firms access to knowledge and technology not previously available to them. They occur because of the way the PC produces a 'dual product' – a submarine and a 'cloud' of knowledge, skills and technology that other firms can benefit from by harnessing spillovers in the cloud for their own innovations[1]. Through this, firms can innovate their own production processes and product/service offerings. This means that their participation in maritime defence projects can lead to the development of new and higher-value products, provide access to new markets and create new forms of knowledge and skill-intensive employment. Firms not involved in defence supply chains can also be major beneficiaries of spillovers through participation in industry networks that seek to commercialise defence originated technologies and systems and through informal exchange of knowledge and skills with industry colleagues. In all these ways the presence of major defence projects can help to accelerate industrial modernisation and diversification, generating increased demand for knowledge and skill-intensive jobs.

1.2 Spillover maximisation

Certain conditions need to be present to maximise beneficial spillovers. These include:

- a demanding customer – a government customer with a well-developed understanding of the procured product's value that translates to demand (reflected in policy);
- a collaborative prime contractor – a supplier that demands high-quality supply to its product R&D and so contributes to the development of local industrial capability by taking on a role as a 'technical university' to train workforces and share knowledge of processes with sub-contracting firms; and
- entrepreneurial local firms – local industrial capabilities to capture spillovers from the prime contractor in order to develop industrial competence.

The quality of a maritime defence project often begins and ends with the quality of the customer. In the case of highly sophisticated vessels, this includes how capable the customer is of understanding the value and importance of the product they are procuring, how willing they are to pay for it, and how much they contribute to developing new technologies for it. If the customer is involved in project development and focused on the best possible outcome, the product will be more advanced and the technology and knowledge spillovers available in the 'cloud' will be much

[1] Eliasson, 2011a

richer[2]. The competence of the customer drives its demand for a high-quality product, this drives the PC to provide a high-quality product and the sharing of knowledge with supplier firms that makes this possible defines the collaborative essence of defence industry innovation. Local firms can capture spillovers if they are entrepreneurial enough, and with their participation build competence so that local industry becomes a 'competence bloc'[3] that sustains capability and forms the foundation for local industry clusters that can supply to future maritime defence projects. Eliasson has described the way that the competence bloc is the 'total infrastructure' needed to innovate, build entrepreneurialism, attract venture capital, maximise spillovers and exploit new developments in new markets[4].

The success of local firms and industry networks as a competence bloc can be measured by the growth of their export capabilities and the diversification of their product offerings. Binding these factors together with collaborative engagement between government and the PC is the key to encouraging innovation and maximising spillovers. Government, industry and the research community can all play a key role in helping to realise this objective.

Lessons for policymakers and industry

While cost effective delivery of safe and reliable defence equipment is of paramount importance, the Federal Government has also indicated it is strongly committed to maximising local industry participation in ship and submarine building projects. This is challenging in practice, requiring significant strategic positioning during contracting, design, construction and sustainment phases. Obstacles to this were identified in the Defence White Paper, which identified a culture of 'risk aversion' which produces a 'path of least resistance' approach to defence industry policy. The White Paper favours a 'management of risk' approach, which requires a highly engaged and participatory public customer in the procurement process. Collaboration from the beginning can minimise risk to both the customer and the PC.

It is important to understand that maritime defence vessels are amongst the most industrially and economically complex products made anywhere in the world today. Complexity is a synonym for, or is equivalent to, the knowledge intensity of the production process and its accompanying interdependent value chain. For example, a submarine consists of various sophisticated systems, from the weapons systems, to its detection systems, sonars, various automation, and a vast array of others. All of these 'discrete' systems need to communicate with each other safely and effectively, and without foreign detection. This requires a 'system of systems' or systems integration – economic complexity par excellence.

Underlining the point about the importance of strategic positioning at the critical phases of such projects, it is worth registering that the conditions surrounding systems integration are crucial from the viewpoint of localising and capturing spillovers. Local involvement in systems integration provides at least the potential for involvement in key technology decisions and opportunities for local industry involvement generally. This can be seen in contrast to a situation in which systems

[2] Eliasson, 2011a

[3] Carlsson & Eliasson, 2003

[4] Eliasson, 1996 p. 14

integration defaults to offshore, off-the-shelf purchase of a 'black box' system, about which even the purchaser may not be well informed[5].

It is in aid of localising and capturing benefits within an economy from major knowledge intensive projects such as these, that governments around the world firstly, 'build locally' and secondly, apply 'advanced procurement as industrial policy' approaches to them. As implied above, Australia has been by comparison reluctant to embrace such policy. However, the latest government statements on the approach to the naval shipbuilding and engineering projects suggest a desire to set a more strategic course[6].

An entrepreneurial local industry is as important to maximising spillovers as a favourable strategic environment. This is because local industry will only be able to capture the benefits from spillovers that they are capable of identifying and utilising. (Of course, having a favourable strategic environment will also lead to the expansion of an entrepreneurial local industry over time). Participation in the process of innovative discovery is of crucial value to local industry and local enterprise must be capable of addressing opportunities and attracting venture capital. Government's role as a 'double customer' can assist where its interest in procuring a high-quality product maximises the benefits of R&D spillovers, incentivising local firms to take risks with new technology and innovative processes. A focus on industry capability development must take precedent to ensure that outcomes from innovation processes are maximised.

Prime contractors must be fully aware of the crucial role that they play in maximising local industry participation. Experience of the operation of the international offsets market tells us that the advanced firm is critical not only to local industrial development, but for national competitive advantage. The convergence of a global market for defence procurement and growing national desire to maximise wider economic benefits from defence investment means that defence prime contractors must focus time and attention on local industry participation.

A further important consideration for industry is intellectual property (IP). A range of IP-related issues will feature in the development of defence industry capabilities, particularly where projects involve foreign contractors developing defence material domestically. The production of advanced products in Australia by foreign firms represents an opportunity for local suppliers to learn from the prime contractor and participate in the process of innovation through maximisation of spillovers. However maximisation of economic benefits requires more than just the right policy context. The PC must be aware of its strategic role in developing an advanced industrial workforce and building sophisticated firm competencies through its supply chain. In this way it becomes the foundation for a 'technical university' – a focal point for building a sophisticated supply chain capable of engaging in the global defence industry and a force for accelerating the uptake, diffusion and commercialisation of advanced technologies, processes and ideas.

1.3 Defence Industry White Paper

In 2016 the Federal Government released the *Defence White Paper* which provided an overview of the Australian defence industry, its economic and strategic significance, and discussed the

[5] This in turn raises issues concerning through-life performance, lock-in or dependency on a single powerful vendor, and many other issues that often support a local build for reasons of defence effectiveness and efficacy, quite apart from economic considerations. But this complex of issues is beyond our present scope.

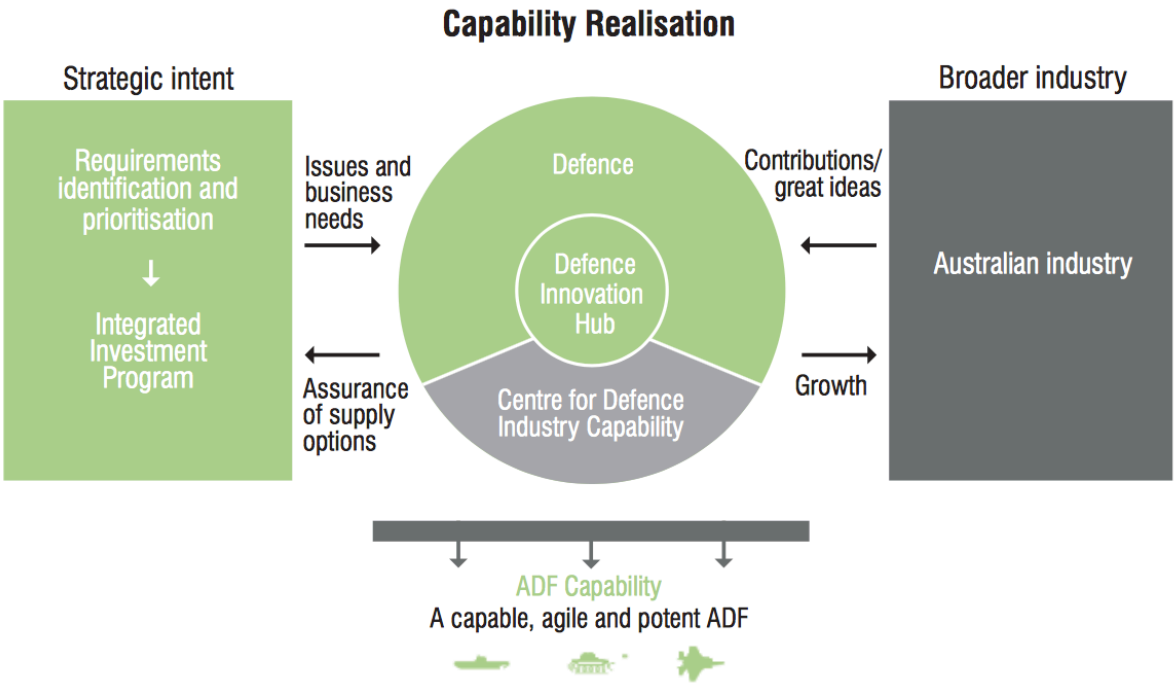
[6] Again, there are also strong arguments for local build to do with the strategic and operational effectiveness of the fleet, quite apart from the economic benefits.

concept of spillover effects generated by the industry. In its preparation of the White Paper, the Defence Sub-Committee learned that although Defence assumes that spillovers are generated by its industry innovation and export assistance programs, they are difficult to measure and so in terms of economic impact, are not considered in evaluations of defence procurement tenders[7].

The White Paper identified that while Defence's Industry policies supported local industry engagement in major projects, it had difficulty translating this into practice. The White Paper concluded that there was "a gulf between policy and practice when it comes to Defence interaction with industry"[8]. This presents significant challenges to those seeking to maximise local industry participation and spillovers.

To help bridge the gulf between policy and practice in seeking to maximise Australian industry participation in defence projects the Federal Government has committed around $1.7 billion to a range of initiatives (see Figure 1) detailed in the Defence Industry Policy Statement including establishment of a $230m Centre for Defence Industry Capability (CDIC), $730m Next Generation Technologies Fund and $640m Defence Innovation Hub are among a suite of new initiatives designed to help bridge the gulf between policy and practice. The development of a Defence Industrial Capability Plan is also proposed to identify 'sovereign industrial capabilities that are required to be maintained and supported in Australia'.

Figure 1: The Defence and industry partnership



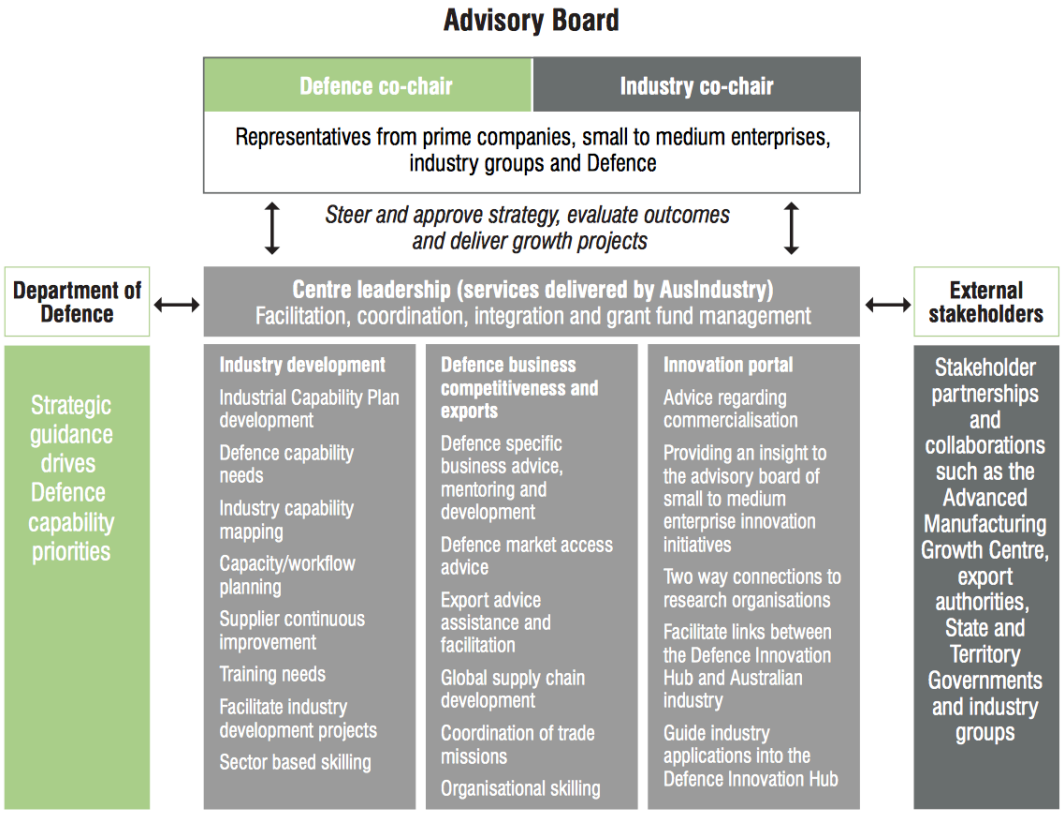
Source: Defence Industry Policy Statement 2016

[7] Defence White Paper, 2016 p. 19

[8] Ibid. p. 59

The Defence Industry Policy Statement indicates that the CDIC 'is designed to help transform the Defence and industry relationship, and to fund new industry development, critical skilling and export programs, as well as facilitate access to Defence's new innovation programs for small and medium sized enterprises'[9]. Importantly the CDIC embeds a relationship between the Federal Department of Industry, the funding body of the CDIC and the Department of Defence, formalising a requirement that new projects meet both the Federal Government's Defence and industry development policy objectives. The involvement of Paul Johnson, former Chief Executive of Lockheed Martin Australia Pty Ltd and Kim Gillis, Defence Deputy Secretary, Capability Acquisition and Sustainment as Co-Chairs of the CDIC Board is designed to ensure closer integration between these (see Figure 2).

Figure 2: Functions and relationships of the Centre for Defence Industry Capability



Source: Defence Industry Policy Statement 2016

[9] Defence Industry Policy Statement, 2016, p 16

2 Towards a more strategic approach to maximising spillovers

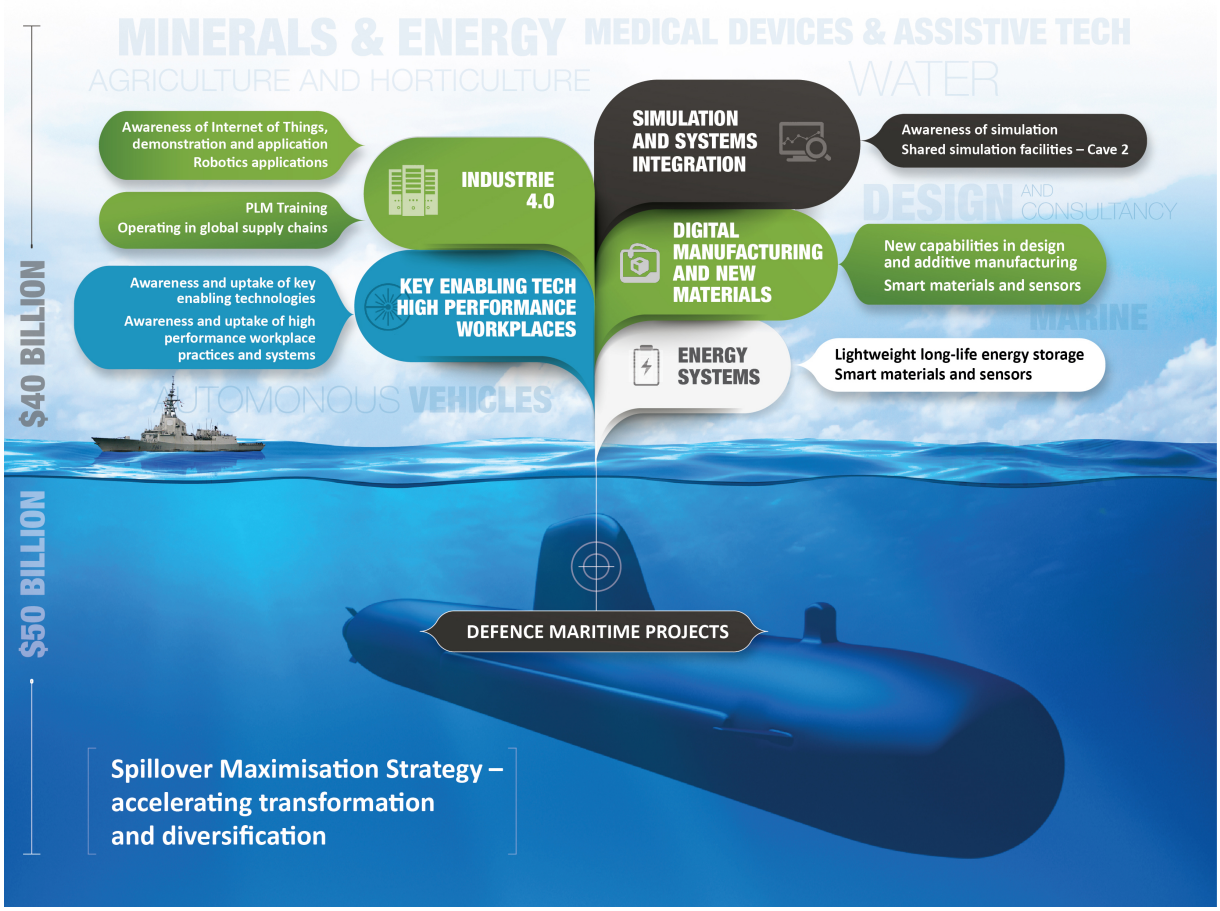
The CDIC and Defence Innovation Hub will both play important roles in maximising the participation of Australian companies in defence project supply chains. Reinforcing this is a requirement on prime contractors to develop Industrial Capability Plans that seek to maximise local industry participation and support the growth of export capable companies. The CDIC and Defence Innovation Hub will be important enablers of these objectives.

This is an opportunity in this context to put in place measures that help to maximise potential spillovers, particularly those that help accelerate efforts to build new knowledge intensive industries and jobs. Past experience demonstrates that participation in defence projects can have dual benefits for companies through knowledge and technological spillovers. More broadly it can deepen the knowledge and skills base of regional economies. Maximising these benefits and those that might be captured by companies outside defence supply chains requires attention to strategic measures that might be implemented successfully in the Australian context. Much has been made of the potential benefits of various spillover maximisation strategies in other nations but these operate in quite different policy contexts, often in the presence of offset agreements.[10]

In the Australian context it would be prudent to initiate a collaborative process for early examination of potential spillovers and how these might be maximised. Figure 3 identifies a range of potentially fruitful targets for such an inquiry. The suite of maritime defence projects will be among the most intensive users of advanced technologies and processes, deepening the capability base of the defence supply chain and knowledge and skills base of the workforce. The projects will necessitate extensive application of simulation technologies, systems integration, digital manufacturing, robotics and automation, new materials, disruptive technologies like nanotechnology and 3D printing, energy storage technologies and high performance workplace systems. As the intensity of the application of these in the defence sector increases so does the possibility that they might be more widely applied in other sectors including health and ageing, mining, transportation, agriculture and horticulture and construction.

[10] An offset agreement is an agreement between two parties whereby a supplier agrees to buy products from the party whom it is selling, in order to win the buyer as a customer and offset the buyers outlay.

Figure 3: Potential Spillovers



To maximise potential beneficial spillovers, a range of strategic measures warrant detailed consideration. These include:

- embedding government as a sophisticated and demanding customer in project contracts, with mutually reinforcing reciprocal obligations alongside contractors to deliver the highest quality outcome for Defence while maximising industry participation and wider industry development opportunities for Australian companies.
- ensuring that defence project contracts and subcontracts include clear expectations of knowledge, technology and skill transfer from defence to commercial applications and mechanisms that enable this to be realised in practice.
- systematic and sustained mapping of potential multi-sector commercial applications of knowledge, technologies and skills present in defence projects.
- building the absorptive capacity of companies both within and outside the defence project supply chain to adopt new technologies, knowledge, workplace innovations and skills.
- developing a dedicated defence technology, knowledge and skills commercialisation and financing capability.
- developing strong industry, government and research partnerships and collaborative processes that underpin active exploration of commercial applications of defence

technologies and the knowledge, processes and skills acquired during the implementation of major projects.

A collaborative process for consideration of these and other measures would be timely given the establishment of the CDIC and Defence Innovation Hub.

3 Spillovers at a Glance

Australian case study examples					
Company/consortia	***Project (Procurer)***	***Date***	***Spillover***	***Outcomes/innovations***	***Capabilities developed as a result***
Bisalloy Steel (NSW) Australia's only manufacturer of high-tensile and abrasion-resistant quenched and tempered steel plate under the brand name of "BISPLATE®".	FFG 7 guided missile frigates (ADF)[11]	1988	***Technology transfer*** – steel plate development in collaboration with BHP & DSTO	Developed steel technology capable of supplying to other defence projects; product developed to US specification and outperformed US competitors	Bisalloy has increased its science, technology and manufacturing processes in the production of defence products so that its commercial products have reached the same standards, with quality assurance meeting ISO 9001 Bisalloy's export sales to US, India, Middle East and Asia have grown significantly Bisalloy is positioned to respond to design, development and manufacturing needs of Australia's defence requirements into the future
	Collins Class Submarines (ADF)[12]	1980s – 2003	***Technology transfer*** - developed steel technology from Swedish prototype in collaboration with BHP & DSTO to create submarine steel plates	Supplied more than 8,000 tonnes of steel to the Collins sub project over its 15 year life	
	Bushmaster (ADF)[13]	1990s –	***Technology transfer*** - used BlueScope Steel product to develop new steel technology in collaboration with DSTO	Created high-performance armour plating; over 3,500 tonnes supplied to Bushmaster program since 1993	
Austal (WA) An Australian global shipbuilder, defence prime contractor and maritime technology partner of choice; designing, constructing and supporting revolutionary defence and commercial vessels for the world's leading operators.	Joint High-Speed Vessel, Littoral Combat Ship (US Navy)[14]	2000s –	***Technology transfer*** – US Navy vessels must be built in the USA in compliance with Navy building regulations; Austal benefited from US IP by building vessels at its facility in the USA after designing and project managing from Perth, WA	Austal continues to play a through-life support role to the vessels and train US workforces; critical component manufacture in Australia is ongoing	Austal's capabilities and new manufacturing technologies have been applied to other nations' naval procurement projects as well as commercial applications Potential deployment of US vessels to South-east Asia would see them based in Darwin; potential continued through-life support role for Austal

[11] TASMAN ECONOMICS 2002. Impact of Major Defence Projects: a case study of the Minehunter Coastal project. Canberra, Australia.

[12] ACIL ALLEN CONSULTING 2013. Naval Shipbuilding & Through Life Support - Report to Australian Industry Group. *Economic Value to Australia - Maintaining Capabilities and Capacity.* Brisbane, Australia.

[13] Ibid.

Favcote (NSW) Australian-owned SME specialising in preparation for and application of protective coatings; has capabilities in marine, commercial and industrial sectors	Collins Class Submarines (ADF)[15]	1990 – 2003	***Technology transfer*** – 'sponge jet blasting' developed for defence projects	Successful use of technology on defence projects led to Favcote's role as supplier to ACS for Collins submarine through-life support as well as AWD project Adaptation of naval shipbuilding and repair technology has seen interest from construction industry	Growth in demand has led to Favcote increasing workforce capabilities through internal training and up-skilling of employees, increased opportunities for the firm to work across industries and sectors
H.I. Fraser (NSW/WA) Design, manufacture, supply and maintenance of high pressure and hazardous gas systems	Collins Class Submarines (ADF)[16]	1990 – 2003	***Improved programs and practices*** – ASC provided opportunities for H.I. Fraser to develop skills in quality programs, project management, risk mitigation, project planning and other documentation	All areas of company skills development underpin basis of its current business, improving its capability Was able to participate in other ADF contracts – AWD, Minehunter Focus on niche markets, away from commodities – remaining competitive in contemporary production climate	Participation in Collins subs project allowed H.I. Fraser to transform from boutique manufacturer with $2m turnover into SME with 75 employees and $35m in sales (including exports) Developed experience and knowledge of processes to resolve large and complex issues that it would not have achieved without participation in defence procurement Systems and certifications with ISO 9001 accreditation; competencies capable of delivering to multi-national oil and gas contractor standards Capability to enter oil and gas industry – accounts for 30% of revenue

[14] Ibid.

[15] Ibid.

[16] Ibid.

MCM Manufacturing (NSW) Engineering and manufacturing solutions – fabrication, heavy engineering, fitting, pressure vessels expertise	Minehunter Coastal Project (ADF)[17]	1996 –	***Knowledge and technology transfer*** – R&D to develop new technologies capable of supplying components (rudders) to defence project	Use of technology in private sector contracts	Increased capability to supply defence projects – supply of manufactured equipment for ANZAC frigate project
Transform Composites (NSW) Plastic composite fabrications	Minehunter Coastal Project (ADF)[18]	1996 –	***Knowledge and technology transfer*** – initially contracted to construct doors & hatches from glass reinforced plastic; benefited from information provided by prime contractor to manufacture new composite technologies with lower magnetic signature to meet defence specification requirements	New technology applied to manufacturing products raised efficiency and quality – the innovation created opportunities for supply to the private sector	Increase in overall productivity, lessons learned from defence project innovations have been applied across the company's non-defence contracts
Baker and Provan (NSW) Heavy engineering, fabrication and reclamation specialists	Minehunter Coastal Project (ADF)[19]	1990s	***Knowledge and technology transfer*** – knowledge obtained from strategic partnership with an Italian business supplying to MHC development enabled the firm to design multipurpose cranes for MHCP vessels	Insights obtained helped the company advance its design in major ways	Insights have increased the company's ability to supply Defence and prime contractors in procurement projects
Marine Plant Systems (WA) Sewage waste systems	Minehunter Coastal Project (ADF)[20]	1996 –	***Market, knowledge and technology transfer*** – company began as importer of marine equipment from European manufacturers, but involvement with MHCP	Strategic partnership with European manufacturers provided knowledge and technology for the firm to transform from an importer to a manufacturer and supplier to defence projects; operations expanded into international markets	Company is now recognised as a global leader in sewage waste systems

[17] TASMAN ECONOMICS 2002. Impact of Major Defence Projects: a case study of the Minehunter Coastal project. Canberra, Australia.

[18] Ibid.

[19] Ibid.

[20] Ibid.

Ferrocut (SA) South Australia's leading profile cutting company with services and products to multiple sectors	Air Warfare Destroyer (ADF)[21]	2009 –	***Improved capabilities and readiness*** – indirect work on several defence procurement projects developed Ferrocut's capability to provide precision components to the AWD project as a Tier 1 supplier	Direct supply to AWD project allowed Ferrocut to locate next to ASC in new facilities, expanding its footprint in the defence industry – first firm to purchase land in Techport Australia Supplier Precinct at Osborne	Prime positioning for future contracting, i.e. Future Submarines project, future defence capability needs; ability to maintain defence industry capabilities in South Australia
International case study examples					
Company/consortia	***Project (Procurer)***	***Date***	***Spillover***	***Outcomes/innovations***	***Capabilities developed as a result***
Saab (Sweden) Swedish aerospace and defence company	Gripen military aircraft project (Swedish Air Force)[22]	1980s –	Development of ***direct technologies***: Core technologies – production of subsystems for Airbus and Boeing; civilian aircraft engine systems ***Related technologies*** Civil security; engineering – light-weight technologies; integrated production	Indirect diffusion of technologies to other industries: Mobile phones, traffic systems, computer and information systems; automotive safety	Regional industrial competence: University research collaboration with aircraft industry, medical applications industry development, digital signal analysis, image recognition, and microwave communications technology competences

[21] ACIL ALLEN CONSULTING 2013. Naval Shipbuilding & Through Life Support - Report to Australian Industry Group. *Economic Value to Australia - Maintaining Capabilities and Capacity.* Brisbane, Australia.

[22] ELIASSON, G. 2011b. Macroeconomic Benefits from Advanced Public Procurement: the Swedish Gripen project. *Sweden Defense Industry Conference.* Washington DC, USA., ELIASSON, G. 2011a. Advanced purchasing, spillovers and innovative discovery. *Journal of Evolutionary Economics,* 21**,** 121-139.

Saab/British Aerospace ***(intermediating joint industrial firm) (Sweden/UK)***	Purchase of 39 Gripen aircraft by South African military; accompanied by industrial cooperation programs to support local South African capacity to benefit from spillovers and presence of Swedish firms	1995 –	***Transfer of management knowledge*** and access to Swedish firm information and expertise ***Technology transfer*** – manufacturing precision and quality control requirements of subsystems and components	Improved business practices; delivery commitments honoured by suppliers has developed a modern logistics system (improved participation in globally distributed production)	Development of competent local sub-contractor industry capabilities Industrial cooperation has helped local firms reach foreign commercial markets Contribution to development of a growing pool of skilled and experienced workers[23]
General examples					
Country/region	***Project (Procurer)***	***Date***	***Spillover***	***Outcomes/innovations***	***Capabilities developed as result***
Australia	ANZAC ship project (ADF)[24]	1989 - 2005	***Technology transfers*** – from prime contractor to supplier SMEs leading to commercial applications ***New business techniques*** – SMEs developed skills from participation in defence contracts	Economic benefits – significant growth in GDP, consumption and employment over life of the project Stronger and more productive Australian businesses – use of new technology, better business practices and more productive/dynamic firms	Exports increased – ASP suppliers five times more likely to export than other Australian manufacturers Improved defence capabilities and defence industry capabilities Lower through-life costs – lower costs from maintaining and upgrading defence equipment in Australia instead of overseas where high levels of Australian industry involvement will ensure high levels of local participation in repairs, maintenance and refurbishment

[23] ELIASSON, G. 2010. *Advanced Public Procurement as Industrial Policy: the aircraft industry as a technical university,* New York, USA, Springer.

[24] IRONFIELD, D. 2000. Impact of Major Defence Projects: a case study of the ANZAC ship project. *Prepared for Australian Industry Group Defence Council.* Canberra, Australia: Tasman Asia Pacific.

United States	KC-X Tanker (USAF)[25]	2010s -	***Technology and knowledge transfer*** – new equipment and manufacturing techniques transferred from Boeing (prime contractor) to cluster of SME suppliers in regions where Boeing produces (Washington state, California)	Economic benefits – significant growth in GDP, consumption and employment over life of the project Increased productivity and product innovation over life of project	Increased competitiveness of US aircraft industry with greater capability for SMEs to supply to defence and commercial aviation contracts
Germany	Security and Defence (S&D) Industry (Germany)[26]	2000s – 2010s	***Technology and knowledge transfer*** – R&D cooperation between firms produced innovations, increased capability of firms to produce high-quality products; R&D activities of intermediate industries stimulated through the consumption of these innovative goods	Production value from spillovers was far greater than initial security and defence industry contract spend; demand for goods and services far beyond project in both S&D and commercial industries far higher rates of direct employment, income and productivity in S&D industry than manufacturing industry as a whole Private sector funding of S&D industry's expanded range of activities increased by billions of Euros between 2005 and 2011 (increase of 52%) as public sector spending on primary defence procurement increased by just 13% Vast majority of companies in S&D have established innovations on the market – double share of innovative firms in rest of German economy	Innovative capabilities in upstream sectors Massive increase in firms receiving supplier contracts from federal defence budget Spillovers from R&D cooperation led to increased firm competence – increased ability to supply defence into the future

[25] SHAPIRO, R. J. & MATHUR, A. 2010. The Employment Effects of Awarding Major U.S. Defense Contracts to U.S.-Based Firms, Compared to Foreign-Based Multinational Firms: an Economic Case Study of the Competition to Produce the KC-X Refueling Tanker. Washington D.C., USA: Sonecon LLC.

[26] OSTWALD, D. A., SCHUBERT, S. & KNIPPEL, J. 2012. Economic effects of the Security and Defence Industry (SDI). Berlin, Germany: WifOR.

European Union	Defence sector spending (hypothetical modelling)	2015	€100m investment in the defence sector generates highly skilled employment and research and development (R&D) at a rate 12-20 times greater than other areas of public spending, including major areas of government spending – transport, education, health and defence	Defence sector spending has enormous potential for long-term GDP growth[27]	

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