Leveraging Defence Innovation For Australia's Economic Growth

Australian Engineering Conference 2016

Brisbane Convention and Exhibition Centre

23rd November, 03:30 PM - 05:00 PM

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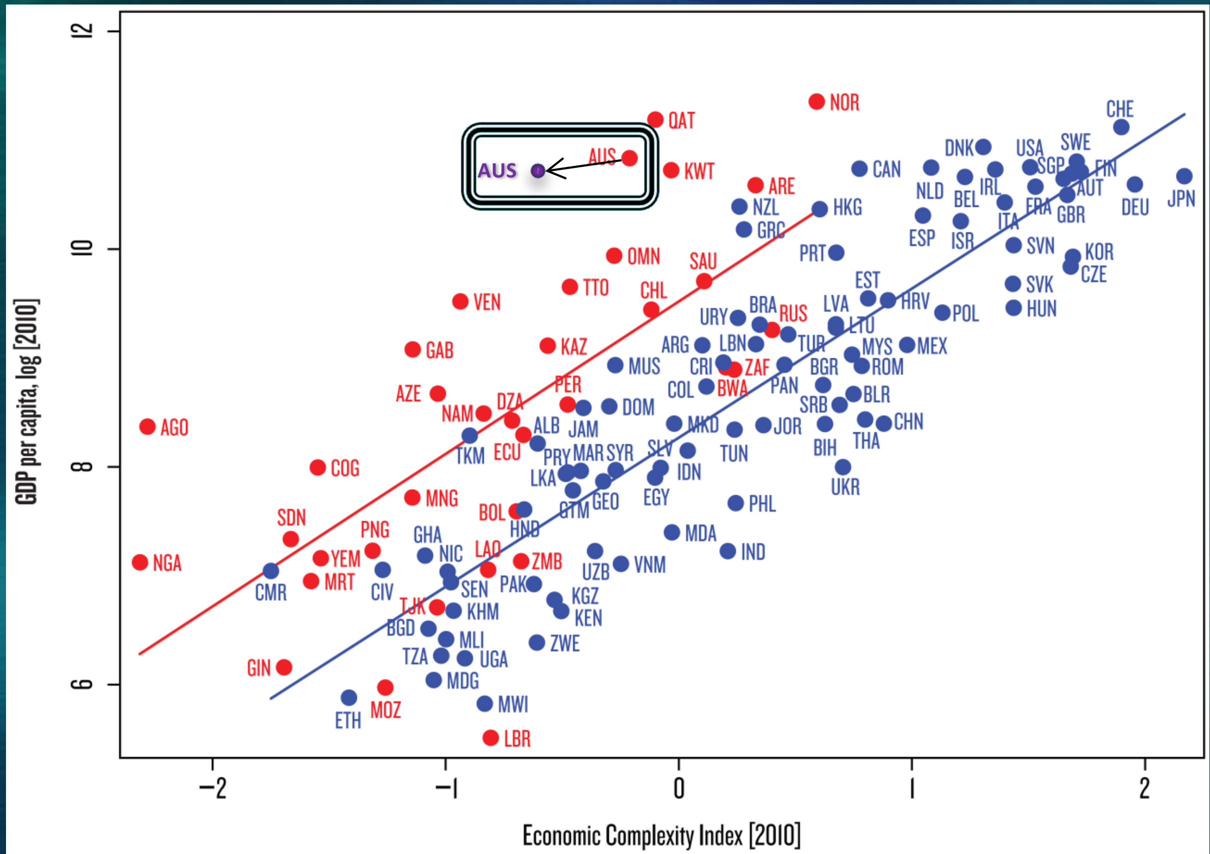
The role of Economic Complexity in generating national prosperity

- Prosperity is driven by Economic Complexity, Endowment Resources, Relational Resources and Organisational Resources.
- Changes of Economic Complexity explains about 70% of changes in Prosperity

- High Economic Complexity is achieved if an economy produce a diverse portfolio of offering of which a very high share is exported and that there are very few other economies that can produce these exported offerings

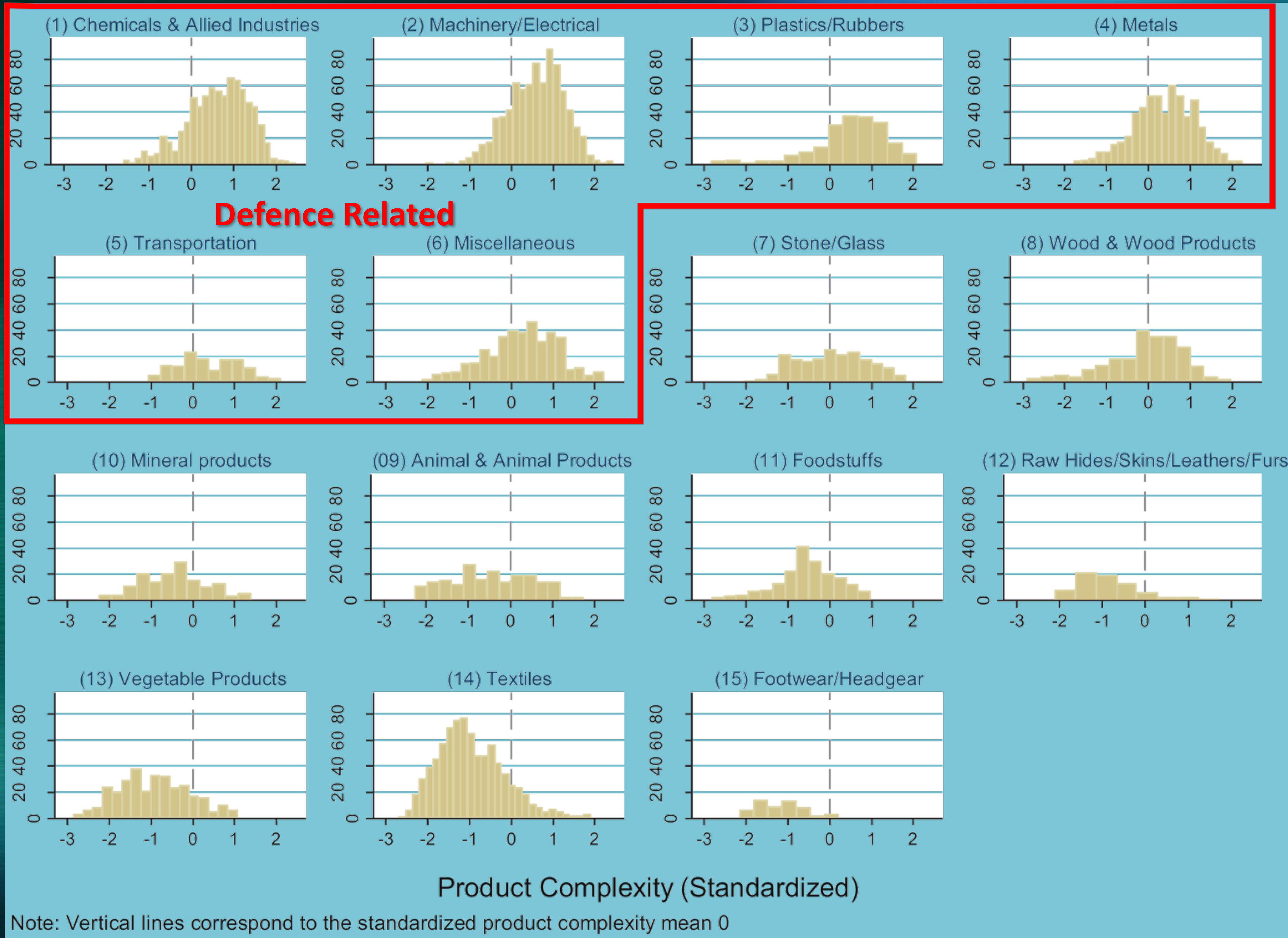


Complexity ranking of selected countries and distribution of exports across six complexity categories

Country name (ISO code)	Rank	Product complexity level (1 – highest; 6 – lowest)						
		1	Top 100	2	3	4	5	6
Japan (JPN)	1	39.7	10.0	19.0	21.9	11.4	6.6	1.5
Germany (DEU)	2	39.6	7.9	24.5	16.0	10.9	5.6	3.4
Sweden (SWE)	3	34.6	4.9	27.7	16.2	12.0	4.6	4.8
Switzerland (CHE)	4	28.6	6.8	25.8	13.9	12.4	10.1	9.2
Finland (FIN)	5	30.1	6.1	32.0	15.2	13.1	4.5	5.1
USA (USA)	6	28.1	7.2	21.5	22.8	12.9	9.4	5.2
United Kingdom (GBR)	7	27.7	5.2	22.1	17.2	13.1	6.5	13.4
Austria (AUT)	8	30.4	6.2	23.3	19.0	15.0	8.8	3.5
Belgium (BEL)	9	27.8	3.8	20.3	15.5	11.3	12.1	13.0
France (FRA)	10	26.2	3.2	22.3	22.0	16.1	7.5	5.9
Canada (CAN)	14	27.8	12.3	13.8	18.7	15.0	12.8	12.0
Norway (SVN)	16	6.2	1.0	12.4	7.6	10.8	17.9	45.2
New Zealand (NZL)	33	5.6	0.6	8.6	22.8	24.6	28.0	10.5
Australia (AUS)	40	6.2	1.8	7.2	8.0	24.7	29.7	24.1

Felipe, J., Kumar, U., Abdon, A., & Bacate, M. (2012). Product complexity and economic development. *Structural Change and Economic Dynamics*,*23*(1), 36-68.

Distribution of Product Complexity by Group using the 6-digit level classification, comprising 5132 products for 176 countries



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Multiplier Effect

- **The idea that government spending creates a multiplier effect for economy benefit was based on the economic theory of John Maynard Keynes, and published by Richard Kahn in 1931 (**Kahn, R. F. (1931). The relation of home investment to unemployment. *The Economic Journal*, *41*(162), 173-198.**)**

- **Economic multipliers can be calculated for three distinct areas of the shipbuilding industry's overall economic impact:**
  - **Direct impacts are employment and activity in the sector itself—US shipbuilding.**
  - **Indirect impacts are defined as "employment and activity supported down the supply chain, as a result of a sector's companies purchasing goods and services from" suppliers.**
    - **For example, when a shipyard is building a new Littoral Combat Ship (LCS), it may order a fire-control system to be installed that was designed in California. That same system may have been built with components from Washington State. The purchase of various equipment and supplies from vendors, as well as jobs and sales at those vendors' offices may be quantified as indirect impacts for investment in the shipbuilding industry.**
  - **Induced impacts are also of economic importance to the study of ship construction. Oxford Economics, (2009) defines induced impacts as "employment and activity supported by the consumer spending of those employed in the sector or in its supply chain."**
    - **For instance, the manufacturer of a component ordered by the shipyard for construction of a new vessel has additional revenue from the sale of that component; he spends this revenue in his local economy buying everyday goods and services, which increases benefits to local economic growth.**

Meyers, N. A. (2010). *An economic analysis of investment in the United States shipbuilding industry* (Doctoral dissertation, Monterey, California. Naval Postgraduate School).

Direct Economic Impact of an Additional $100 Million Output from Sector

Sector	Purchases made by the sector in order to produce its final output (M$)	Value Added (M$)	Indirect effects (M$)	Type 1 multiplier	Induced impact (employment and activity supported by the consumer spending of those employed in the sector or in its supply chain) (M$)	Type 2 multiplier (based on an average everything included tax rate of 35% and an average marginal propensity to save of 7%, resulting in a marginal propensity to consume of 93%)
Automobile manufacturing	**74**	**26**	**97**	2.7	**71 – 242**	3.4 – 5.1
Aircraft manufacturing	**65**	**35**	**69**	2.3	**34 - 168**	2.7 – 4.0
Armored vehicles & tank parts manufacturing	**60**	**40**	**60**	2.2	**20 - 140**	2.4 – 3.6
Shipbuilding and repairing	**57**	**43**	**52**	2.1	**9 - 118**	2.2 – 3.3
Offices of physicians, dentists, health care practitioners	**35**	**65**	**25**	1.6	**0 - 20**	1.6 – 1.8

After carrying out a literature review, the RAND report (Birkler et al., 2015) determined that the multiplier effect of spillovers is around 1.7 in Shipbuilding

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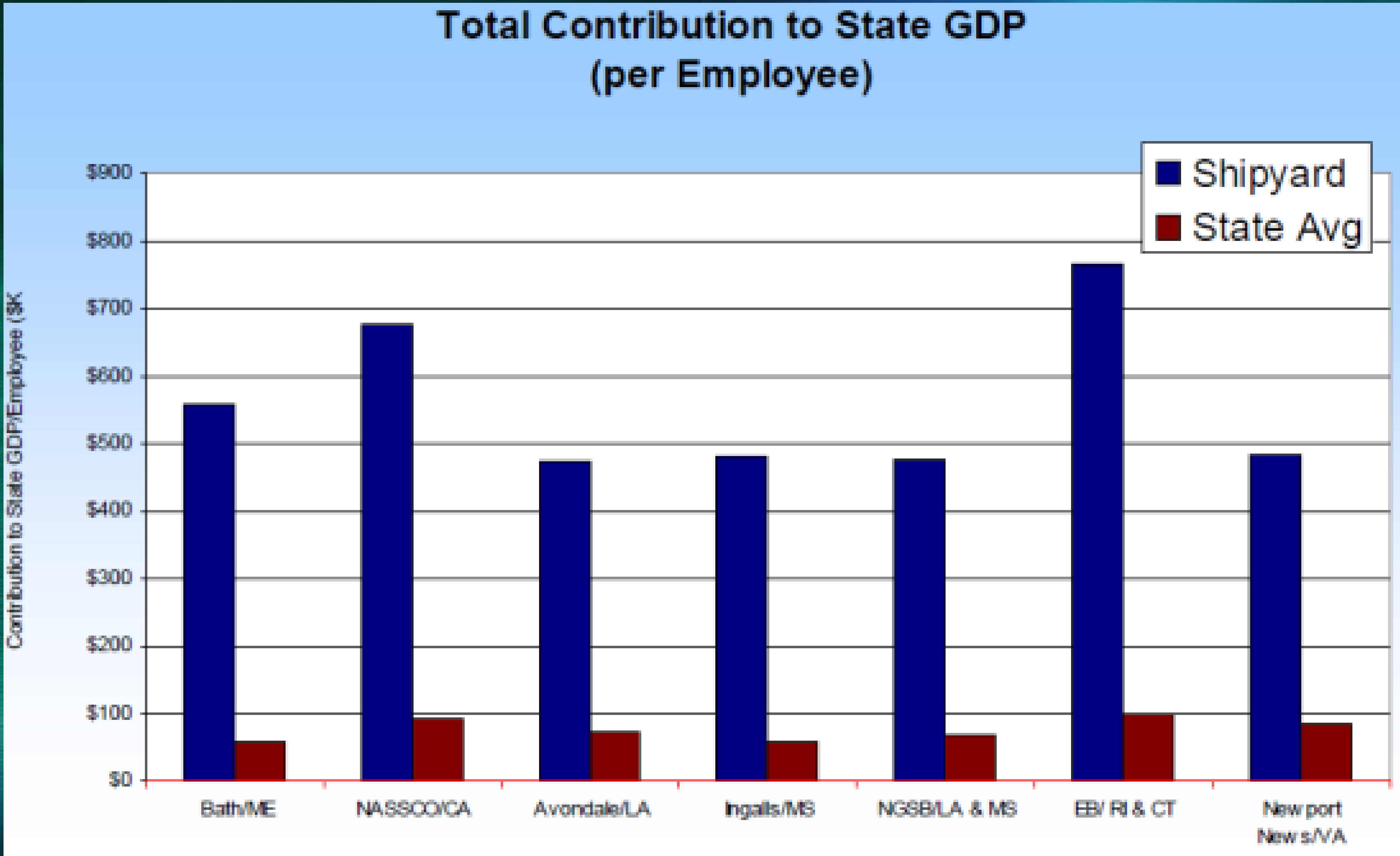
Number of Employees Needed to Generate $100 million of Output

Sector	Number of employees	Employment multiplier
Automobile manufacturing	**1380**	
Aircraft manufacturing	**1430**	
Armored vehicles & tank parts manufacturing	**1530**	
Shipbuilding and repairing	**1670**	1.45
Offices of physicians, dentists, health care practitioners	**1380**	

Program	Prime employment (Approx.)	Subcontractor employment	Employment multiplier	Multiplier for total employment effect in the economy	Source
ANZAC	1225	1335	1.52	2.85	Ironfield (2000); NIEIR (1989)
The Mine Hunter Coastal project	1800				Commonwealth of Australia. (2013)
AWD	1800	1200	1.4		Commonwealth of Australia. (2013)

Meyers, N. A. (2010). *An economic analysis of investment in the United States shipbuilding industry* (Doctoral dissertation, Monterey, California. Naval Postgraduate School).

US data indicates that a shipbuilding worker contribute more to GSP than an average worker



NAVSEA 05C Portfolio Assessment Team Economic Impact Study; Wright & Fields, 2009

Rand corporation states

- “The literature search uncovered no consensus on the effect of military spending on local and regional economies. However, the case studies suggested that spending on naval shipbuilding can have favorable local and regional effects, especially during times of overall economic distress. But those effects are localized to a large degree, and it is unrealistic to expect that shipbuilders will produce significant favorable spin-offs and spillovers. Sweden’s experience with the Gripen, which spawned ancillary jobs and start-up companies, was not seen to have been replicated in the U.S. military shipbuilding environment and, as such, might be an overly optimistic analogy for Australia’s industry”

- The JAS 39 Gripen combat jet development program has generated (in the Swedish economy) over and above the opportunity costs, an additional social return to society (a spillover multiplier) in the order of magnitude of at least 2.6 times the original development investment during the period from 1982 through 2007. This means that an average investment per year of 0.17% of the Swedish GNP, in the Gripen case, has generated a return to society of 0.43% of GNP annually. Swedish society, in effect, paid nothing for the development of the aircraft and still received significant benefits in return.

Birkler, J., Schank, J. F., Arena, M. V., Keating, E. G., Predd, J. B., Black, J., ... & Lough, R. (2015). *Australia's Naval Shipbuilding Enterprise*. Rand Corporation. P. xxxviii
Eliasson, G. (2010). Advanced public procurement as industrial policy: The Aircraft Industry as a Technical University (Vol. 34). Springer.
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Roos, G. (2014). Defence funding – an investment, not a cost. Connections. Issue 197. November

The economic benefits from advanced and complex defence systems routinely exceed the development costs of these systems because:

- The realisation of such projects requires a large number of technical problems to be solved. These projects therefore become broad-based technology drivers that generate a flow of technology spillovers. The result is a situation of dual production since there are two outcomes:
  - the defence system and
  - the spillovers that surround the development project. These spillovers predominantly originate during the product development phase – if the procurement is military off-the-shelf there will be minimal or no economic benefits.
- There will be no new products better and more sophisticated than those demanded by sophisticated and competent customers. Without competent customers who understand what is possible, know how to put what is possible to use and are willing to pay to get what they want, these types of products will not be developed. When it comes to complex and sophisticated products such as military systems, customers often contribute user knowledge.

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Defence industry – equivalent to, or better than, a high quality technical university

- Long-term competitive sustainability of any industry requires local presence of one or more technology-leading firms at its helm for the rest of the industry to learn from.
- The defence industry develops and manufactures extremely complex products, developing and using leading edge industrial technology.
- The defence industry already uses many of the technologies that will be used in the broader engineering industry tomorrow.
- It operates as, and compares well in terms of performance with, a really good technical university, both in generating and proving new technologies and in supplying well-educated and experienced workers and engineers to industry at large.
- In fact, while some advanced knowledge may be taught in principle in a university environment, many critical industrial competences, such as systems integration in which defence industries excel, can only be acquired through direct experience from production.
- In other words the presence of a sophisticated defence industry accelerates the dissemination of productivity-enhancing knowledge and practice to the broader industrial base.
- The continued role of the defence industry as a technical university for engineering industry and hence for manufacturing in general (and its associated service input industries) should not be underestimated.

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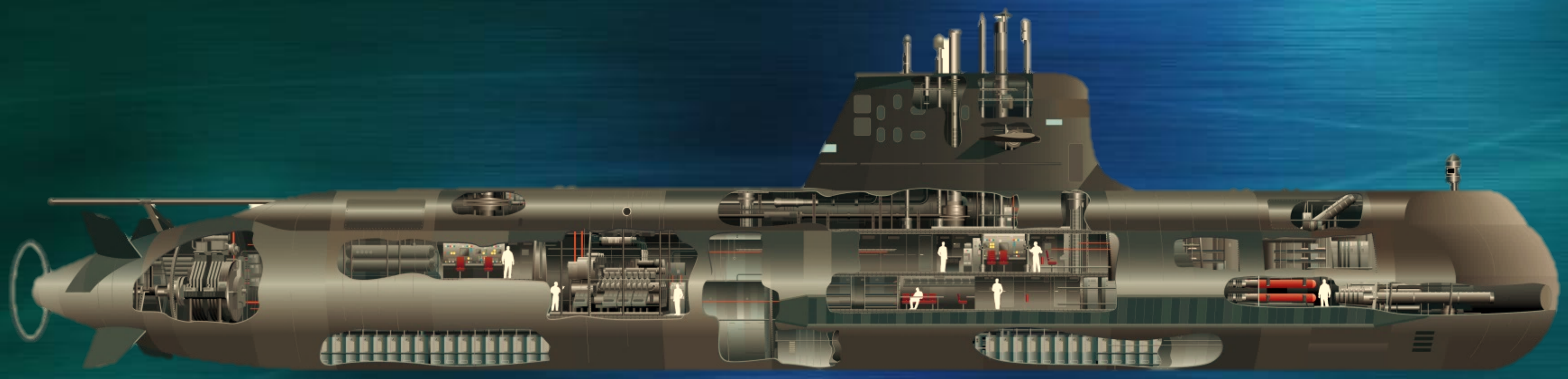
Defence R&D

- The quality of military equipment is highly correlated with absolute R&D investment (no other factor correlates anything like as well).
- The benefit in terms of equipment quality depends equally on R&D investments made about 20 years before going into service (the research phase) and on those made five years before going into service (the development phase).
- Innovation is critical to achieving effective military capability.
- Whilst innovation is necessary at all levels within the equipment supply chain, there is a need to stimulate greater innovation and inventiveness at the earlier stages of R&D.
- Defence needs access to highly capable scientists and engineers, within both government and the private sector

Sutton, P. (2007). UK policy for defence research and technology. In Cornish, P. (2007). Britain and security. The Smith Institute. London.

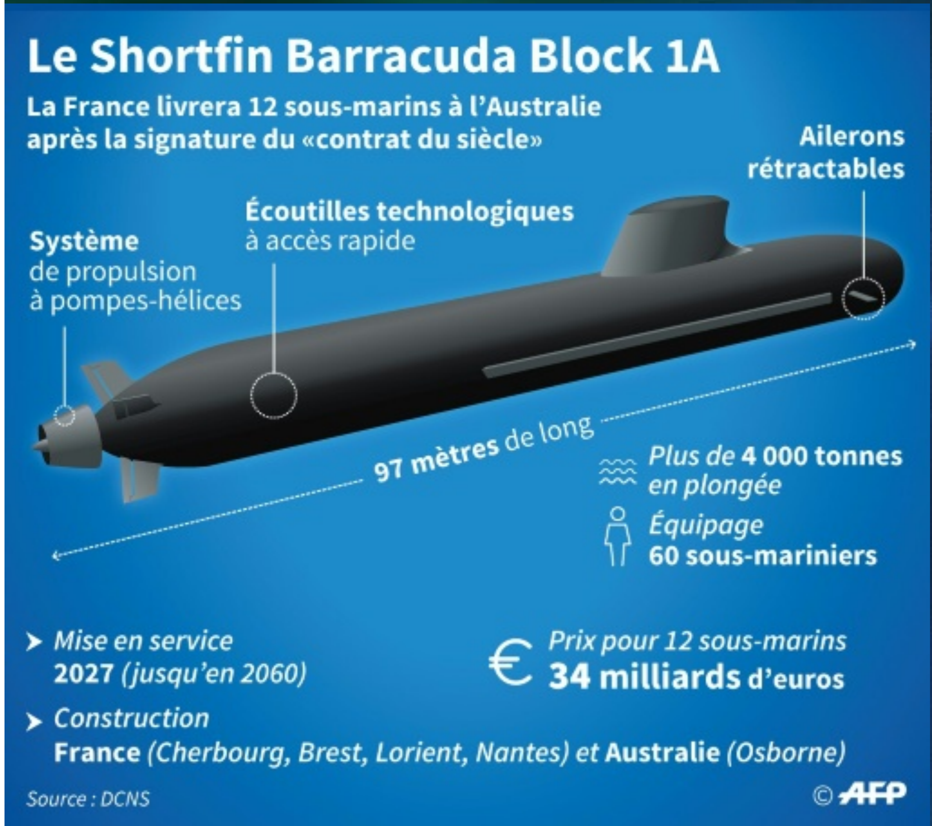
The Collins Experience



- The Collins Class build involved approx. 1600 sub-contractors
- 75% of these were based in Australia
- Officially 70% of the content was Australian in effect only around 18% was Australian
- The rest came from:

Picture from: http://www.theleadsouthaustralia.com.au/industries/defence/counting-the-real-costs-of-submarine-building-program/

Short Fin Barracuda Block 1A

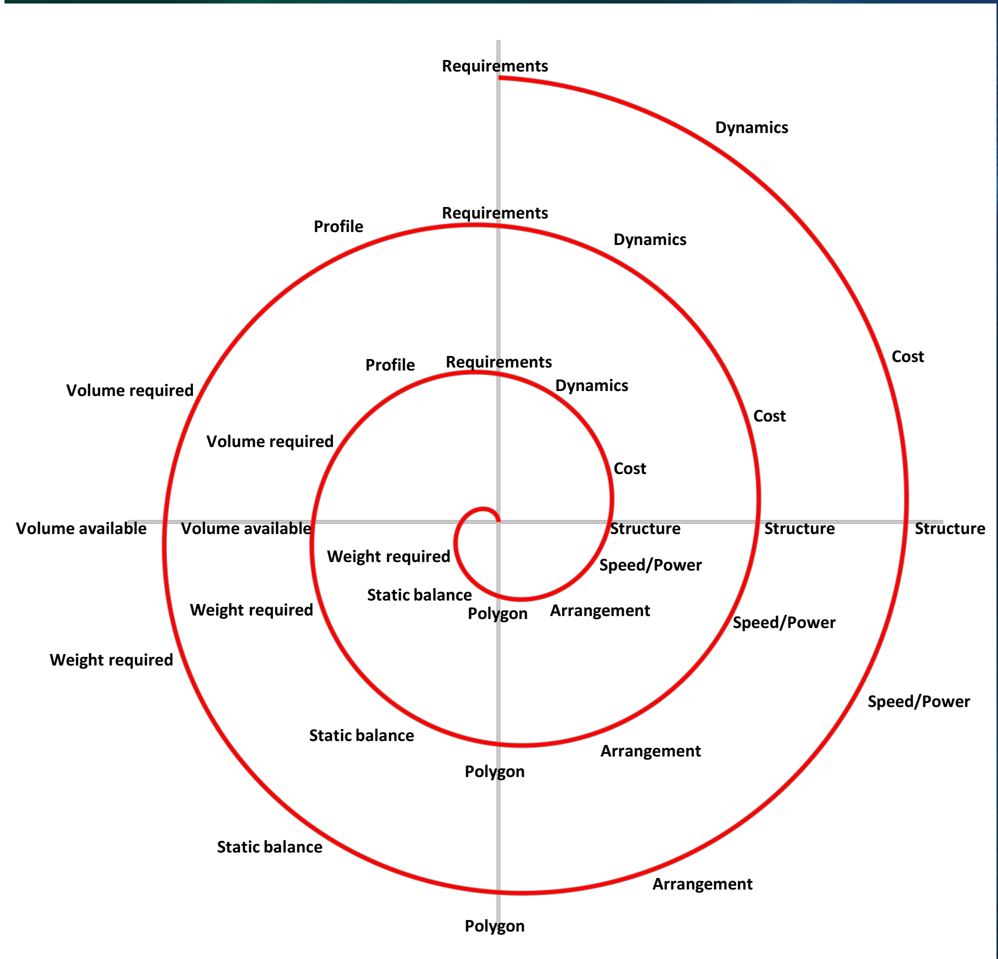


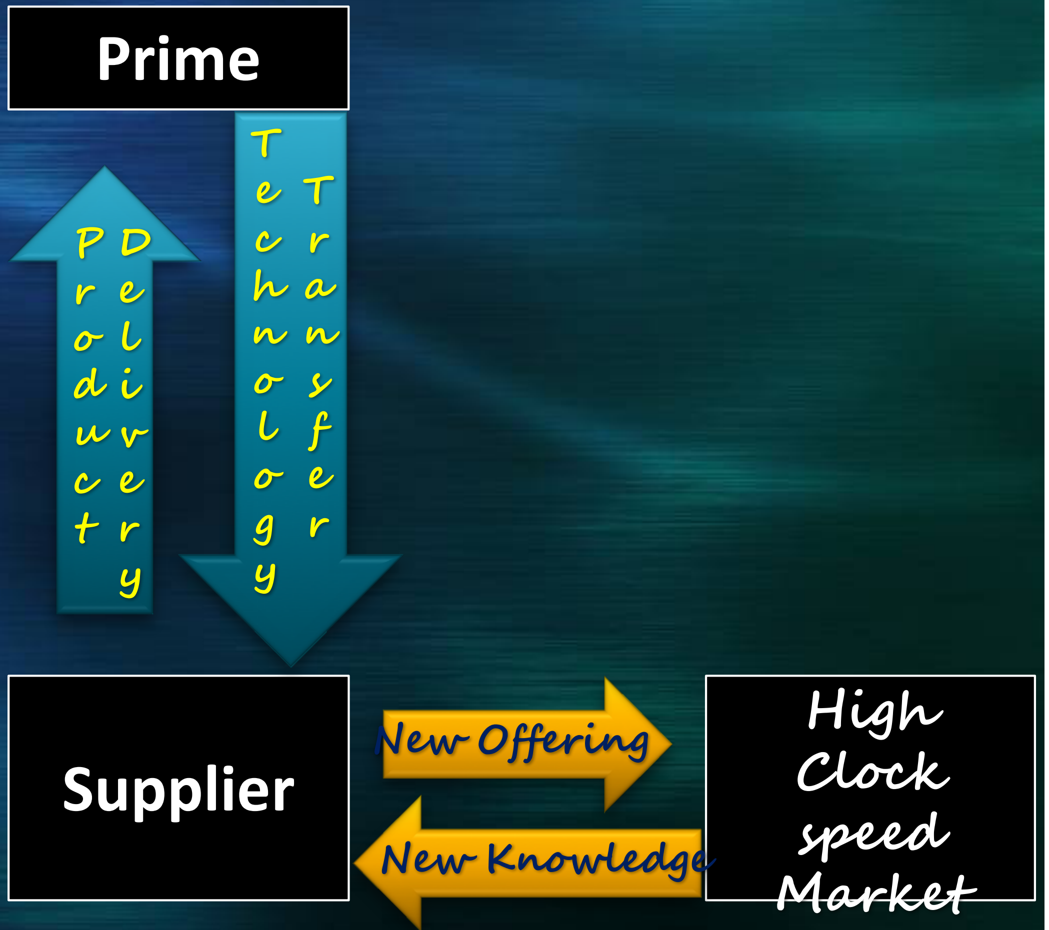
Phase	Cost (±10%)	Manhours in Design
Study	0.05%	50,000 (< 1 year)
Conceptual design	0.4%	100,000 (2-4 Years)
Preliminary design	1.1%	300,000 (3-4 years)
System & detail design	10.5%	1,300,000 (4 years)
Building	34.5%	800 manyears (4 years)
Test, evaluation and sea trials	1%	75 manyears (2 years)
Phase	**Cost (±10%)**	
Maintenance	20%	
Operation	5%	
Crew	18%	
Upgrade	5.5%	
Phase	**Cost (±25%)**	
Decommissioning	1%	
Phase	**Cost (±20%)**	
Facilities	3%	

Picture from: http://www.lepoint.fr/societe/sous-marins-dcns-decroche-en-australie-un-megacontrat-a-34-milliards-d-euros-26-04-2016-2034987_23.php

Technology Transfer Issues

- You need to understand “know why” in addition to “know how”
- You need to have Absorptive Capacity
- You need to participate in the Design Process
- You will be required to enhance the knowledge received






WHO
WHAT
WHERE
WHEN
WHY
HOW
QUESTIONS
ANSWERS