DEPARTMENT OF INDUSTRY, TOURISM AND RESOURCES SUBMISSION TO THE SENATE INQUIRY INTO NAVAL SHIPBUILDING

Section 1: The capacity of the Australian industrial base to construct large naval vessels over the long term and on a sustainable basis.

Current capacity

Introduction – the economic and strategic drivers are changing

Australia has produced large steel commercial and naval vessels in the past. There has been no commercially driven large steel shipbuilding conducted in Australia since the 1970s, but fast aluminium vessel shipbuilding emerged in the late1980s.

As in virtually every sector of the economy, a driving factor determining whether Australia can produce on a long term and sustainable basis is whether Australia can achieve the required economies of scale to be competitive. In shipbuilding, as in other sectors, the technological and economic drivers are for increasingly globally integrated production systems, with Australia playing a role where it can create competitive capabilities.

Barriers to trade, including those based on national disclosure policies or military self-reliance, are in conflict with these global economic and technological drivers and Governments around the world are increasingly forced to choose between policy objectives.

Global economics is pushing military self-reliance objectives, based on import replacement policies, towards a new conception of operational sovereignty as the objective, with an economic "make or buy" decision determining the cheapest way to achieve operational sovereignty. Indeed, many would argue that at a strategic level the threat scenario is no longer world wars of attrition, which required long term industrial capacity, but threats which require operational sovereignty (for periods of time at various levels of intensity) and this may sometimes just as well be provided by an imported stock of spares, as a national capacity to repair and maintain.

Economies of scale are critical

The ability to achieve economies of scale depends on the economics of the particular ship project and its component systems. The higher the fixed costs, for example new infrastructure costs or design and development costs, the larger the number of units likely to be required to amortise these costs so that the average fixed costs can be competitive with existing suppliers.

For example, in 2004 Tenix won an international competition to build a fleet of seven ships for the Royal New Zealand Navy. The small ships are being constructed in Australia and New Zealand while the single larger ship is being constructed in the Netherlands. To facilitate through life support, Australian and New Zealand sourced equipment is being sent to the Netherlands to be incorporated in the large ship as it is constructed. In this recent market tested example, Australia and New Zealand were not competitive in producing a single large ship where the design is already in production offshore. However, this example also demonstrates that Australian project managers and suppliers of equipment for large ships (especially that equipment requiring support during the life of the ship) are internationally competitive.

Naval shipbuilding capacity encompasses many domains

The construction of a large naval vessel encompasses a number of separate domains, ship design, ship systems (propulsion, plumbing, electrical), ship (or module) fabrication and assembly, and integrated military combat systems (command, sensor and weapons systems). The economics of each of these domains can be considered separately.

Design

The large naval ships produced for Australia (FFG, ANZAC, Collins and prospectively Air Warfare Destroyers (AWD) and Amphibious ships (LHD)) are typically modifications of overseas designs. A fully indigenous naval ship design capacity over the full range of platforms required by the RAN would require a larger demand to sustain than is feasible in Australia.

However, Austal and Incat have designed and exported naval ships based on indigenous commercial designs. They have been able to capture economies of scale based on having unique capabilities and intellectual property in the aluminium fast ferry business, which they have been able to carry over into naval vessels.

Propulsion and other ship systems

Again due to global economies of scale, many of the systems for naval vessels are modifications of overseas designs and larger systems (such as engines) are imported and integrated into the ship within Australia. Some components and systems can be economically produced in Australia, especially where they (or the capabilities that produce them) have a commercial use in other sectors of the economy.

Ship (module) fabrication and assembly

Australia's existing capacity is optimised for smaller rather than larger ships and modules. For example, the Amphibious ships designs (both with 32 metre beam) will require expensive investment in infrastructure to be assembled in Australia. Australian shipyards have typically invested less in automation technologies than some off-shore yards, optimising for shorter production runs.

In the aluminium shipbuilding sector, Austal's design approach has allowed it to capture production economies and they are further exploring advanced shipbuilding techniques, including with the assistance of a R&D Start grant of $2.4 million to develop innovative shipbuilding processes and designs.

Military systems (Command, combat, sensors, weapons)

The very expensive major military combat systems are inevitably sourced from overseas, for example the latest version of the United States AEGIS system will be incorporated into the Air Warfare Destroyers. Australia will reduce through life support costs by maintaining commonality with the US system through its life, avoiding becoming the operator of an orphan system with unique requirements.

The core military combat system can be complemented by indigenous Australian systems (or systems imported from elsewhere) such as CEA Technologies innovative radar systems (the development of which was supported by an R&D Start grant of $2.6 million dollars).

The major cost, capability and schedule problems that have occurred with Australian shipbuilding (the Collins combat system and the FFG weapons system upgrade) have been in the expensive and complicated combat/weapons system aspects rather than in ship fabrication and assembly and are generally said to have occurred because they have been attempted without adequate overseas (parent navy) support.

Table 1. Summary of Australian large naval ship building capabilities

Shipbuilding domain	**Australian capability**
Ship design	Modify overseas design with support from overseas, world leading in niche capabilities such as aluminium fast ships
Ship fabrication and assembly	Indigenous capability
Ship systems production and integration	Some, such as turbine engines, imported; some indigenous capabilities
Combat systems (weapons, sensors, command) production and integration	Integration and modification of core overseas systems with support from overseas; development and integration of complementary indigenous systems.

Future capacity

Three additional factors should be considered in evaluating the long term and sustainable capacity of Australian shipbuilding, these are skills, the provision of common user infrastructure by State Governments, and export markets.

Skills

Increasing construction costs driven by labour and materials costs is a concern in the major projects sector. This sector will compete for scarce skills with the major shipbuilding projects.

A study by ACIL Tasman for the Australian Shipbuilding Advisory Group, *Skill shortages and the Amphibious ship project*, uses economy-wide employment by occupation in various sectors of the economy to argue that the additional skill demand from the amphibious ships project would only be a small percentage increase in the employment of relevant occupations compared to the total supply of such skills.

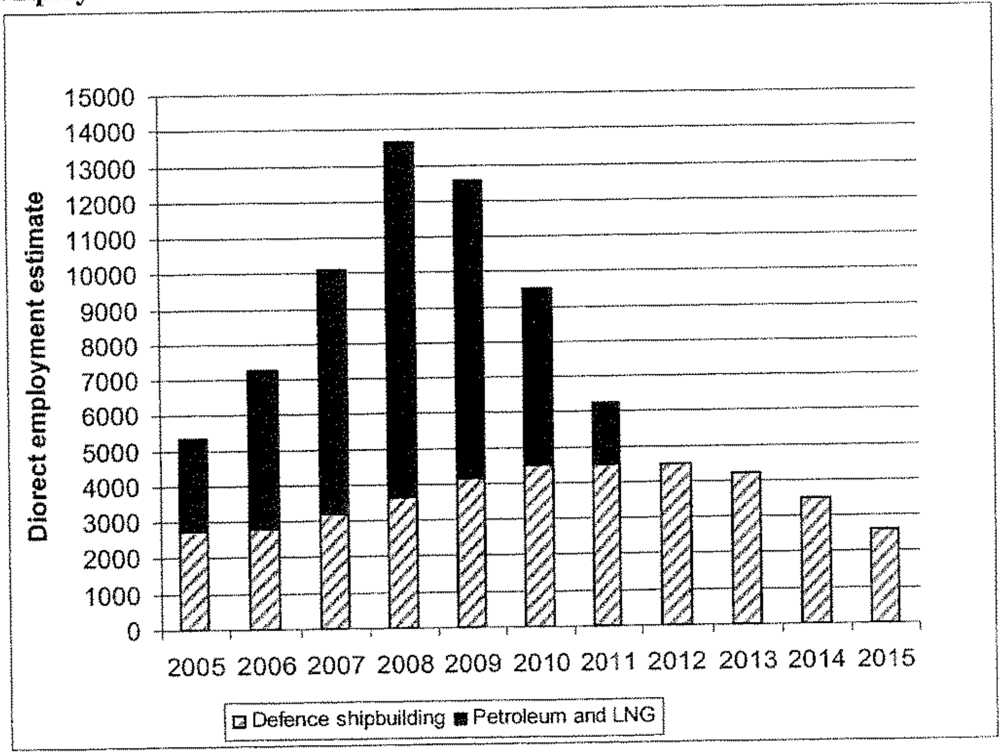
While this is arithmetically true, it may overestimate the geographic and industrial mobility and substitutability of people with different types of skills and experiences within such broad categories such as structural steel and welding trades, metal fitters and machinists, electricians and plumbers. The evidence is anecdotal, but the experience of some shipbuilding firms, such as Austal, is that they have been particularly affected by the demand for skilled labour from the resources sector. That is not something that has been as apparent in the motor vehicle trades for example.

Offshore resource projects are likely to be competing for some of the same skills as the naval shipbuilding projects. The likelihood and timing of commercial projects is subject to continuous adjustment, but a list of the current committed and possible projects is provided at Attachment A for the information of the committee.

To indicate the comparative magnitude of this potential employment demand relative to the Defence Department's estimate of labour demand for the AWD and Amphibious ships project, DITR has made rough order of magnitude calculations of possible employment for identified offshore projects and overlaid the total over the Defence Department chart provided to the Committee. The chart is illustrative, it is not meant to forecast that all these projects will go ahead on schedule.

It should be noted that the estimates of offshore petroleum employment are based on very approximate data. Possible future projects are not included, so absence of longer term information is not a prediction but a reflection of data availability.

Chart 1 Defence Shipbuilding employment and rough order of magnitude employment from identified offshore Petroleum and LNG projects



Source: Defence Department and DITR estimates

The chart suggests that the availability of skills is an issue that will have to be managed and that there may be risks to the naval ship building projects if all the resource projects go ahead. This risk is being actively managed by Defence and other stakeholders through increased training provision.

The risk can also be allocated through the contracting process. To the extent that the Amphibious ships project contract will be a firm fixed price contract, then the risk will be a matter for the company that wins the contract. However, to the extent that there may be "escape clauses" in the contract (through wage indexes or clauses accommodating schedule delays or cost increases due to lack of supply of labour) then the risk becomes a matter for the Commonwealth.

Common User infrastructure

The provision of common user infrastructure can underpin a more competitive shipbuilding sector as the infrastructure costs can be amortised over additional projects, including non-shipbuilding projects, than might be possible if the infrastructure assets are available only to a single ship-building company.

To the extent that State Governments compete and provide the common user infrastructure on a non-commercial basis they subsidise shipbuilding and associated activities that use the infrastructure, which may be at the expense of the wider economy if there was a better alternative use for the resources.

Export markets

It is worth quoting RAND Corporation research carried out for the UK Ministry of Defence, as it appears to apply equally to Australian steel shipbuilding.

> "*... RAND Europe found that the prospects for broadening UK shipyards' customer base were poor. The UK would face strong competitors in attempting to re-enter the commercial shipbuilding market. RAND researchers concluded that the UK has a stronger industrial base to support naval export sales than it does in the commercial arena, but that the match between most current UK military ship products and global demand is not a close one. The naval export market is largely focussed on modestly priced frigates, economic exclusion-zone patrol vessels, and small conventionally powered attack submarines, UK warships are in general more complex and expensive than potential buyers demand...*"
>
> Rand Corporation, Trends in the United Kingdom's Naval Shipbuilding Industrial Base: Lessons for the United States, John F. Shank. Testimony presented before the Senate Armed Services Committee, Subcommittee on Seapower on April6, 2006, page 10.

The experience in Australia has been similar, with naval exports limited to patrol boats (essentially economic exclusion-zone patrol vessels). The notable exception is of course Australian companies' success in exporting fast aluminium vessels, ferries in the commercial sphere around the world and militarised versions leased to the United States military.

The Air Warfare Destroyer is in a complex class of vessel that customers such as Spain, Japan, Korea and Australia wish to build for themselves. This was also the case for the FFG guided missile destroyers, Australia purchased 4 and built 2, Taiwan and Spain both built six. Submarines produced for export markets around the world have tended to be smaller and less capable than the Collins. Part of the reason that more complex vessels are self-built rather than purchased is that building them is a way of developing the domain knowledge required to maintain and operate the vessel.

The less complex ANZAC class frigate, which was a modification of the German Blohm and Voss MEKO 200 design, appears to be at the crossover point between imported less-complex and self-built more-complex vessels. Some countries such as Australia and Greece chose to build their own. However, Germany built and exported to South Africa a coastal patrol version (corvette) that was smaller, faster and more lightly armed than the ANZAC.

Major Australian naval vessels (other than those based on fast aluminium ferries) are likely to include significant overseas sourced intellectual property in the design and this could limit the ability to export the vessels in competition with the intellectual property owner.

In addition, Australia's desire to maintain a regional capability edge is likely to constrain the desire to export highly capable vessels.

However, a number of Australian companies have had success in exporting ship components and systems into the global market and others are developing capabilities with the intention of reaching global markets from Australia. The internationalisation of production systems may allow competitive Australian companies to access global supply chains through the sale of ship components and systems even when other countries decide to build their own ships.

Section 2: The comparative economic productivity of the Australian shipbuilding industrial base and associated activity with other shipbuilding nations.

Market evidence

The comparative economic productivity of shipbuilding industries around the world, determined by underlying economic factors and various past and current government subsidies, is revealed by market outcomes.

Australia is very productive in aluminium fast ferry shipbuilding. Australian companies virtually control the world market for large fast ferries and are thereby revealed to be the most productive in the world in this market segment.

In large commercial steel ships the evidence is equally clear that Australia is not as productive as other countries, we have not produced large commercial steel ships for around thirty years. Tenix's decision to produce the large ship component of project Protector (a militarised commercial roll-on roll-off vessel) overseas is a recent example.

Australian policies have not discriminated between aluminium and steel ships. The existing comparative productivity reflects the companies and technologies involved and the comparative strengths of overseas producers, which are influenced by many things, including past and current subsidies and other interventions by overseas Governments.

The market outcome evidence on the comparative economic productivity of Australian shipbuilding in the various domains is summarised in Table 2.

Table 2 Comparative shipbuilding economic productivity as indicated by market outcomes

Shipbuilding domain	Market evidence on comparative Australian productivity
Ship design	World leading in niche capabilities such as aluminium fast ships
Ship fabrication and assembly	World leading in niche capabilities such as aluminium fast ships. Not competitive in large steel commercial ships. Market evidence for large naval ships not applicable as outcomes determined by government polices rather than comparative productivity
Ship systems production and integration	World leading in niche capabilities such as aluminium fast ships, plus limited exports of other capabilities
Combat systems (weapons, sensors, command) production and integration	Not applicable. Market outcome determined by government polices rather than comparative productivity

Going beyond the immediate shipbuilding sector, to associated activity and the related industrial base, makes the question harder to answer in such black and white terms.

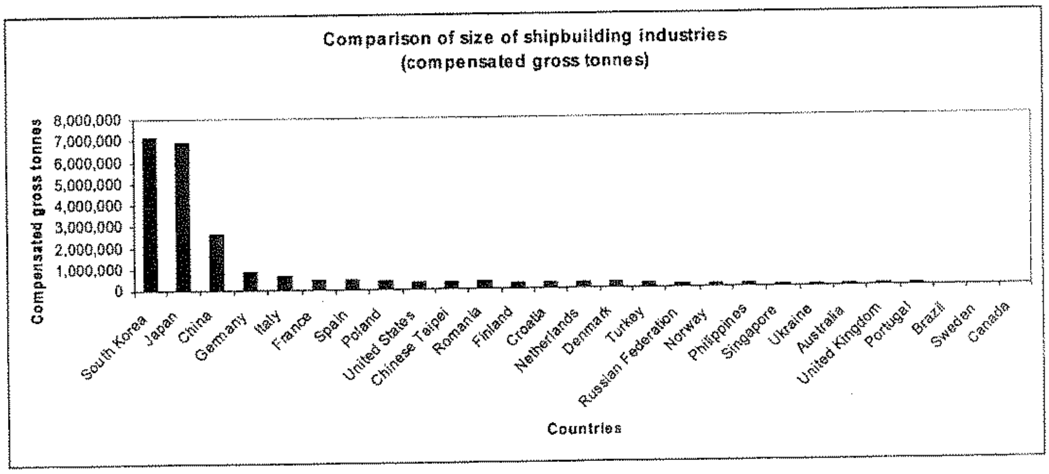
The evidence from the large metal structure fabrication sector, for example for the resource extraction and processing sector, is mixed. In some circumstances Australian producers are winning work in Australia and for export markets, but there are examples of large modules being produced offshore and barged to Australia. Subject to transport and logistics costs, the globalisation of supply chains discussed earlier in this submission is equally relevant to the large metal structure fabrication sector.

Productivity comparisons based on economic data

Apart from simply referring to market outcomes it is, in principle, possible to use national industry level data to evaluate comparative economic productivity. Productivity measures the relationship between units of output per unit of inputs. However, available industry statistics provide imperfect measures of output and very partial measures of inputs (essentially only labour, excluding capital and other inputs).

The physical output, measured in compensated gross tons[1], of shipbuilding industries varies greatly between countries, as indicated by Chart 2. The figures underlying this chart are presented in Table 3, together with an (imperfect) value measure of the size of the national shipbuilding industries, sales revenue (turnover).

Chart 2 Output of major shipbuilding countries



[1] Compensated Gross Tons (CGT) take into account the complexity of the vessels produced as well as their size. There are internationally agreed coefficients for commercial vessels but not for naval vessels.

Table 3 – World shipbuilding 2003

Country	**Turnover** (US$m)	**Output** (cgt)
South Korea	na	7,166,899
Japan	$14,484	6,887,434
China	na	2,598,938
Germany	$4,995	866,534
Italy	$4,500	664,137
France	$5,048	486,963
Spain	$3,814	470,364
Poland	na	363,333
United States	$12,763	333,492
Chinese Taipei	na	328,595
Romania	$416	324,362
Finland	$1,872	279,873
Croatia	na	272,733
Netherlands	$2,313	262,103
Denmark	$922	256,451
Turkey	na	207,843
Russian Federation	na	146,946
Norway	$6,560	143,650
Philippines	na	107,422
Singapore	$2,181	89,817
Ukraine	na	65,886
Australia	$1,148	47,913
United Kingdom	$2,869	47,229
Portugal	$389	42,276
Brazil	na	30,908
Sweden	$387	18,574
Canada	$386	11,645
Belgium	$195	na
Ireland	$35	na
Austria	$19	na
Hungary	$5	na

Sources: Australian Bureau of Statistics, Eurostat, US Census Bureau, Strategis, Lloyd's World Fleet Statistics, Association of Singapore Marine Industries, Ministry of Economy, Trade and Industry Japan.
Notes: na = not available, cgt = compensated gross tons.

Productivity and scale

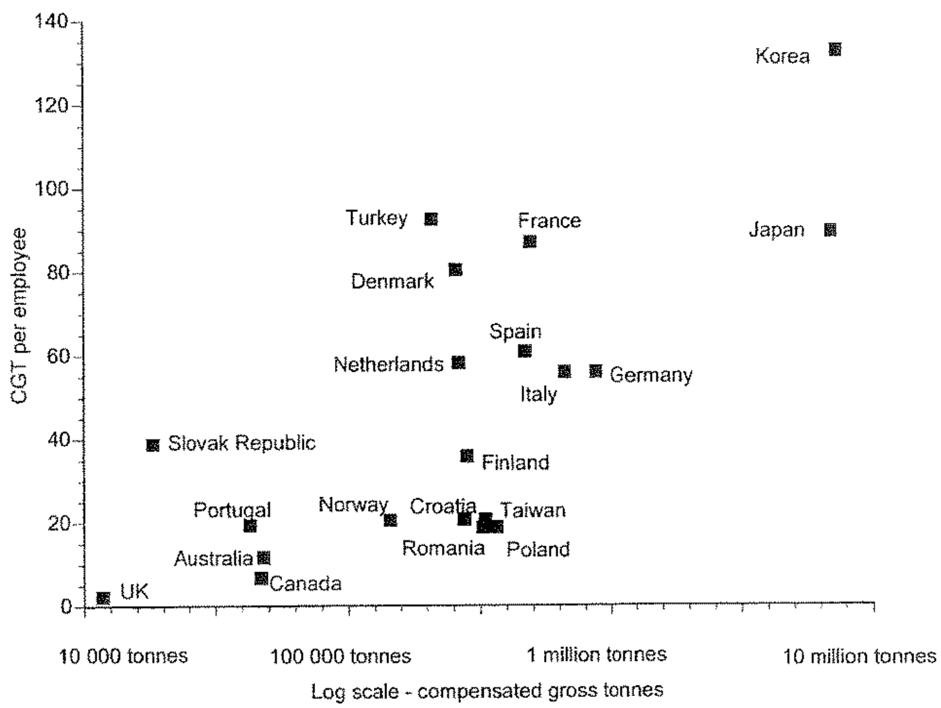
The only generally available measure of shipbuilding input is labour, so it is only possible to derive labour productivity comparisons. These comparisons should be treated with care as there may be significant differences in the amount of capital associated with each unit of labour in different countries.

Comparing physical productivity of labour with output (measured in compensated gross tonnes per employee) for different countries does indicate that labour productivity increases with the size of the industry, as illustrated in Chart 3.

Chart 3 shows labour productivity in compensated gross tons per employee against a logarithmic output scale for selected countries. This demonstrates the impact that large scale production has on productivity; countries producing larger volumes of ships are generally more physically productive. In the chart, Australian shipbuilding is relatively small scale and has relatively low labour productivity.

However, the data underlying the chart are imperfect. The output measure only covers self-propelled, sea going commercial ships but the input measure covers all shipbuilding. Therefore the comparison is biased against countries with a high proportion of defence shipbuilding, such as Australia. As a physical measure of productivity it is also biased against shipbuilding countries that have a high value per compensated gross tonne, such as Australia and the United Kingdom. Australian shipbuilding production runs are generally small and some yards compete on the basis that they customise vessels for each client, they also specialise in high value per tonne defence projects.

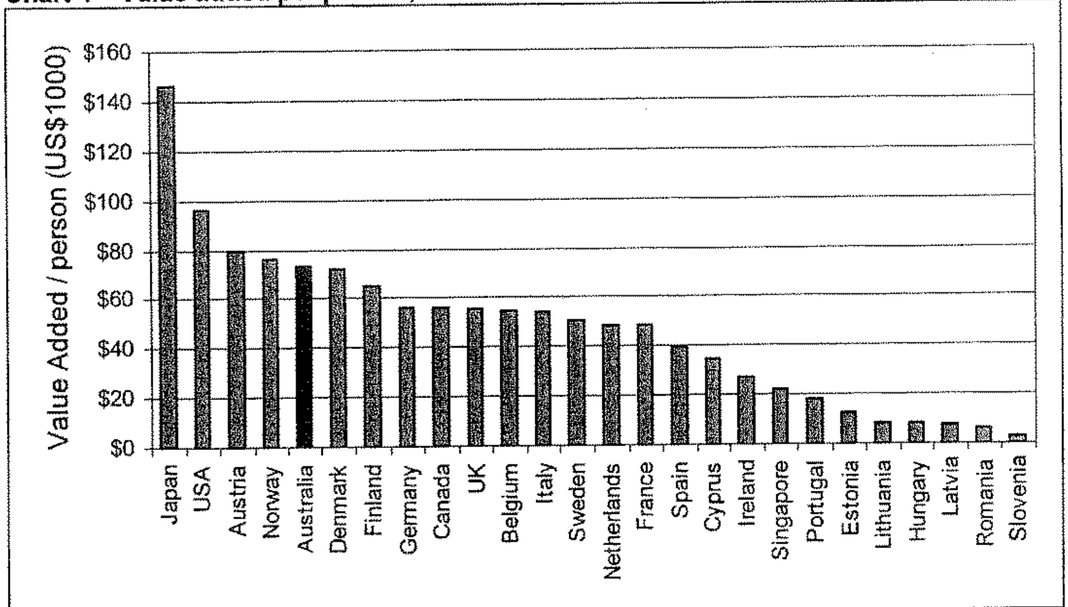
Chart 3 – Shipbuilding physical productivity and production



Source: *Benchmarking Australia's Marine Industries*, The Allen Consulting Group, March 2005

Another measure of productivity is value added per person. This measure has the advantage of measuring the value of output rather than physical output. Under this measure the Australian shipbuilding and repair industry appears relatively productive, as seen in Chart 4. The measure has not been adjusted for hours worked per employee. The value added measure is biased upwards for countries such as the United States that protect their shipbuilding industry as the value added in such countries is measured in domestic prices rather than world prices.

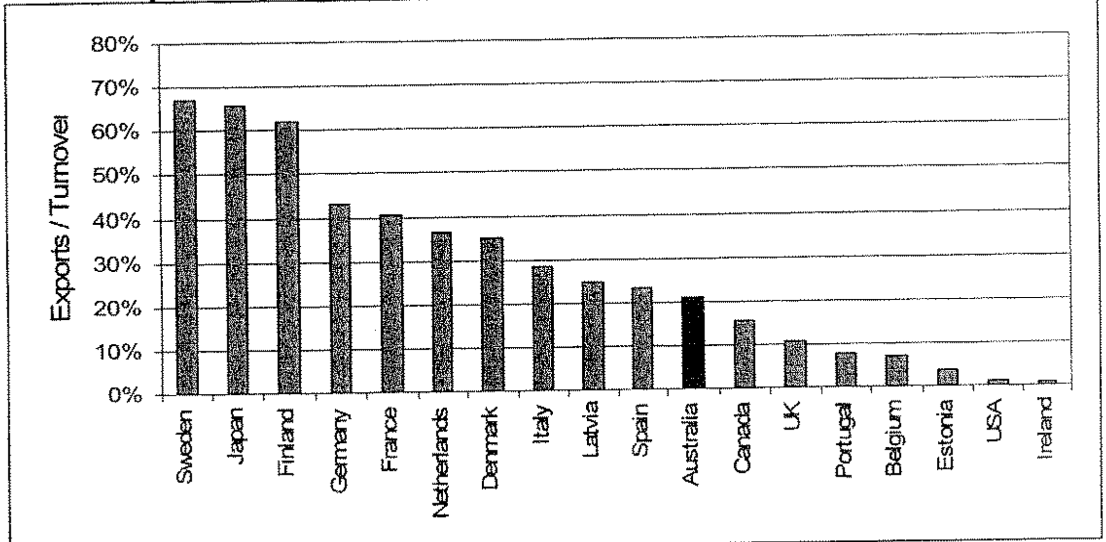
Chart 4 – Value added per person, 2003



Sources: Australian Bureau of Statistics, Eurostat, US Census Bureau, Strategis, Association of Singapore Marine Industries, Ministry of Economy, Trade and Industry Japan, OECD.

An indirect measure of productivity is the share of turnover that is exported. A high export propensity indicates that the sector is internationally competitive. But the relative size of the defence shipbuilding sector, which tends not to be a traded sector, distorts the value of this comparison. Chart 5 indicates that Australia does not have a high export propensity, but this reflects the naval shipbuilding sector rather than the commercial shipbuilding sector.

Chart 5 Export Propensity of shipbuilding and repair sector



Sources: Australian Bureau of Statistics, Eurostat, US Census Bureau, Strategis, Association of Singapore Marine Industries, Ministry of Economy, Trade and Industry Japan, OECD.

Productivity comparisons based on company data.

An independent shipbuilding consultancy firm, First Marine International, has been conducting benchmarking studies of shipyards since 1991. A study of the global shipbuilding industrial base for the United States Department of Defense was published[2] in 2005, but it does not cover Australian shipyards. In evidence to this inquiry Tenix has indicated that Australian shipyards have been subject to a recent benchmarking study by First Marine International.

In considering any information that may become available from this study of Australian shipyards it is important to realise that such productivity benchmarking is not the same as a comparison of price or competitiveness. For example, productivity benchmarking accounts for differences in scale of production. So a good productivity benchmark for a low throughput yard producing the first of a class does not mean that the yard could compete in the open market with a yard producing further along the experience curve.

The First Marine International report points out defence vessels are generally more complex than commercial vessels and their complexity has been increasing. All new vessel designs, but especially complex naval vessels, are affected by the first-of-class productivity drop-off. It takes time to learn how to build a new series of vessels so actual productivity may be reduced by up to 50 percent for the first vessel in the case of the particularly complex vessels produced in US yards.

[2] First Marine International findings for the global shipbuilding industrial benchmarking study. Part 1 Major Shipyards, August 2005.

SECTION 3: The comparative economic costs of maintaining, repairing and refitting large naval vessels throughout their useful lives when constructed in Australia vice overseas.

The impact of location of build on through life support costs should be identified by the Government's 'Kinnaird' procurement process.

The Kinnaird two pass process that the Government has adopted for procurement decisions is designed to answer this question, amongst others. The two pass system ensures that the whole-of-life cost of options will be considered by the Government when making decisions concerning naval procurement.

Kinnaird[3] stated that the government should compare a military off-the-shelf (MOTS) option (necessarily built offshore in the case of large naval ships) with the other options (built onshore in this case). Kinnaird[4] also recommended that in comparing options Government should include rigorous assessment of costs on a whole of life basis, risk, including the capability of tenderers to supply and support the capability, schedule and performance.

Therefore, to the extent that there are differences in the "economic costs of maintaining, repairing and refitting large naval vessels throughout their useful lives when constructed in Australia vice overseas", these differences should be identified by the Kinnaird processes and the Government can take any such differences into account in making its decision.

In the case of the Amphibious Ships, the Defence Minister's press release of 2 May 2006 states that the tender documentation will allow bidding companies to submit fixed price bids and bid through life support solutions.

ANZAC ship study estimate is not a basis for generalisation.

DITR has only been able to identify a single publicly available estimate of the comparative economic costs of maintaining, repairing and refitting large naval vessels throughout their useful lives when constructed in Australia vice overseas. However, this estimate is based on specific assumptions that may not apply generally.

For the ANZAC ship project, consultancy firm Tasman Asia Pacific[5] calculated a net present value saving of $518 million. This was based on Defence advice[6] that annual costs of $45 million on repairs, maintenance and spares "could be higher by a factor of two if the original source of supply had been overseas". The $518 million figure comes from discounting a 25 year stream of $45 million per year by 7.12 per cent, the then long term (risk-less) bond rate.

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[3] "*At least one off-the-shelf option must be included.*" Defence Procurement Review 2003, p15.

[4] Kinnaird Recommendation 3 reads: "*Government should mandate, and enforce via revised Cabinet rules, a rigorous two-pass system for new acquisition with Government considerations dependent on comprehensive analyses of technology, cost (prime and whole-of-life) and schedule risks subjected to external verification.*"

[5] Tasman Asia Pacific, Impact of Major Defence Projects: A case study of the ANZAC ship project Final Report February 2000. see p38-39, pp49-50.

[6] The Defence advice is not attributed to a published document, but appears to have been provided for the study.

The main problem with generalising this estimate is the presumption that domestic sourced equipment (the equipment that will be repaired, maintained and for which there will be a requirement for spares) can only be installed through a domestic build. It is wrong to assume that an overseas build means that repairable equipment must be sourced overseas. For example, Tenix are sourcing much of the equipment for the larger Protector vessel, which is being built in the Netherlands, from Australia and New Zealand precisely to ensure that the costs and problems with maintaining overseas sourced equipment are avoided or minimised. Equipment is being containerised and sent to the Netherlands for installation. The ship will also have final fit out in New Zealand[7].

Assuming an overseas build means equipment must be sourced from overseas is wrong, and the quantitative effect of the error depends directly on the proportion of the equipment that can be sent overseas or fitted when the ship arrives in Australia for final fit-out. If half the equipment could still be sourced from Australia then the cost saving estimate would be halved.

(It is perhaps worth noting in this context that an overseas designed ship built in Australia will use overseas sourced equipment unless the design is modified to incorporate Australian sourced equipment. In addition, some equipment will not be produced in Australia even for a ship produced in Australia. The difference between the Australian content of an Australian built and an overseas built ship is not the difference between 100 per cent and zero per cent.)

The estimate of savings in the ANZAC ship study is also sensitive to the discount rate applied. A long term government bond rate is a risk-less rate. If there is a risk associated with the assumed savings through time, perhaps the company that produced the parts might stop producing these parts or go out of business, then a higher discount rate might be more appropriate. A 10 per cent discount rate reduces the $518 million figure to $408 million.

If the Defence estimate that the "costs could be higher by a factor of two" is not well based then the estimate is not well based.

Whole of life costs are driven by a number of factors, not just location of build

The Defence Procurement Review 2003 (Kinnaird) recommendation to focus on whole of life costs, rather than just on prime costs, was of course motivated by more than the possible cost differences between an onshore and offshore build. By taking into account whole of life costs, the procurement process focuses on measures, especially design and contractual measures, that can reduce the through-life-support costs of a vessel.

Many of these measures are independent of the location of the build. Managing crewing costs (which are typically stated to be around two thirds of total through life support costs) is a design issue that does not depend on the location of build. The

[7] www.tenix.com.au/PDFLibrary/239.pdf

vessel can be designed with more or less automated processes to reduce whole of life crew costs by investing in capital costs at acquisition.

Intellectual property issues are also generally not simply related to the location of build. For example, ensuring that access to intellectual property for maintaining, repairing and refitting (and wider defence purposes) is permitted on reasonable terms and conditions is a contractual and national disclosure policy issue, not a location of build issue.

Ensuring that the domain knowledge is available for "maintaining, repairing and refitting" also does not depend on the location of the build, but on having access to the build process. Personnel can be posted offshore to participate in the build. Of course the more complicated the domain knowledge, the more intensive is the required process of developing the domain knowledge, tending to suggest that there are greater benefits (and risks) from conducting an onshore build of complex vessels rather than simple vessels.

DITR interprets the Department of Defence submission to this inquiry as indicating that the onshore build of the Air Warfare Destroyers will create the required (in quantitative and qualitative terms) domain knowledge for "maintaining, repairing and refitting" naval ships and that there is little additional benefit in terms of skills development from building the Amphibious ships in Australia.

DITR suggests that a rough first-order calculation of the relative complexity of different ships could be simply the cost per tonne. The suggestion is based on the simple proposition that the degree of fit-out of the ships with expensive complex electronic and weapons systems will determine the cost per displaced tonne. In this admittedly very simplistic approach, the Air Warfare Destroyers are 7-9 times as complex as the Amphibious Ships.

A comparison with past projects brings in additional uncertainties about usefulness of the comparison. That aside, the complexity of the Air Warfare Destroyers appears to be in the same order of magnitude as Collins, more or less depending on whether one takes a pessimistic or optimistic view of the AWD cost from the range published in the Defence Capability Plan. The Air Warfare Destroyer appears to be significantly more complex than that ANZAC, which was "fitted for but not with" some of the military systems. The Minehunter cost may partially reflect the additional cost of composite materials over steel, and the patrol boats appear noticeably less complex despite being constructed from more expensive aluminium rather than steel.

Table 4: A first-order estimate of relative complexity based on cost per tonne

	Total Estimated Price ($Billion)	Year of Estimate	Total price in 2004 dollars ($Billion)	Number of vessels in contract	Vessel displacement single vessel, tonnes	$'000/tonne (2004$) Thousand dollars per tonne
AWD	6.00[a]	2004	6.0	3	6000[b]	333
LHD (Armaris)	2.00[c]	2004	2.0	2	21000	48
LHD (Navantia)	2.00[c]	2004	2.0	2	27000	37
Collins	5.10[d]	1999	6.1	6	3050[e]	331
ANZAC	6.10f	1999	7.2	10[g]	3600	201
Minehunter	0.92[h]	1993	1.3	6	720	310
Armidale	0.30[i]	2003	0.3	12	270	96

[a]Expected maximum cost taken from the *Defence Capability Plan 2004-14.*
[b]Mid-point of estimated range of size of vessels (5000-7000).
[c]Expected maximum cost taken from the *Defence Capability Plan 2004-14.*
[d] Based on a final cost of $850 million per vessel. Figures sourced from the Report to the Minister of Defence on the Collins Class Submarine and related matters, 1999
[e] Floating displacement for comparison with ships, underwater displacement is 3350 tonnes.
[f]ANAO Audit, *Management of Major Equipment Acquisition Projects*, 1999. A figure of $5.6 billion in 1999 prices is given in *Impact of major defence projects: A case study of the ANZAC ship project*, 2000, Tasman Asia Pacific, page 49.
[g] The total build is broken down as 8 for the RAN and 2 for the RNZN.
[h] This is the contract price in 1993 prices (ANAO audit, *Australian Industry Involvement Program*). The contract was signed in 1994.
[i] This is part of a contract with Defence Maritime Services that includes construction and 15 years of maintenance and support. The total contract value is $552.86 million for the first 12 vessels including 15 years of maintenance and support. Austal is constructing the vessels and has reported its share of the contract value as "approaching $300 million" (Austal media release, 17 December 2003) for the first 12 vessels. The Australian Government has subsequently decided to purchase two additional vessels.

SECTION 4: The broader economic development and associated benefits accrued from undertaking the construction of large naval vessels.

There is little quantitative evidence available to address this question and that which is available needs to be interpreted carefully.

A great deal has been made of the Tasman Asia Pacific studies of the ANZAC ship project and the Minehunter project. The methodologies used in these studies and the results should be considered in context.

Two common methodologies were used in the analysis of macro-economic benefits, multiplier analysis and general equilibrium analysis.

Input-output multiplier models assume unlimited unemployed resources

Input-output multiplier analysis was developed by Leontief in 1951 and is based on the technical interdependencies between industries, increasing the output of one industry requires an increase in the output of all the related industries, including the industry itself.

Using this technical input-output relationship to model the macroeconomic effect of an increase in the demand for one industry, shipbuilding, essentially assumes that resources are otherwise unemployed and an increase in demand brings otherwise unemployed resources into employment and that induces even more resources being employed at existing prices.

In a relatively fully employed economy, with scarce skilled labour and price pressure on raw materials, input-output multipliers do not provide credible results. Their attraction is the ease of calculation; their drawback is that they are based on an unrealistic model of the economy. Wordsworth thought that by getting and spending we lay waste our powers, the multiplier would have it that by taxing and spending we increase our economy without limit.

General equilibrium gain based on assumed efficiency increase

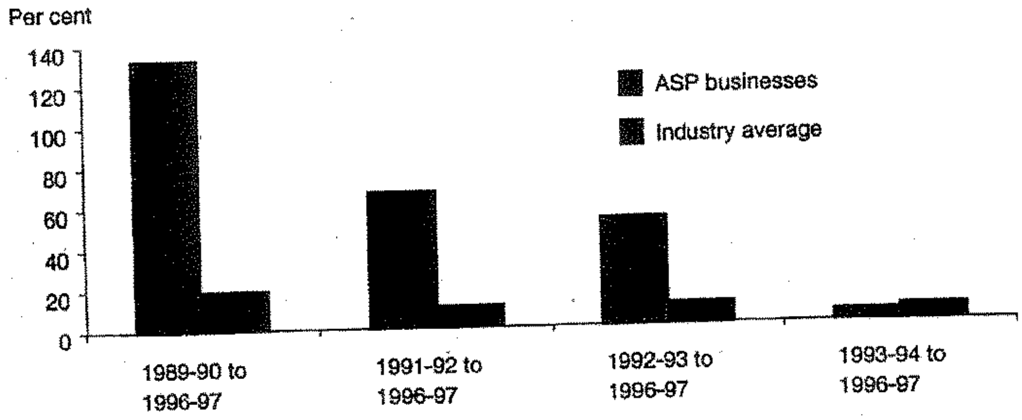
A more modern approach to analysing the effects of changes in the economy is general equilibrium analysis. General equilibrium analysis allows for the effect of changes in relative prices and takes into account constraints in the economy such as limits on available resources such as labour. In typical scenarios, the model assumes full employment (so called long run closure). With all resources fully employed, the way that the model can generate an increase in GDP (or consumption or other measure of economic welfare) is for an increase in efficiency to occur.

However, not all policy changes generate efficiency gains in the model, and occasionally modellers determine an efficiency change outside the model, insert that efficiency change into the general equilibrium model and use the model to estimate the effect of the efficiency gain. However, in such circumstances the model is not the source of the economic gain; the assumed or separately estimated efficiency gain generates the estimated economic gain. In crude terms, you put in the (assumed) increase in efficiency and the model cranks out the resulting increase in GDP.

The ANZAC ships study reports labour productivity gains for suppliers (properly noting the limited number of responses means that care should be taken in interpretation). In fact these productivity gains are very large; around 135 per cent compared to an industry average of around 20 per cent over the period 1989-90 to 1996-97 is the most surprising result[8]. Figure 4.6 from the study is reproduced below as Chart 6.

Chart 6 Anzac Ship project chart

Figure 4.6 Average labour productivity growth (year prior to involvement with the ANZAC Ship Project to 1996-97)



Source: *Impact of Major Defence Projects: A Case Study of the ANZAC Ship Project*, Tasman Asia Pacific, February 2000, p26.

These large productivity increases are not used in the general equilibrium model, presumably because they are not believable and the results would not be credible. A more moderate assumed productivity growth figure of 3 per cent is used to generate a more believable GDP growth figure. The justification (page 46) is as follows:

"For the purposes of the simulation we have assumed that Anzac Ship Project (ASP) subcontractors' productivity in their other (non-ASP) activities would have been lower by around 3 per cent. This productivity change is considerable smaller than the estimates of the change in labour productivity derived from the ANZAC ship survey data and reported in Chapter 4. However, given the small number of respondents that provided data suitable for productivity analysis it was decided that the productivity shock for the general equilibrium analysis should be conservative."

This assumed 3 per cent productivity increase is the source of the $200 million per year annual increase in GDP, which is cumulated over 15 years to provide a GDP increase of at least $3 billion. If you believe the productivity growth assumption you can believe the GDP growth figure. But the use of the general equilibrium model merely converts that assumption into a dollar figure, it does not justify it.

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[8] See Chart on page 26 of the ANZAC ship study.

It should be emphasised that this critique of the available quantitative estimates of broader economic benefits from shipbuilding is not intended to suggest that no such benefits exist, but to point out that it is difficult to estimate their value. The size of any such benefits is a matter for judgement that will depend on the particular circumstances of the project, the involved firms and the broader economy.

Offshore Petroleum Developments

(Under construction or likely to proceed, excludes possible projects and those on-hold)

[*] = commercial in confidence information not included in table.

Project	Company	Cost $m	Construction Period	Type of construction	Construction Employment	Operation Employment
Construction						
NWS Train 5	Woodside	2000	2005-2008	onshore LNG train	1500	20
Goodwyn LPT	Woodside	[*]	2005-2006	modifications to existing offshore platform		
Perseus over Goodwyn	Woodside	700	2005-2007	undersea completions and flowline connections		
Enfield	Woodside	1500	2005-2006	FPSO, undersea completions	100	80
Otway Gas	Woodside	1100	2005-2006	small platform, pipeline to shore, onshore gas plant		
Perseus 1B	Woodside	200	2005-2006	undersea completions and flowline connections		
Angel	Woodside	1700	2006-2008	new platform, pipeline connection		
Cliff Head	Roc	227	2005-2006	undersea completions, pipeline to shore		
Basker-Manta oil	Anzon	260	2005-2006	undersea completions, leased FPSO		
BassGas	Origin Energy	500	2004-2006	small platform, pipeline to shore, onshore gas plant	200	20
Puffin	AED	<100	2006-2007	undersea completions, leased FPSO		
Likely to proceed						
Egret	Woodside	[*]	2007-2009	undersea completions, pipeline to Cossack Pioneer		
Basker-Manta-Gummy gas	Anzon		2009-2011	undersea completions, pipeline to shore, onshore gas plant?		
Greater Goodwyn Gas	Woodside	[*]	2008-2011	undersea completions and pipeline connections		
Greater Goodwyn Oil	Woodside	[*]	2008-2011	undersea completions and pipeline connections		

Project	Company	Cost $m	Construction Period	Type of construction	Construction Employment	Operation Employment
Gorgon	Chevron	11000+	2007-2011	undersea completions, two pipelines to shore, onshore LNG plant, carbon dioxide sequestration	3000	600
North Rankin B	Woodside	[*]	2007-2009	new platform		
PNG pipeline	ExxonMobil	4000	2006-2009	gas pipeline	1500	50
Kipper	ExxonMobil	600	2008-2009	undersea completions and flowline connections		
Stybarrow	BHP Billiton	815	2006-2008	FPSO, undersea completions		
Pluto	Woodside	5000	2007-2010	undersea completions, new platform, pipeline to shore, onshore LNG plant	1500	150
Pyrenees/Macedon	BHP Billiton	~1000	2007-2010	FPSO, undersea completions, gas pipeline to shore		
Vincent	Woodside	1000	2006-2008	FPSO, undersea completions		
Blacktip	ENI	750	2007-2009	new platform, pipeline to shore, onshore plant, onshore pipeline		
Montara	Coogee	450	2007-2011	small platform, leased FPSO, floating methanol plant		
Crux	Nexus	500	2008-2011	FPSO, undersea completions		
PNG Pipeline	ExxonMobil	3000	2008-2010	gas pipeline from PNG to Queensland	1500	50
Weipa to Gove Pipeline	AGL Petronas	n/a	2008-2010	gas pipeline from Weipa to Gove		