
Industry Networks in the Australian Marine Complex

Strategic Networking within the Western Australian Maritime Engineering Sector

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THE UNIVERSITY OF
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CEMI REPORT



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Contents

<i>/SECTION 1</i>	7
<i>Introduction</i>	7
Overview of the Australian Marine Complex.....	8
Objectives of the Study	10
Methodology Used in the Study	10
<i>/SECTION 2</i>	13
<i>The Shipbuilding Sector</i>	13
Structure of the Shipbuilding Sector.....	13
Australia’s International Competitive Advantage in Shipbuilding.....	15
Key Issues Facing the WA Shipbuilding Industry.....	16
Competitive Forces Shaping the WA Shipbuilding Industry	16
The State’s Competitive Advantage in Shipbuilding.....	19
The Production Network Layer	20
The Resource Network Layer	24
The Social Network Layer	26
Analysis of Case Study Findings	28
<i>/SECTION 3</i>	30
<i>The Boatbuilding Sector</i>	30
Overview of the Boatbuilding Sector	30
Competitive Forces Shaping the WA Boatbuilding Industry	31
The State’s Competitive Advantage in Boatbuilding	33
The Production Network Layer	33
The Resource Network Layer	39
The Social Network Layer	41
Analysis of Case Study Findings	42
<i>/SECTION 4</i>	43
<i>The Offshore Oil and Gas Sector</i>	43
Overview of the Offshore Oil and Gas Sector	43
Competitive Forces Shaping the Offshore Oil and Gas Industry	44
Business Activity System and Case Studies	45
Production Network Layer.....	48

Resource Network Layer	51
The Social Network Layer	53
Analysis of the Case Study findings	54
<i>/SECTION 5</i>	56
<i>The Marine Defence Sector</i>	56
Overview of the Maritime Defence Sector	56
The Defence Industry and the AMC	57
Competitive Dynamics and the Business Activity System of the Defence Industry	58
Selected Case Studies	61
Production Network Layer	62
Resource Network Layer	65
The Social Network Layer	67
Analysis of the Case Study Findings	68
<i>/SECTION 6</i>	71
<i>A Survey of the WA Marine Industries</i>	71
Sample Demographics	71
The Importance of Lead Customers	73
The Importance of Key Suppliers	74
The Importance of Joint Initiatives and Alliances	75
Technology Transfer within the Sector	78
The Value of Alliances and Networks	80
The Importance of Innovation	81
Export Orientation	83
Doing Business in Western Australia	83
<i>/SECTION 7</i>	84
<i>Conclusions and Recommendations</i>	84
The AMC as an Industry Cluster	85
Recommendations for future action	87
References:	90

Executive Summary & Recommendations

This report outlines the findings of a research study undertaken by the Centre for Entrepreneurial Management and Innovation (CEMI) of the University of Western Australia's Graduate School of Management (UWA-GSM), into the Western Australian marine engineering industry. Drawing on multiple case study research and a survey of firms in the industry, the study examined four key sub-sectors: i) shipbuilding, ii) boatbuilding, iii) defence, and iv) offshore oil and gas. A team of students from the GSM MBA program undertook the case study research and the WA Government's Department of Industry and Resources (DOIR) assisted with databases and access to industry information.

The study identified that the Western Australian marine engineering industries have grown into a strong and internationally competitive industry cluster, based around the Australian Marine Complex (AMC). Over the past thirty-five years, the industry has evolved until it has secured a strong position in shipbuilding and boatbuilding, with defence and offshore oil and gas as emerging new growth segments. Significant Government investment in the AMC at Henderson on Cockburn Sound, and the HMAS Stirling Fleet Base West, has assisted this cluster formation and growth.

The research examined the basis of the competitive advantage enjoyed by these industry sub-sectors and also mapped the networks and strategic alliances of the firms within the sectors. Each of the four industry sub-sectors had slightly different industry dynamics, but all were highly internationally focused and had within them several key "focal" firms that were examples of best practice. These firms had forged strong partnerships with their leading customers and key suppliers. As most of their customers were located overseas, the senior managers of these firms (usually the CEO) devoted a lot of time to international travel to meet regularly. This face-to-face contact was most important to their ability to maintain market position and generate ideas for new products or services.

There was evidence of fairly strong local production networks (LPN) within the AMC and many key suppliers worked closely with the firms to innovate or lower costs. A strong interpersonal network was found to exist among the firms and with their suppliers, subcontractors and related and supporting industries. Within each sub-sector the pattern of social interaction differed, but industry associations and professional bodies served to channel the flow of human capital and facilitate the exchange of ideas.

Despite the success of the AMC, issues emerged that require further attention. Many firms expressed concern over what they saw as gaps in the skilled labour market, particularly in such areas as fibreglass fabricators, defence subcontractors, acoustics engineers, naval architects and shipwrights. There was also a perceived shortage of qualified and experienced managers who could lead these companies in their international growth. Linkages between the local universities and the industry for research and development (R&D) were identified, but were generally weak. Also a lack of appropriate university courses in naval architecture or marine engineering was viewed as a problem for the long term.

Within the oil and gas sub-sector many of the larger prime contractors were equivocal toward the AMC, and appeared to lack a strong appreciation of the capabilities of the complex. While the shipbuilding and defence industries companies were largely in favour of the AMC and comfortable within its precincts, many of the boatbuilding firms were small companies and felt that the AMC was not designed for them.

Key findings that emerged from the survey of firms within the sector were the emphasis is placed on local production networks and the strong orientation toward market-led, incremental innovation rather than more fundamental research-driven activities. Many firms felt that it was difficult to access skilled workers in the State and to find suitably qualified managers. The majority also considered that it was not easy to access high quality research centres within the State.

Key recommendations from this study are:

- Examine the skills shortages within the labour market for the marine engineering sector and develop a coordinated strategy designed to match the needs of industry to the courses being offered by the State's education and training sector.
- Examine the potential for future university level courses such as in marine engineering or naval architecture to provide a framework for the development of research activities designed to support the industry.
- Undertake further research into the boatbuilding sub-sector to provide a better picture of the size, scope, contribution and potential of this industry and to assess its needs.
- Develop and focus industry policy on the needs of the boatbuilding sub-sector with particular emphasis on small firms. Schemes designed to assist such firms with management and international market development should be explored and if required considered as part of a wider industry support package.
- Examine the needs of the defence subcontractor firms to identify their specific needs and develop strategies to assist them in sustainable growth.
- Prepare a strong business case for the AMC as the location of choice for the fabrication of major offshore oil and gas platforms and components. This will need to be sold to the large prime contractor firms based within WA.
- Seek to develop a package of measure that delivers a "risk-free" environment for major construction projects in the offshore oil and gas sector. This is likely to involve collaboration between the subcontractors, trade unions and government.

|SECTION 1

Introduction

The following report outlines the findings of a study of the strategic networking behaviour of firms within the Australian Marine Complex (AMC) in Western Australia. It outlines the nature of industry supply-chain relationships and local product networks within the Western Australian marine engineering sector, with a view to identifying the possible existence of industry clusters. Also examined were the levels of innovation and competitiveness within the local marine engineering sector, in order to provide insight into the sustainability of the AMC.

The Centre for Entrepreneurial Management and Innovation (CEMI), of the University of Western Australia's Graduate School of Management (UWA-GSM) undertook the study with assistance from the MBA students enrolled in the unit *Networks and Alliances for Innovation and Entrepreneurship 455:627*. The study involved a total of six months research, including four months of fieldwork from September to December 2003.

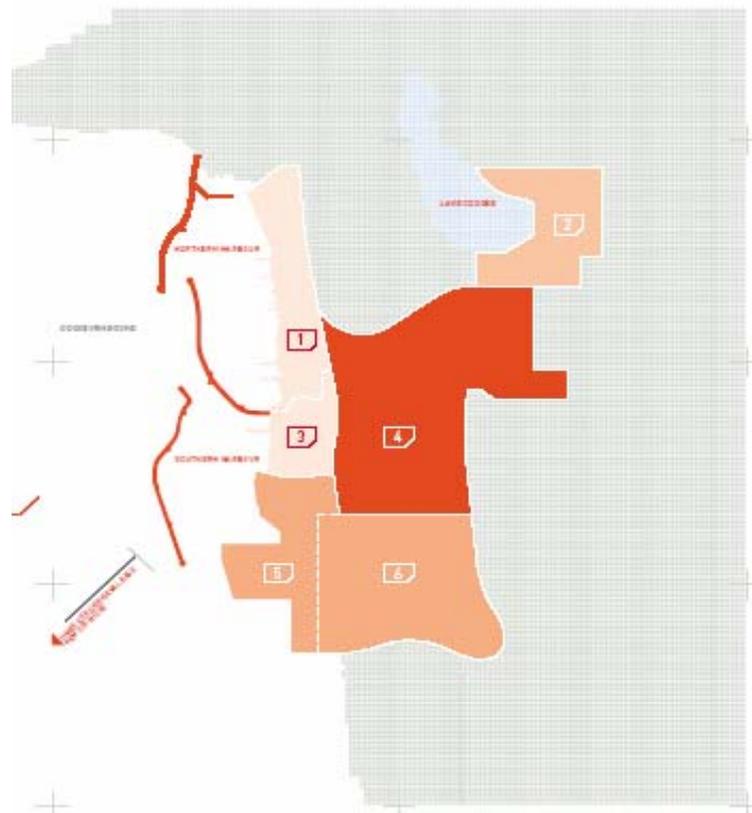
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The study was assisted by the WA Department of Industry and Resources (DOIR), which provided guidance to the UWA research teams, assisted in identifying firms within the AMC for interviews, and the distribution of a field survey to firms operating within the marine engineering sector in Western Australia. Also assisting the project was the South West Group. Acknowledgements are made to Steve Arnott, John O'Hare, Keith Antonisz and Andrew Mann of DOIR, John McIlhone of the South West Group and those managers from the WA marine engineering firms who participated in the study.

Overview of the Australian Marine Complex

The Australian Marine Complex (AMC) is the name given to the marine engineering and shipbuilding industrial area located on Cockburn Sound, Western Australia, approximately 23 kilometres south of the city of Perth. In 2004 it was the largest commercial shipbuilding concentration in Australia, accounting for approximately 55 percent of national production (DOIR 2003). The AMC comprises four adjacent precincts incorporating shipbuilding, marine support, heavy fabrication and technology. Figure 1 illustrates the location of the AMC and its precincts.



Source: DOIR, 2003.

Legend:

- 1) Shipbuilding precinct; 2) Technology precinct; 3) Marine support facility;
- 4) Support Industry precinct; 5) Common user facility; 6) Fabrication precinct.

Figure 1: The Australian Marine Complex

The Shipbuilding Precinct

Located in the northern harbour area this precinct covers a total area of around 35 hectares. It features a fully protected harbour, with easy access to shorefront launching, commissioning, and fuelling and testing facilities. A marine support facility is also included in this precinct.

This area is home to such companies as Austal Ships and its divisions Oceanfast and Image Marine, as well as Transfield. It is a centre for the construction of high-speed aluminium ferries and steel hulled ships. Vessels produced from the AMC shipbuilding programs include luxury yachts, harbour tugs, and rescue, customs and naval patrol craft and offshore supply ships.

Support Industry Precinct

Encompassing an area of approximately 35 hectares, the Marine Support Precinct is designed to accommodate smaller industrial firms that provide support to the shipbuilding, oil, gas and mining industries. The industrial land development in this area has been specifically targeted at small to medium sized firms engaged in “activities associated with, or ancillary to, the assembly, fabrication, manufacture, repair and maintenance of marine industries such as marine engineering, boatbuilding, ship repair, maintenance and the offshore resources sector” (Landcorp 2003).

Fabrication Precinct

The southern harbour marine heavy fabrication precinct is targeted at the offshore oil and gas sector for the fabrication of large offshore platforms and associated capital equipment. The precinct encompasses an area of approximately 80 hectares and features a 12-metre deep approach channel and harbour basin able to accommodate heavy lift vessels, semi-submersibles, barges and drilling rigs. There are mobile cranes and other heavy lift devices as well as a mobile module assembly hall (DOIR 2003). In addition the fabrication area and the shore area host a common user facility that incorporates a 250 metre berthing facility designed to enable the fitting out or refitting of large marine structures, and load out wharf facility with a 150,000 tonne capacity (Landcorp 2003).

Technology Precinct

The Marine Industry Technology Precinct (MITP) was designed to house those related and supporting industries associated with the core shipbuilding and marine engineering construction firms comprising the AMC. A focus of MITP is on education and training activities, technology development and research. The area is essentially a technology park that is to provide the focus of high technology, research and knowledge intensive activities on a land area of approximately 52 hectares. A Marine Skills Training Centre was proposed for the site (Landcorp 2003).

Over the longer term the MITP is designed to accommodate a central administration site, research and testing facilities for hydrodynamics, vessel design, underwater and offshore minerals exploration, and training and education. It is also envisioned that

the MITP will be home for a technology incubator designed to assist the establishment of new small firms servicing the AMC core industries (DOIR 2003).

Objectives of the Study

A major objective of this study was to examine the linkages that exist between firms within the AMC and wider Western Australian marine engineering and construction sector with a view to identifying the role such networks play in enhancing innovation and competitiveness. Strategic networks offer firms the potential to increase their competitiveness through the securing to enhance access to new markets or product and process technologies. Such networks and alliances also offer firms the ability to build their business capacity by access to knowledge, skills and expertise from other firms both with their own industry and in other industries. Strategic alliances and networks enable firms – both large and small – to better defend their market position through cooperative marketing and joint responses to threats from new market entrants and substitutes (Jarrett 1998). The AMC is a major investment by the State Government of Western Australia, and has been designed to facilitate the emergence of an internationally competitive marine industry cluster. This study also sought to examine the viability of this goal, using established frameworks for the identification and analysis of industry clusters.

Methodology Used in the Study

The study methodology involved four key phases. These were: 1) identification of key industry sub-sectors; 2) review of the literature; 3) survey of firms in the industry; and 4) case study development of selected firms in industry sub-sectors. Each of these elements is examined in more detail below.

Identification of Key Study Sectors

In the first phase of the study, representatives from the Department of Industry and Resources (DOIR), as well as the South West Group briefed the research team. These briefings involved both individual discussions between UWA staff and representatives from DOIR, and briefings to the MBA class by the government and industry spokespersons. It was decided during this first stage of the study to focus attention on four key sectors important to the AMC:

- **Shipbuilding** – specifically commercial vessels usually over 10 metres in length.
- **Boatbuilding** – specifically pleasure or non-commercial vessels usually under 10 metres in length.
- **Marine Defence Industries** – including naval systems and naval vessels, plus the repair and maintenance of naval equipment.
- **Offshore Oil & Gas sector** – including the construction, repair and maintenance of offshore drilling platforms, tender and supply vessels and related equipment.

A Review of the Literature

During the second phase, the research team examined the available literature relating to the key industry sub-sectors both nationally and internationally. In addition the literature relating to industry clustering and the role of strategic networks and alliances as a source of innovation and enterprise enhancement were reviewed. This phase of the study provided the research team with a series of framework and theoretical models with which to evaluate and analyse the findings and relate them to the AMC.

Four research teams were organised focusing on the four key industry sub-sectors. Each team, comprising between 3 and 4 students from the UWA MBA program, prepared a review of the literature relevant their specific industry sub-sector. All teams were provided with common frameworks for analysis.

A Survey of the Industry

In this phase of the study a survey was undertaken of the Western Australian marine industries. This involved the mailing of 1,500 questionnaires to firms drawn from a variety of databases identified by DOIR as relating to this sector. This questionnaire comprised 49 question items focusing on strategic alliances, export activity, innovation and supply chain management. All questionnaires were accompanied by a covering letter from both UWA and DOIR explaining the purpose of the study and seeking confidential responses. A pre-paid, return envelope was included addressed to UWA.

Response to the survey was disappointing, with a high proportion of forms returned uncompleted due to the wrong address being placed on the envelopes. Of the original forms distributed a total of 87 questionnaires were returned, of which 41 were usable. Such a low response rate was attributed to two key factors. First, the poor quality of the original databases used to address the envelopes. The high proportion of envelopes returned unopened due to the addressee no longer being at this address suggests that many of the database entries were inaccurate. Second, the nature of the industry, with many firms – particularly in the offshore oil & gas and defence sub-sectors – being difficult to readily identify as participants in the AMC. Despite this low response rate the survey provided useful results with indicative findings complementary to the case study analysis.

Case Study Development

The fourth phase of the study involved the preparation of a series of case studies of firms within the four key industry sub-sectors of interest to the AMC. A total of sixteen case studies were developed. The development of each case study involved the research teams interviewing one or more senior managers from within each case study firm using a common discussion protocol. Interviews usually lasted around 1-3 hours and were transcribed for subsequent analysis.

Cases were examined with a view to mapping the nature of the firm's relationships on three levels. The first of these was the production network (e.g. supplier through firm to customer). The second the resource network (e.g. horizontal links with such groups as banks, venture financiers, government agencies, education and research organisations). The third level was that of the social network (e.g. interpersonal

relationships between the staff of these firms and other key persons) (Holmlund & Tornroos 1997).

|SECTION 2

The Shipbuilding Sector

Project Team: *Sabrina Cocking, Lawrence Fernando, Laust Riemann & Petter Smith.*

The commercial shipbuilding sector is generally defined as those firms engaged in the design and construction of those vessels greater than 8-10 metres in length, but not including defence or naval vessels. This definition is consistent with that used in earlier industry studies (Deloitte Touche Tomastu 2002).

A feature of this sector is the relatively small number of businesses engaged within it. For example, in Australia during 1999-2000, there were 80 establishments nationally, representing around 2.8 percent of the total number of establishments in the transport equipment sector. Further, these shipbuilders employed 8.8 percent of the total employment in the transport equipment sector (IBIS 2003).

During the past fifteen years Australian shipbuilders have invested substantially in innovation, research and development, and workforce skills training and development. This has influenced design and construction techniques, and has enabled Australia to position itself as a world leader in the production of lightweight high-speed passenger ferries and patrol vessels (ASA 2003).

From mid-1980 Australian shipbuilding output grew from a total production value of only AUD\$5 million per annum, to over AUD\$1 billion by 1999. However, from that peak to 2003 the overall contract value of international orders declined to around AUD\$600 million. This reduction was due to a reduction in fast ferry orders and the impact of OECD agreements on shipbuilding, which commenced the phasing out of subsidies to shipbuilders from the end of calendar year 2000. In 2002, industry sources were predicting an improvement in the sector (ASA 2003).

Structure of the Shipbuilding Sector

Sixty-five percent of industry turnover is generated from defence related industries. Commercial shipbuilding, repair and maintenance make up the remaining 35 percent. Commercial ship repair activity has been on the rise in recent times due to greater tonnage flow to and from Australia (IBIS 2003). Figure 2 shows these trends.

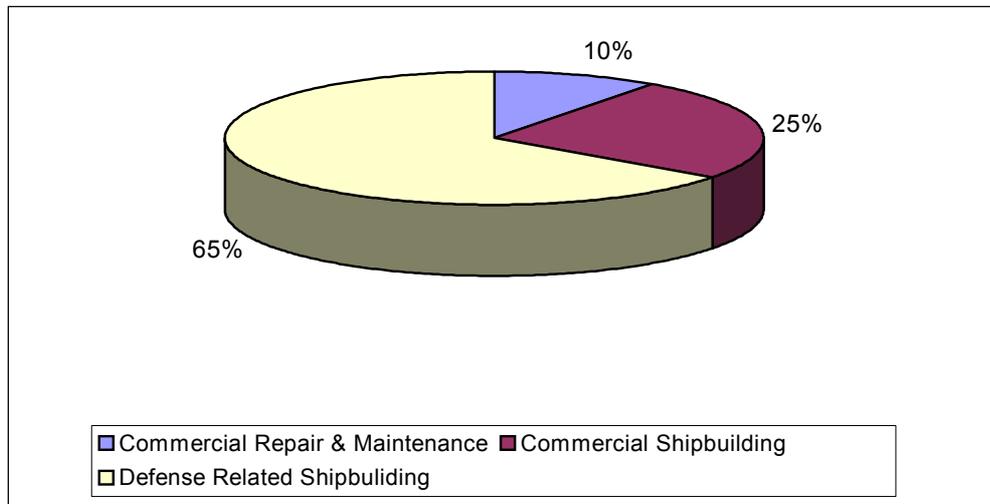


Figure 2: Segmentation of the Australian Shipbuilding Industry

During the period 2001-2003 the Australian shipbuilding industry experienced mixed fortunes. This was due, in part, to a decrease in ocean and coastal fishing activity that led to a down turn in demand for fishing vessels. At the same time the manufacturers of steel hulls for commercial vessels experienced a decline in demand due to cheaper second hand imports. However, those firms that specialised in servicing naval requirements and the manufacture of speciality craft (e.g. ferries), outperformed most in the industry due to long-term contracts and export opportunities.

The Australian shipbuilding market is small and generally the conventional shipping tonnage is imported, but the ferry industry exports most of their production. Australian firms have 30 percent of their segments in the world market, in terms of the number of vessels sold.

There are five major groups of stakeholders, which have key roles to play in developing the Australian shipbuilding industry. The first of these is the *shipbuilding industry* itself, comprising those firms engaged in the construction of commercial vessels over 8-10 metres in length. The second is the *support industries*, or those firms engaged in providing ship components, design and engine supply, as well as materials suppliers and even medical and health sciences. The third group is the *allied industries*, which are commonly clients and use the shipbuilder products, but also have an important input in terms of future market requirements, as design or demands of quality and performance.

The *government* comprises a fourth stakeholder group within the shipbuilding industry. It comprises both federal and state governments and has several important roles including: development of industry, in-market support, a source of new technology and innovation, a source of finance to different projects and sometimes as a client. Finally, there are the *ship operators*, who are worldwide customers who play a key role in guiding the future direction of shipbuilding in Australia. It is important that Australian shipbuilders have the ability to offer flexibility and quality, in order to survive in what is a highly competitive global market (ASA 2003).

The Western Australian Shipbuilding Sector

At a national level the Western Australia shipbuilding sector has grown significantly over the past twenty years. This is due to the establishment of two of the largest shipbuilding firms within the State, comprising Austal Ships (with 26.4% of national market share in 2002), and Tenix (with 21% of national market share in 2002) (IBIS 2003).

Over the period from 1997 to 2001 the value of shipbuilding revenues in Western Australia increased by 56 percent, or an increase from AUD\$219 million to AUD\$341 million. Historically, as much as 81 percent of these values were contributed by high-speed aluminium ferries. However, the importance of ferries has declined in recent years as a proportion of the total output. For example, in 2001 only 51 percent of total shipbuilding output comprised ferries with a further decline during 2002 (Deloitte Touche Tomastsu 2002).

Australia's International Competitive Advantage in Shipbuilding

According to the Australian Shipbuilder's Association (ASA), the key sources of competitive advantage offered by the Australian shipbuilding industry were innovative design, advanced materials and construction methods, good fit-outs, a flexible and capable workforce and the ability to deliver to customer requirements (ASA 2003).

Innovative Designs

The different types of catamarans and their low wash environmentally friendly ferries, which are capable to make high speed operations in confined or congested waterways, have given Australian designers and shipbuilders a competitive edge in the export market.

Advanced Materials and Construction Methods

The Australian shipbuilders have borrowed ideas from the automotive and the aerospace industries. This has given them the ability to use non-traditional ship construction methods, which have produced competitive lightweight ships.

Good fit-out

Their good reputation for being able to produce quality fitted out vessels and the fact that a range of Australian shipbuilders have international standard assurance and quality control systems in place, is a security for their customers.

Workforce capability and flexibility

Australian shipbuilders have highly skilled tradesmen and a high standard of workmanship. They also have good relations between the management and their workforce.

Delivery to Buyer Requirements

This has given them a good reputation for on time delivery and for to performance specifications. They are successfully tailoring the ships to their buyers' need market.

Key Issues Facing the WA Shipbuilding Industry

Against this background in the national shipbuilding sector, the Western Australian shipbuilding industry must deal with several key issues. The first of these is significant fluctuations in the domestic market over the past five years. The level of exports depends on the exchange rate, but more importantly, innovative design, quality and timely delivery. The market wants safer, faster and more comfortable vessels. The importance is most significant in Europe, Asia and the Pacific. Industry sources also indicate that there are opportunities in the passenger and car carrying segments around the world (Deloitte Touche Tomastsu 2002). Important factors in the commercial market are:

- Price competitiveness
- The ability to build to specifications
- Provision of innovative design work
- Timeliness in delivery
- The ability to meet cost budgets and the provision of backup support and
- The trend for larger firms to subcontract to smaller firms.

Government policies state that most of the refurbishment and repair work on naval vessels will be reserved for Australian firms. However, the competition between states can be high with strong political influences affecting final tendering decisions. Entry barriers include; high start up costs including the acquisition of land and the uncertainty of securing long-term contracts.

In recent years the demand for shipbuilding within the fishing industry has been stagnant and only replacement orders have been let. Worldwide growth in the fast passenger ferry market has been optimistically forecast for growth of around 20 percent. Passenger traffic carried on fast craft is expected to increase from 62 million to 74.4 million in 2010. A further 30 million potential passengers are identified as currently travelling by other means. For example, in the Mediterranean, passenger numbers are expected to increase by 50 percent to 10.5 million and in the Baltic area passenger numbers are expected to almost double, reaching 2.6 million (Deloitte Touche Tomastsu 2002).

Competitive Forces Shaping the WA Shipbuilding Industry

Industrial economic analysis suggests that industry structure and competitiveness can be evaluated with reference to five key forces: 1) the number of competitors within the industry; 2) the bargaining power of customers; 3) the bargaining power of

suppliers; 4) the threat of new entrants to the industry; and 5) the threat of substitutes allowing customers to switch (Porter 1980). Of these forces the power of price sensitive and powerful customers able to secure supply from overseas competitors remains the most significant.

Competitive Rivalry

The number of competitors within an industry determines the level of rivalry that exists within the sector. Although the WA shipbuilding industry competes on a national and global level, there are an estimated 22 shipbuilders and or repairers listed in the State (Sensis 2003). Approximately half of these firms are located in the AMC area or its adjacent suburbs. A variety of suppliers of diesel engines, equipment and parts, fibreglass and outboard motors are also to be found in the same area, along with naval architects, boat and yacht designers, marine contractors and marine engineers. A recent analysis of the number of firms and employees located within Western Australia in these industries found that the State had an above average concentration of such professions. For example, in 2003 there were 14 naval architectural firms listed as operating in the State and 60 marine engineering firms (Sensis, 2003). In comparison with other states and territories, Western Australia had significantly higher per-capita concentrations of such businesses (Mazzarol, van Heemst & Patmore, 2004).

The competition and rivalry within the shipbuilding sector is high, particularly in the lightweight high-speed aluminium ferry segments in which WA firms have principally operated. In this segment WA shipbuilders must compete with rival firms from Norway, Japan and Singapore. Despite such competition, WA firms have secured a significant share of global markets. Further, in recent years the local industry has diversified away from ferries toward luxury yachts, survey and work vessels. Nevertheless, competition within the shipbuilding sector remains high.

Customer Bargaining Power

The buyers of the ships produced in Western Australia are both public and private organisations. Government purchasing is usually undertaken via competitive tender process that tends to squeeze profit margins. However, repeat purchases represent a high proportion of sales and shipbuilders can recover some profit margins in these sales due to economies of scale and scope. Generally, buyers are price-sensitive resulting in reduced profit margins for shipbuilders. As illustrated in Figure 3, the trend has been toward a higher reliance on domestic sales in recent years, although the trend is toward stabilisation in the two markets (Deloitte Touche Tomastsu 2002). These figures suggest that buyers are able to exercise a high degree of bargaining power.

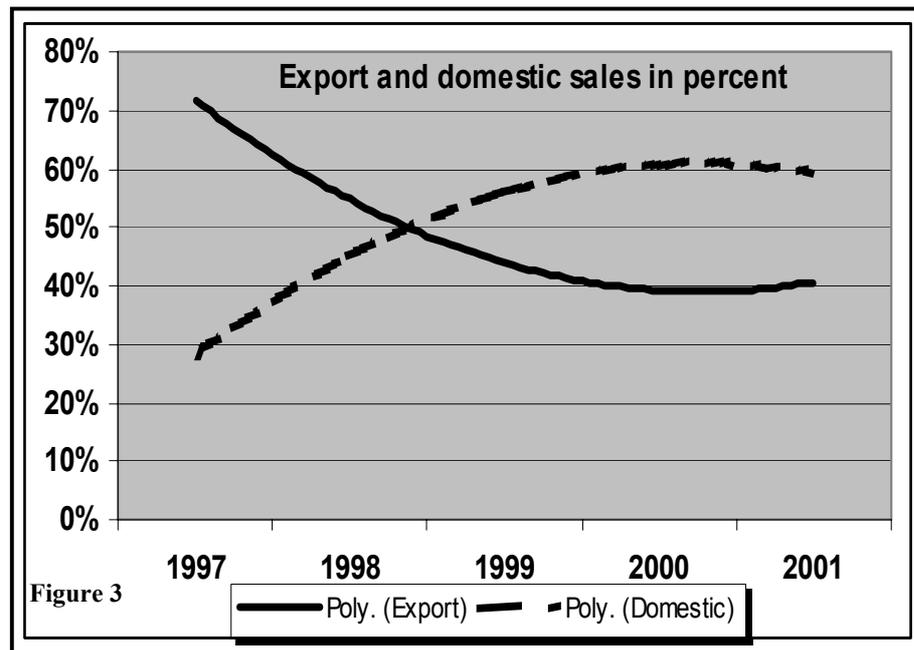


Figure 3: Export and Domestic Sales of Vessels

Supplier Bargaining Power

The main components in most shipbuilding are aluminium, steel, engines and associated services and products. Australia is the world's largest alumina producer and one of the largest aluminium exporters (AACL 2000). Some of the larger suppliers that often service Western Australian shipbuilders are Capral Aluminium, AMI Sales (a large sales agent / whole sale distributor) and all are Australian firms, however many suppliers are foreign. For example, MTU, Hamilton Water Jets for Catamaran Ships, Germany's Cummings diesel engines and America's Caterpillar and the electrical equipment provider Schneider. A high proportion of sales are made via agents, however, some direct purchasing is undertaken to secure better prices. In general, the bargaining power of suppliers is low due to the ability of local firms to secure alternative sources for components.¹

Threats from New Entrants and Substitutes

The major threat from new entries into the industry stems from subsidies given to shipbuilders from Korea, China and to a lesser extent Japan. Many sales are achieved through winning tenders and being able to build to the buyer's specifications. That implies that switching costs are minimal and as a consequence, that a medium threat exists from potential new entrants. However, the risk from substitute products appears very modest and the most likely threat to the ferry segment probably stems from the growth of low cost airfare carriers. Based on the

¹ Information supplied from interviews with WA shipbuilding firms.

suppliers' and buyers' bargaining power, the threat from both new entrants and substitute products and the rivalry, the WA shipbuilding industry is best described as being very competitive.

The State's Competitive Advantage in Shipbuilding

The competitiveness of a national or regional industry within global markets is dependent on the interaction between six key variables: 1) Factor conditions (e.g. land, labour, capital); 2) Demand conditions (e.g. the size and structure of markets); 3) level of strategy, structure and rivalry within the local industry; 4) the existence and strength of related and supporting industries; 5) the influence of government; and 6) the influence of chance (Porter 1990). Using this framework for analysis the following assessment is made of the international competitiveness of Western Australia's shipbuilding industry.

Factor conditions

The area encompassing the AMC has a population around 300,000, which is forecasted to reach almost 400,000 within the next 15 years. Hence, growth and labour resources relevant for the marine sector should be adequate as long as the proper education and training is provided. Since 1999 the workforce structure has changed from predominately sub-contract workers to more full time employees. However, sub-contracting continues to be important in areas of skilled labour shortage (e.g. shipwrights, glass fabricators, fishing and paint, laminators). Continuing shortages of skilled workers in the areas of glass fibre and aluminium fabrication have been particular causes of concern within the industry in recent years (SWG 2003). In addition to skilled labour, other key factor conditions that can be identified within the AMC are the excellent climate, allowing year-round operations, good capital infrastructure and relatively low cost land.

Demand conditions

The WA shipbuilding industry is strongly export oriented and most large vessels manufactured in the past five years have been sold overseas. As shown in Figure 2, the level of demand from overseas customers has experienced a decline that has been partially offset by domestic sales (SWG 2003).

Enterprise strategy, structure & rivalry

As discussed above, the WA shipbuilding industry has only a few firms actually based within the AMC, but the competitors that face this sector are to be found both nationally and internationally. Competition within the shipbuilding sector is strong, with price sensitive buyers and subsidised foreign competitors increasing the level of competition. The domestic producers within the AMC are less likely to compete against each other, however overseas competition does represent a significant challenge. Over past decades, the Western Australian marine engineering sector has grown strongly and as noted above, the concentration of businesses and employees within the sector is now significantly greater than is typical for other parts of Australia. Such a concentration of businesses is likely to enhance competitive rivalry.

Related & supporting industries

Key related and supporting industries co-located with the AMC in Western Australian are the offshore oil & gas sector, the aluminium mining and production sector, the Royal Australian Navy's (RAN) Fleet Base West at Garden Island and the Port of Fremantle.

The Western Australian aluminium industry is accredited with the production of almost half the nation's output and there are steel fabrication operations within the Kwinana industrial zone (AAFL 2000). Located just to the north of the AMC at Cockburn Sound, the Port of Fremantle is the State's largest transit point for import and export and is currently expanding at a rate of 12 percent (SWG 2003). Further, the greater concentration of naval architecture and marine engineering firms, along with related distributors, trade-training centres (e.g. Challenger TAFE) and to a lesser extent research centres (e.g. through the MITP), serves to enhance the overall competitiveness and viability of the AMC.

Government

Government support for the AMC has been significant. This support has included physical infrastructure investments including land development, common user facilities and other technology. Such support is equivalent to that found in other countries including Japan, Korea and China (DOIR 2003). Shipbuilding in many countries remains heavily subsidised and protected.

Both the federal and state governments, along with many other institutions and associations support and fund activities aimed at AMC. These activities include the work of the Australian Science and Technology Council (ASTEC), the Australian Centre for Maritime Studies, Austrade, Australian Shipbuilders Association, Industry Direct and the South West Group.

Competitive Advantage

The forces that influence the international competitiveness of the shipbuilding in WA are strongest in terms of the related and supporting industries surrounding the AMC. Also important are the factor conditions, although some concerns may exist over the availability of skilled labour. While rivalry between shipbuilders within the AMC remains low, competition within overseas markets is high.

The Production Network Layer

The WA shipbuilding sector was examined through the development of five case studies of three shipbuilding firms and two suppliers. For the purposes of confidentiality these firms have not been identified. The first level of the strategic networking to be examined was that of the production network layer, or the flow of activities from suppliers through the manufacturers to their customers (Holmlund & Tornroos 1997). Of importance was the role of key suppliers and lead customers. The former are defined as those suppliers that provide critical resources and inputs without which the firm's performance would suffer. The later are defined as those

customers that lead the market in recognising new needs and determine standards or set benchmarks within their industry.

Overview of the Cases

Each of the three manufacturing cases – Shipbuilders 1, 2 and 3 – were well-established WA firms specialising in the design and construction of aluminium vessels from 10 to 100 metres for a range of civilian, police and military purposes. All three firms undertook their own design work, but outsourced varying amounts of the production operations, usually in areas of specialist engineering. As each firm had grown in size, it had developed greater in-house capacity.

All three firms had key suppliers of specific components such as engines, aluminium, water jets, seats, windows and pumps. Many of these components suppliers were overseas firms, although a few were local. In addition, all three firms used a “floating” workforce of subcontractors able to provide key skills in the production cycle.

The customers of these shipbuilders were to be found in Australia and overseas and included both civil and military users. All three firms were able to identify several lead customers whom they viewed as assisting them to develop their own business and widen their market opportunities.

Of the supplier cases – Shipbuilding Suppliers 1 and 2 – both were local WA firms. These two firms were significant suppliers of key components within the aluminium shipbuilding industry both within WA and internationally. While supplying to firms within the AMC they also provided a high proportion of their output to overseas customers exporting between 50 and 80 percent of their production.

Table 1 shows the production system of these shipbuilders and whether or not they outsource a particular process or undertake it in-house. It can be seen that these firms undertook most of the key production and customer support activities in-house, particularly design and hull manufacture. Components suppliers were outsourced, although as some of these firms grew in scale they were beginning to produce their own components in-house.

Table 1: Production Networks of WA Ship Builders

Ship Builder Firm	1	2	3
<i>Production Activity:</i>			
Tendering	In-house	In-house	In-house
Sales & marketing	In-house	In-house	In-house
Client services	Both	Both	Both
Financial planning	Outsourced	Outsourced	Outsourced
Design	In-house	In-house	In-house
R&D	Both	Both	Both
Manufacturing	In-house	In-house	In-house
Components	Both	Both	Outsourced
Fit-out	In-house	In-house	In-house
Distribution	In-house	In-house	Outsourced
After sales service	In-house	In-house	In-house

Key Component Supplier Relationships

The shipbuilding case study firms were able to separate their key suppliers into those supplying products or components and those supplying services. Of the first, each firm was able to identify around 7 to 8 key component suppliers. These components were such items as diesel engines, water jets, seats and internal fixtures and fittings, electronics and pumps.

Relationships between the three shipbuilders and their key component suppliers were largely formal and rather “arms length” in nature. Most components manufacturers were located overseas or outside the State with only local representatives or agents in WA. The shipbuilders sought to maintain good links to these suppliers primarily because some customers specifically requested the inclusion of particular components in vessel design. However, pricing of components was a key issue and it was not uncommon for the shipbuilders to bypass the local agents and go directly to the manufacturers to secure better prices. This was justified on the grounds that the agent’s mark up was considered too high and that without this lower price the shipbuilder could not remain competitive.

Shipbuilder 2 was actively seeking to diversify its component supply in order to reduce the bargaining power of key suppliers, while also seeking to maintain cordial relations with such firms. By comparison Shipbuilder 3 maintained a group of key component suppliers with whom it regularly dealt, although it also viewed pricing as a key issue in selection of components. Shipbuilder 3 noted that it was always open to new sources of supply if they could offer enhanced prices for similar quality.

Communications between the shipbuilders and the key component suppliers usually took place on an order-by-order basis and was fairly formal in nature. Despite their arms length relationship, key component suppliers were a source of information for new product technologies and also assisted to some degree with product modification and innovation. Although most components were purchased off the shelf, Shipbuilder 3 had collaborated with key component suppliers to modify standard equipment to suit customer needs.

The relationship Shipbuilding Supplier 1 had with its suppliers was quite formal. Very few are overseas suppliers. The firm actively pursues a strategy to integrate backwards within its own supply chain. The firm’s approach to company operations was to purchase as many of their key suppliers as possible to maintain reliability of supply. To date, the firm had replaced five key suppliers with in-house production facilities. The firm believed WA was poorly equipped with infrastructure and felt local suppliers lack dedication to on-time delivery. Shipbuilding Supplier 2 is a major manufacturer and also had strong control over its own supply chain within Australia.

Key Labour Suppliers

In addition to the component suppliers, all three shipbuilders maintained a network of subcontractors who provide specific skills in the fit-out and servicing of engineering and electronics components and furniture and fittings. They also have a

pool of skilled workers, usually in aluminium welding and fabrication, who provide a ‘floating’ workforce that moves from one shipbuilder to the next depending on available work.

All three Shipbuilders followed a similar pattern with respect to these labour suppliers. While the relationship between these Shipbuilders and their “floating” workforce was somewhat arms length in nature, this was not the case for the subcontractors. Inter-firm relations between the three Shipbuilders and these smaller subcontractor firms were highly collaborative in nature. According to the Chief Executive Officer (CEO) of Shipbuilder 1, *“Their work is good, and they’re good to work with”*. The firm displayed a high degree of preference for using such subcontractors for all work.

Shipbuilder 2 had an immediate group of local subcontractors and maintained excellent relations with them, dependent on the quality of their work. Shipbuilder 3 had a handful of subcontractors they use for electrical fit-out, painting and air-conditioning. Prices between these firms were relatively competitive. The firm’s decision to continue relations with these firms was based on the quality of the work undertaken, their capacity to work together and the willingness of these subcontractors to *“go the extra mile”*, particularly in times of crisis. However, as the use of subcontractors was limited, Shipbuilder 2 did not view these subcontractors as potential building blocks to the long-term sustainability of the AMC.

Leading Customers

All three shipbuilders maintained close and highly cooperative relationships with their leading customers. The nature of these relationships was generally close and based on fairly high levels of trust. Communications intensity between the shipbuilders and their leading customers was high. In all three shipbuilder cases the principal point of contact with leading customers was the firm’s CEO, who was responsible for initial establishment of the relationship and also ensuring that it continued smoothly. The CEO was usually highly networked and used personal and professional links to secure new contracts and reinforce existing ones. It was common for the CEO to travel frequently overseas to meet customers.

The three shipbuilders worked closely with their customers over the design, development and manufacture of each vessel. As Shipbuilder 1 explained, their policy was to *“be honest to customers...have their trust...know what they want and deliver exactly as requested”*. These close customer relations had led to the generation of new sales with the customer, performance improvement and customer referrals to new customers. However, all three firms acknowledged that despite such close links, future orders were dependent on their capacity to provide quality products that were delivered on time, on cost and tailored precisely to what the customer wanted.

It was acknowledged that customers remained price sensitive and even long-term repeat buyers would shift their business if the shipbuilder could not offer a competitive cost. However, the main factor that secured new business was the firm’s ability to tailor products to the specific needs of customers. Shipbuilder 3 gave an example of a contract to build a new vessel for a buyer who was known to be price sensitive. Three WA firms tendered for the work including Shipbuilder 3, who was surprised to find the contract let to a competitor for a final bid price that was

AUD\$100,000 more than the next highest bid. According to Shipbuilder 3, this was attributed to the ability of the successful tender to know exactly the style of vessel required by the customer and tailor their offer to these needs.

Only 20 percent of the sales of Shipbuilding Supplier 1 came from local customers with most new business coming from marketing activities and referrals from existing customers. Lead customers offer Shipbuilding Supplier 1 useful insights into competitor activities. The firm believed that their main focus in dealing with customers was not on the customer firm, but on key personnel within these firms. They targeted people within their customer organisations who served as “gatekeepers”, able to open the door to more networks and new customers. By contrast, Shipbuilding Supplier 2 sold around 50 percent of its products locally. However, few of its WA customers sought close relationships. Local shipbuilders were viewed as being highly price driven with little interest in long-term contracts.

The Resource Network Layer

The *resource network* of the WA shipbuilding industry was found to comprise a wide cross-section of other firms, industry associations, government agencies, financiers and educational institutions. These relationships varied in strength from fairly loose associations, to strong and intense linkages of strategic importance to the firm. At least six broad categories were identified: 1) financial links; 2) government links; 3) industry associations; 4) joint venture alliances; 5) universities and research organisations, and 6) other industry actors.

Financial Links

In structuring deals for overseas customers, the shipbuilders relied upon the assistance of the Australian Government’s Export and Insurance Corporation. At the local level the shipbuilders used banks, venture capital suppliers and other sources of finance. For example, some component suppliers such as engine manufacturers offered financing packages. These relationships were largely formal in nature and in most cases (apart from venture financing), based on the duration of a contract with a customer for the construction of a vessel. Where venture capital financing had taken place, the shipbuilder had sought this to facilitate their growth. It had created changes within the business in terms of the new equity partners, but had substantially assisted their operational capabilities and international growth.

Government Links

All three shipbuilders had various links to state or federal government agencies in Australia and some, links to overseas governments. Most of these links were in conjunction with their entry into the defence; police or customs markets both nationally and internationally. There was some association with the Federal Government via AUSTRADE, but such support was limited and most felt that they did not need its services now.

Industry Associations

The Western Australian and Australian Shipbuilders Associations (WASA & ASA) were the two key industry associations with whom the shipbuilders maintained links. However, while the firms were members of these associations they did not view either entity as offering them much assistance with their business. Shipbuilder 1, for example, described the activities of WASA as largely “*socially oriented*”, while the ASA was viewed as “*too detached from specific state issues*”. Shipbuilder 3 was less critical of the WASA, suggesting that it was a useful body for industry networking. It also viewed that ASA as a useful lobbying body to the Federal Government, but of relatively low value add to their organisation, primarily due to the “*tyranny of distance*”. Of the two shipbuilding suppliers, one did not consider the WASA of value to its operations and focused instead on other industry networks. The other did not have any links to either the WASA or ASA.

Joint Venture Alliances

The three WA Shipbuilders also maintained joint ventures with other firms both within Australia and overseas. For example, Shipbuilder 1 supplied some vessels in a kit form to a joint venture partner in Asia who undertook the final assembly. This was frequently necessary in defence related contracts where the foreign government required some local offset production to help boost their own defence industry capability. Within the local defence industry sector collaborative alliances were the norm for large contracts in which shipbuilders joined with defence specialists in armaments, electronics and other naval systems to complete the final product. Such alliances were viewed as an opportunity to enhance capabilities and transfer new knowledge and technologies. The larger shipbuilders were also establishing spinout ventures with a focus on the design and manufacture of specialist components. The creation of these new ventures was designed to enable the sale of these new technologies and services to other rival shipbuilders.

Universities and Research Organisations

Of the three shipbuilders, only one had any strong relationship with universities or research organisations. Universities were viewed mainly as a source of graduates and occasional assistance with testing. It was noted that WA-based universities did not provide courses in naval architecture and most designers were sourced from eastern states institutions (primarily the University of NSW). Non-degree personnel (e.g. draftsman) were sourced locally. Curtin University of Technology was mentioned as having supplied occasional assistance with thermodynamic testing and the University of Western Australia (UWA) had collaborated with one shipbuilder to undertake noise reduction research for the design of watercraft for the Australian Special Air Service Regiment (SASR). UWA had also undertaken research work to design mounting brackets for vessels. The shipbuilders had also gone to Tasmania to have the Australian Maritime College in Launceston provide evaluations of their hull designs using their test tank facilities. There was comment from the shipbuilders that they generally had limited knowledge of the type of research being undertaken within WA universities and would like to see “*greater enthusiasm*” from universities and government research houses to promote activities with their industry.

Other Industry Actors

A variety of linkages and alliances were found to exist between the three shipbuilders and other industry actors. These included independent designers and smaller boat builders who offered useful access to specialist market niches. There was even evidence of rival local shipbuilders sharing people and resources when needed. It was also found that shipbuilders would sometimes refer a client to another shipbuilder if they felt they could better service a specific need. Consultants, particularly in design, were occasionally required to work with the shipbuilders at the request of clients who specified the need to use such third party specialists. Finally, all three firms were engaged with trade shows, industry journals and newspapers for promotional purposes and as useful sources of new ideas and market intelligence.

The Social Network Layer

The *social network* comprises those interpersonal linkages that may be both formal and informal in nature and take place between managers and employees within organisations. These relationships were categorised into relationships with customers, suppliers, joint venture partners, industry actors and government. These relationships were both formal and informal in nature and varied in terms of their strength and duration. It was noticeable that the CEO of each shipbuilder was viewed as the most important element in this social networking. They were in possession of a strong personal network of contacts with whom they secured opportunities for their company. However, as the shipbuilders had grown in size they had sought to groom replacements to relieve the CEO of some of this work.

Customer relationships

The most important relationships in the social network of the shipbuilders and shipbuilder suppliers were their customers. These were relations managed mostly by the CEO and other senior managers and had developed from an initial formal level (based on contracts) to a more informal one (based on social interaction). Contact with customers was viewed as important to the firm's ability to secure repeat orders and key referrals. Customers also contribute to technology advancements and the development of knowledge about issues within the industry.

As noted above, the CEO was a key actor in the maintenance of customer relationships and it was common for the CEO of the firm to be travelling overseas regularly to meet with customers and ensure that a personal touch was put on the company's products. There was a trend in one of the shipbuilders (Shipbuilder 3) to encourage contact between customers and lower level management from the company. It was felt that this assisted in keeping all of the firm's people in touch with the needs of customers.

Supplier relationships

The main focus for supplier relationships was in securing components at the most competitive price. In the opinion of the shipbuilders, this was a result of the price pressures that they were placed under by customers. Unless they could secure the most competitive pricing for key components, they would be unable to deliver at a competitive price to the customer and still make a reasonable profit margin. Relations between the shipbuilders and their key component suppliers were described as "*cordial*", with neither side seeking to "*force the other's hand*". There

was evidence of the shipbuilders seeking to diversify their component suppliers so as to weaken the overall bargaining power of each supplier. However, some suppliers were viewed as “core” and were difficult to replace. As the shipbuilders grew in size they were seeking to manufacture more components in-house, but there were limits to this level of vertical integration.

The relationships between the shipbuilders and the smaller subcontractors who supplied skilled labour for fit-out and servicing were generally quite close. Smaller shipbuilders were more likely to rely on such subcontractors than larger ones, and in this case these smaller shipbuilders developed close social relations between their management and that of the subcontractor.

Joint Venture Partners

Where shipbuilders maintained formal joint venture alliances the level of social interaction between managers from both firms within the alliance was high. This involved visitors from Perth going overseas regularly to meet with joint venture partners and reciprocal visits inbound. As the shipbuilders became more familiar with the business environment in these overseas markets, they grew in their confidence to undertake more diverse and ambitious projects there, using their joint venture partners to assist.

Relationships with Other industry Actors

Given the small number of shipbuilders in WA and the close geographic proximity of most manufacturers within the AMC it was unsurprising to find a high level of social interaction between the managers of the various shipbuilding firms. There were fairly close social relationships between CEO and other senior managers. Most senior managers had known their counterparts for many years and seen their respective businesses grow and develop over this time period. Other affiliations and associations the shipbuilders had were via their membership of the ASA and WASA, as well as such groups as the National Marine Safety Committee and International Maritime Organisation, and Australian Maritime Safety Authority. Such social and professional links were viewed as of value in terms of strategic networking.

Government Actors

A final element of the social networking undertaken by these shipbuilders was with government actors from both Australia and other countries. All three shipbuilders were engaged or seeking access to lucrative defence, police and customs contracts. While such tenders went via a formal system, it was important for firms to engage in social networking with politicians and military or police personnel as part of the way the game is played. Within overseas markets, the shipbuilders were reliant on Australian defence attachés to assist with initial introductions and to facilitate early negotiations.

Analysis of Case Study Findings

The pattern that emerges from these case studies is suggestive of a strong *production network layer*, strongest at the customer end and growing weaker toward the supplier side. Relationships between the shipbuilders and their subcontractors were mostly strong, particularly among smaller manufacturers. However, the level of cooperation and strategic alliances across the *resource network layer* was weaker. There were examples of close and effective partnerships between shipbuilders and venture capital suppliers and university researchers, but such examples were viewed as untypical.

All shipbuilders engaged in various levels of innovation in the development of their products. There were examples of fairly significant product innovations taking place, with some collaboration with component suppliers and universities in the design and development of new or adapted components. However, most innovation took place in the interaction between the shipbuilders and their customers and was incremental rather than radical.

The role of the CEO in the *social network layer* of these shipbuilders was of critical importance. In most cases the CEO was also the founder or one of the founders of the business and continued to play a key role in customer management. While some attempt was being made to devolve such responsibilities, the firms remained heavily dependent on their original founders. None of the firms appeared to have a culture where networking and openness was widely embedded, indicating a rather top-down approach to networking, which severely limits the exchange of more tacit or “deep” knowledge.

The overall impression that emerged from these case studies was of a local shipbuilding sector that has developed a strong national and international profile and has apparently reached a point of critical mass in relation to the concentration of businesses and skilled labour pools within Western Australia. However, while the industry is to be commended for its success and is a demonstrable leader at the national level, some areas of concern remain. Of particular concern to the long-term sustainability of the WA Shipbuilding sector were four key issues that are discussed in the following sub-sections.

Dependence on a few key-founder entrepreneurs

As noted above, the typical pattern for these shipbuilders was of a medium to large company that was still dependent on its original founder-entrepreneur(s) for leadership, innovation and customer-market interface. Many of these companies were still managed in such a way as to ensure that control and key decision-making vested in these founder-entrepreneurs who were typically the CEO. While such firms had taken on external equity and created corporate governance boards, the CEO remained a pivotal figure. Over time the challenge facing many of these companies will be the issues of growth and succession planning. The larger that a WA-based shipbuilder firm grows, the more likely that it will become subject to take over, or merger with national or international operators. Further, as the original founder-

entrepreneur(s) are also key shareholders in these firms, it is likely that they will seek to exit from these businesses and sell out their equity. While predominately the shareholding currently remains in local WA hands for most of these firms, this may change over time. The long-term future of the State's shipbuilding sector is likely to face succession-planning issues as these original founders retire or exit.

Competition based on cost rather than innovation

While these shipbuilders have clearly created their internationally competitive advantage around their capacity to offer high quality, differentiated products, the overall level of innovation intensity within the sector remains low to moderate. Cost was mentioned by all cases as a key factor in securing and retaining contracts, leading to firms engaging in ongoing negotiations with key suppliers and subcontractors over ways to remain cost competitive. Exchange rates have tended to favour WA shipbuilders in recent years, but this pattern has changed. Faced with a rising Australian dollar, local shipbuilders will need to focus on higher levels of product innovation and differentiation to ensure that they remain internationally competitive.

Labour market skills shortages

While most of the firms maintained a core group of favoured subcontractors and a floating workforce of skilled tradespeople, the case studies also demonstrated concerns over the supply of skilled employees in a variety of areas. In the blue-collar technical trades areas there were reports of gaps in the numbers and quality of key workers. There was also some criticism of the effectiveness of the State's TAFE and Vocational Education and Training (VET) sector in preparing apprentices for work within the sector. While it was not possible to fully verify these claims, these concerns were echoed by other case studies undertaken within the boat building and defence sub-sectors and industry survey outlined in subsequent sections of this report.

A similar concern was raised over the availability of white-collar employees, particularly in such professions as naval architects and business managers. As has been noted, the lack of local university-based courses in naval architecture and marine engineering or related research should be a concern given the relative importance of the AMC to the State's economy and the apparent concentration of such businesses within WA. The longer-term growth of the industry is likely to depend on the availability of skilled shipwrights, marine engineers and naval architects who can eventually assume senior management positions in such shipbuilding companies.

Weak resource network support

Finally, while the industry has an apparently strong production network with close linkages between these firms and their lead customers and key suppliers, the resource network of related and supporting industries was considerably weaker. This was particularly noticeable in relation to the education and training sectors as mentioned above, and the area of research activity. While the level of fundamental research undertaken within the sector remains low to modest, the need for firms to go to Tasmania or Victoria to seek assistance in research and development (R&D) work should be a cause for concern.

SECTION 3

The Boatbuilding Sector

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The leisure craft or boatbuilding sector is defined as those firms designing and manufacturing vessels (mainly under 10 metres in length) used primarily for recreational use. In turn the sector may be further divided into small leisure craft and luxury yachts. The Western Australian boatbuilding sector is largely a spin off from the commercial fishing industry, with a high proportion of firms in Western Australia building in aluminium and taking inspiration from the success of larger aluminium shipbuilders and TAFE college courses focusing on aluminium fabrication. Fibreglass is an attractive alternative construction material to aluminium, but many WA boat builders do not use it due to a lack of skilled fibreglass workers and the absence of trade certificate training courses in fibreglass construction.

Overview of the Boatbuilding Sector

The WA boatbuilding sector is characterised by a relatively large number of small firms and limited available information on their activities. Although a body of information is publicly available on the activities of WA shipbuilders, this is not the case with vessels of less than 8-10 metres in length. It is difficult to accurately estimate the precise number of firms within the WA boatbuilding sector, their size and annual turnover. The Boat Industry Association of WA (BIAWA) has 68 members registered in their database, but claims many more firms within the Perth metropolitan area. According to the Sensis *Yellow Pages* database at least 200 firms are listed as boat builders in the Perth area (Sensis 2003). Many of these firms are likely to include very small firms.

Discussions with the BIAWA indicate that there is no reliable records of the number of boats build each year in WA, or the value of the industry sector to the State's economy. Anecdotal evidence suggests that turnover within the sector is high, with many individuals attracted to the idea of boatbuilding, setting up a small firm and abandoning the venture within a few years in the face of what can be an intensely competitive market. At least one case was identified of a firm that won industry awards in one year, only to plunge into bankruptcy during the following year. While the industry comprises many small, undercapitalised firms, it has also spawned a number of highly successful companies with national and international reputation, that employ relatively large numbers of people and turnover multiple millions of dollars.

Competitive Forces Shaping the WA Boatbuilding Industry

The WA Boatbuilding industry can be segmented into two distinct sub-sectors. The first of these is the high-end luxury sector; the second is the lower-end small leisure craft sector. However, for the purposes of industry analysis, both sub-sectors are combined.

Competitive Rivalry

The level of competitive rivalry within the WA boatbuilding industry is quite high. There are relatively few firms of any size, with many micro-enterprises (e.g. firms with less than 5 employees) making up the majority of industry participants. WA firms must compete with rivals located elsewhere in Australia, as well as overseas. While WA has a growing number of firms that are active in the small leisure craft sector, it has only a few firms engaged in the high-end luxury market.

The high upfront costs associated with establishing a sizable boatbuilding operation create significant barriers to new entry for firms seeking growth. Competition within the sector is based on price, innovative design, reputation and performance, as well as the ability to deliver on time and on-cost to required specifications.

Many WA boat builders are motivated to enter and remain in the industry over the long-term because of their passion for boats and ability to translate this into a reputation for high quality products, supported by close relationships with customers. Departure from the sector is likely to be driven more by market failure than a decision to shift toward more lucrative business opportunities.

The luxury segments of the boatbuilding market are expected to grow over time (IBIS 2003). Future expansion of the WA boatbuilding sector may be contingent on securing access to skilled labour, particularly in the fibreglass-manufacturing segment.

Customer Bargaining Power

Within the luxury boat segment of the market, buyers are located throughout the world with no specific concentrations geographically. Such customers can also be difficult to reach for new entrants to the market. Each luxury craft is custom made and may take an average of 1½ years to complete. Buyers initiate purchase and initially have considerable bargaining leverage. The potential for repeat purchase adds to their power.

In the lower cost small leisure craft sector, the buyers consist mainly of dealerships and business-to-business interactions. Dealerships are located both within Australia and overseas. Many dealerships are difficult to reach for new market entrants due to pre-existing relationships with competitors. Each boat is standardised with minor custom-made alterations and takes an average of 4 weeks to 6 months to build. The dealerships usually initiate the purchase and have considerable bargaining leverage.

Within the boatbuilding industry there are sufficient competitors to allow buyers a wide range of alternative options and the ability to switch easily from one firm to

another. Usually a buyer will switch to a new boat builder if they are offered a better price or a more innovative design within the same price-performance package. Eventually, price generally carries more influence than brand names in the sector. Overall, buyers in the boatbuilding industry have high bargaining power.

Supplier Bargaining Power

The bargaining power of suppliers in the boatbuilding industry is generally low. This is due to the large number of competing firms in each of the key supply areas. This is less the case for fibreglass suppliers and skilled fibreglass workers with boatbuilding experience. Within WA, local suppliers are highly concentrated with many having offices or agents close to the boatbuilding firms. The cost of raw materials is estimated to represent a large part of the total cost of the boat. All suppliers are highly specialised in their field and have established long-term relationships with the boat builders. At times, these relationships transform into friendships but are always predetermined by price. There is sufficient supply available and usually they are commodities.

Threats from New Entrants and Substitutes

The level of threat from new entrants or substitutes within the boatbuilding industry is medium to high. Within the luxury end of the boatbuilding market there are few opportunities for economies of scale via mass production. Each boat is custom made and tailored to suit the individual needs of each customer. By contrast, within the lower-end leisure craft segment of the market there is the potential for mass production through standardised models produced in volume.

Luxury boat builders need to invest larger sums of private capital to acquire land, tooling and skilled labour for the production of craft that can take up to 1-2 years to complete. For the lower-end leisure craft sector, capital investments are typically smaller at start-up, but increase as the business grows and expands.

For boat builders seeking to secure a competitive advantage it is difficult to place patents on designs. Copying of designs is common and relatively easily undertaken by competitors. The main means of securing competitive advantage involve the development of expertise in boat design and construction and the reputation that this creates over time within the market place. For the manufacturers of luxury craft the customer is typically a multimillionaire and it is difficult to access such individuals without prior knowledge and contacts, plus the established reputation that can only be developed over a long time period. Customer loyalty is also to be found in the lower-cost small leisure craft segment, although this end of the market is price sensitive.

Boatbuilding demands the development and delivery of products that fit tight price-quality-performance ratios, plus the ability to deliver on time to such specifications. Prices can vary substantially depending on fit-out and features, as well as basic construction materials. It is relatively easy for customers to switch from one builder to another, although in practice a high degree of customer loyalty is to be found. In general the customer's propensity to change boat builders is linked to their financial resources and personal preferences.

The State's Competitive Advantage in Boatbuilding

The main source of competitive advantage for the WA boatbuilding sector appears to come from the high levels of competitive rivalry that exist between local industry actors. Innovation within the sector is driven by the owner-managers of what are mostly small firms, seeking to win business from local rivals through continuously improving their designs and products. Despite their size, most WA boat builders undertake a high proportion of the design, manufacture, fit-out and sales activity in-house. It should be noted that many of the more successful and innovative firms export most of their product and compete with overseas firms rather than locals.

The leisure craft industry in WA has addressed the challenge of not having close geographic proximity to its customers by developing strong partnerships with leading customers using email, telephone calls and long-distance travel for face-to-face meetings. Such frequent contact with customers is a valuable source of new ideas and market intelligence that allows the boat builders to predict future trends and continuously improve the performance of their products.

Future growth in the WA Boatbuilding sector will require export activity. Key factor conditions that have assisted the development of the industry have been access to infrastructure, affordable land and skilled labour. However, the appreciation of the Australian dollar and the lack of skilled labour in some key areas (e.g. fibreglass fabrication) may constrain future growth. Lack of access to venture capital is also a potential impediment to growth.

The local boatbuilding sector enjoys close geographic proximity to many of its key suppliers, and there is evidence of information sharing and technical support that has assisted the pace of innovation. Government support to the industry has been important, specifically in terms of export grants, R&D taxation concessions and investment by State Governments in the AMC infrastructure. State Government support for industry associations, apprenticeship support and educational programs have also assisted the sector. Such conditions have taken many years to evolve, commencing with the success of the WA-based America's Cup syndicate in the early 1980s, which helped to put the State's boatbuilding and design sector in the global limelight.

The Production Network Layer

As with the Shipbuilding sector, the WA Boatbuilding sector was examined in relation to the three network layers: production, resources and social, in order to gauge the nature and extent of strategic alliance formation within the sector.

Overview of the Cases

A total of 12 in-depth interviews were undertaken with firms within the boatbuilding sector for this phase of the study. Four case study firms were identified and selected for analysis – boat builders A, B, C, and D – although additional interviews were undertaken with six key local suppliers and two leading customers, also locally based.

Three of the four case study firms were located in the Henderson AMC zone, with the fourth at Bibra Lakes. Suppliers were located in Fremantle, Bibra Lakes and Canning Vale creating a micro-cluster or local production network concentrated in the south metropolitan region of Perth. Figure 4 illustrates this distribution and linkages network.

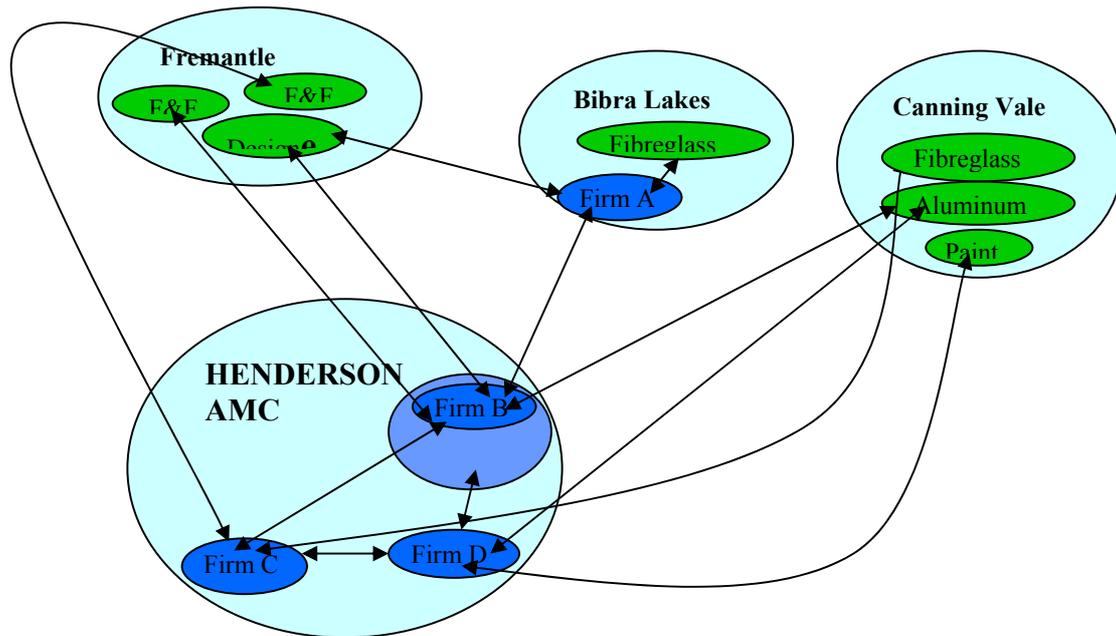


Figure 4: Map of Local Firms and Suppliers

Boat Builder A is a specialist manufacturer of sports, fishing and pleasure craft, motor yachts and luxury “marine limousines” that serve as tender boats for super-luxury motor yachts (the parent vessel is usually in excess of 75 metres in length). These limousine tenders are valued at AUD\$1 million to AUD\$2 million each and service the very high premium end of the market. Such craft can take up to 1½ years to complete and require the use of both advanced composite fibreglass materials, and expert craftsmanship in the design, finish and fit-out.

Boat Builder B is an award-winning manufacturer of luxury yachts in excess of 50 metres in length, each of which sell for over AUD\$50 million. Such vessels typically take up to 2 years to complete. Boat Builder C manufactures fibreglass catamarans and employs innovative hull designs to achieve reduced noise and enhance stability. Boat Builder D is a manufacturer of aluminium vessels for the leisure craft sector. It manufactures in volume.

All four of these boat builders were locally owned and had well-established track records within the industry. At time of interview these firms were of medium size, employing around 100 people each, although one case study firm had grown to over 200 employees making it a large company in Australian terms.

Key Elements of the Production Network Layer

The business activity system within the production network layer of these four boat builders generally involved 7 to 8 distinct activities comprising: sales and marketing, design, R&D and manufacturing, components installation, fit-out, distribution and after sales service. Some of these activities were undertaken in-house, while others were out-sourced, with slightly different arrangements for each case. Table 2 shows the pattern of in-house and outsourcing undertaken by these firms. It can be seen that manufacturing and fit-out were usually retained in-house as core business activities, while other activities could either be undertaken in-house or outsourced.

Table 2: Production Networks of WA Boat Builders

Boat Builder Firm	A	B	C	D
<i>Production Activity:</i>				
Sales & marketing	In-house	In-house	Outsourced	In-house
Design	Both	In-house	Outsourced	In-house
R&D	In-house	Both	Both	Both
Manufacturing	In-house	In-house	In-house	In-house
Components	Both	Outsourced	Both	Both
Fit-out	In-house	In-house	In-house	In-house
Distribution	Outsourced	Outsourced	In-house	Outsourced
After sales service	Both	Both	In-house	Outsourced

Customer Relationships

Customers for Boat Builder A were primarily multimillionaires comprising a global market of little more than 1,000 persons. Also included in the customer list were brokers, who contracted to supply luxury leisure craft of the kind produced by Boat Builder A, captains of luxury yachts and boat designers who served as sources of referral. All the firm's customers were located overseas within all parts of the world. There was an equal mix of new and repeat customers. Customers were generally sourced via word of mouth referral or when viewing the products.

Sales contracts were on a boat/project basis and were different every time. It could take up to 18 months to get a contract signed and the building started. A contract could last for approximately 1½ to 2 years and would generally stipulate price, timing and specifications. Boat Builder A worked closely with its customers to improve its end products and service. The nature of the relationship with customers was very personal and friendly, but a long-lasting relationship with such customers was not usually possible. Demand was usually cyclical as the purchase of luxury goods was sensitive to changes in global economic cycles.

Customers play an essential role for Boat Builder A in enhancing credibility and increasing sales, sourcing new ideas through their personal requirements, providing access to new customers and maintaining high quality standards. Direct contact with customers was important so the CEO travelled overseas for an initial contact and to negotiate the contract. Afterwards communication was mainly via email and phone on a weekly and daily basis. The firm's location in Perth did not seem to be an impediment to doing business on a global scale.

The customers of Boat Builder B were also largely multimillionaires mostly located overseas. As with Boat Builder A, it was important for the CEO and senior management of the firm to maintain close personal relationships with customers during the contracting and production process. All boats were sold prior to the firm commencing production and most customers become closely involved in the design stage to ensure that their individual requirements were met.

By comparison, Boat Builder C was only exporting 60 percent of their product, with domestic sales having previously played a much stronger part in the business. However, competition within the local domestic market had increased in recent years, with falling sales forcing the firm to seek greater exports. The lead customers for Boat Builder C were retail, government, businesses and overseas dealerships. The government contracts were with a range of different departments, both in WA and interstate. The company had also supplied foreign governments. Government contracts were seen as a good source of repeat business. As a result, Boat Builder C had sought to establish strong formal business relationships with its government customers, although this was not easy to maintain. Within the domestic retail sector, Boat Builder C usually had little opportunity for establishing long-term relationships with retail customers. After the sale was completed it was rare for the customer to maintain contact with the company. The firm's export markets were different again, with the key point of contact being overseas dealerships. These agents were a good source of market intelligence on the standards required for finish and fittings in these foreign markets. Boat Builder C had established fairly close personal contact with its key international distributors and sought to keep such dealerships "comfortable" with the firm as a "reliable supplier". The management team at Boat Builder C was willing to listen to any suggestions made by such foreign distributors.

Boat Builder D was the smallest of the case study firms and sold most of its product within the domestic market via intermediary retailers who also provided after sales service and support to customers. The lead customers for Boat Builder D were domestic and overseas dealerships located throughout Australia, New Zealand, the Pacific and Europe. The firm recognised these dealerships as vital to its success and maintained regular contact. However, many of these dealers had well-established relationships with rival boat builders and were frequently reluctant to harm such existing relationships by favouring one manufacturer over another. The company had made a decision to own and operate its own retail operation in the Perth market with a view to using this business to get a stronger feel for the market and end-user customer.

As with the other boat builders, Boat Builder D made significant adjustments to its products when exporting in order to ensure that finishes and fittings were tailored to international standards and tastes. The company sought to partner with its foreign distributors to secure enhanced market penetration and intelligence of local market conditions. Over time a series of strong, formal relationships had emerged between Boat Builder D and some of its overseas dealers.

Supplier Relationships

Boat Builder A favoured working with fewer key suppliers with long-term stable relationships preferring quality to speed and price. The firm mainly used local suppliers for key raw materials. Boat Builder A had known its local suppliers for many years and the relationships were rather friendly. On some occasions, Boat

Builder A imported special items from Europe to fulfil its customers' special requests. However, Boat Builder A preferred local to overseas suppliers, as the import process was lengthy and time consuming. Most purchased items were commodity products, leaving little room for product innovation. The relationship was very much an arm's length subcontractor-customer one. There was little collaboration between the firm and its suppliers except in the development of new ways to use components and materials (for example fibreglass).

Boat Builder B tried to source as much as possible from the local market. With 60 percent of the final cost of the boat being for materials and about 60 percent of that being sourced locally. The remaining 40 percent tends to be either luxury items, such as leather and marble, or specialist items such as engines that have to be imported. It was the intent of Boat Builder B to undertake as much production in-house, including the manufacturing of its own components. This required the firm to undertake a lot of R&D, with low-level innovation focusing on development rather than research as the key emphasis. Given the highly customised nature of the product it was difficult for the company to achieve scale economies via mass production.

For Boat Builder C, the majority of its key suppliers were locally based, especially when building catamarans for the local market. However, when building catamarans for the overseas market, the firm imported products from overseas suppliers to ensure that the catamarans met overseas standards. Key suppliers included fibreglass and fittings and fixtures. Boat Builder C did not have long-term contracts with its key suppliers, instead using trade accounts. The CEO of Boat Builder C stated that the company had open communication channels with its suppliers informing them of any changing requirements from the end user. The suppliers also encourage this openness and were willing to help solve any problems.

While fixtures and fittings are supplied locally, local suppliers generally source them from overseas. However, new products need to meet Western Australian standards even though they have International and Australian standards approval. When new products do not meet the Western Australian standards, they cannot be sold in the State. It is worth noting that other Australian states accept new fixtures and fittings that are approved by the International and Australian standards. This appears to limit the range of products available in Western Australia.

According to Boat Builder C, it had "a good working relationship" with its key suppliers but did not partner with them. The firm acknowledged that in the future when its financial situation had strengthened it would consider developing partnerships with its key suppliers to research new techniques and designs. The company had no immediate plans to work with suppliers to enable future growth. However, the fibreglass supplier was attempting to form a stronger relationship, but was finding this difficult in a price driven market.

Boat Builder D used local Western Australian based suppliers and had three key suppliers in the areas of aluminium, fixtures and fittings, and paint. The company had implemented a tendering process and used one-year contracts with most key suppliers. This meant that supplier relationships were formal business relationships and goods were supplied according to the agreed contract. The CEO of Boat Builder D indicated that that the firm did not have an open communication channel with its

suppliers. The approach taken by Boat Builder D when a problem was identified was to approach a supplier who had a good reputation and attempt to resolve the problem with them at the best price. It was also noted that the company had good business relationships with its key suppliers, but partnering had only occurred through the tendering process. Partnering with suppliers was viewed as of limited value if it did not lead to lower costs. The company had no plans to work with suppliers to enable future growth.

The Culture of the Boat Building Sector

The case studies illustrated a fairly close-knit and highly competitive boat building industry existing in Western Australia, with relatively small firms seeking to secure competitive advantages using design and personal contacts. Investment in product development is taking place, but price sensitivity at the lower-end of the market remains intense.

When interviewed, Boat Builder A was reconsidering its business model in the face of increasing pressures on its profit margins. Faced with a relatively high level of fixed costs and a capital-intensive production process, the company was looking to new innovative production processes as a way of manufacturing boats in a more profitable and sustainable manner. The outsourcing of key elements of the production and distribution process was seen as necessary to keep costs down.

The CEO of Boat Builder C described the boat building industry as “incestuous” and the industry “grapevine” as a very effective way to obtain information. However, in relation to the development of the business, the company did not feel that the information obtained from its suppliers had been helpful. Nevertheless, its fibreglass supplier had provided the initial contacts for the first government contracts. Also other key suppliers utilised sales representatives to stay in touch with the firm and organised road shows when introducing a new product to the market.

The CEO of Boat Builder D believed the WA marine industry was very isolated and although acknowledging the existence of an extensive industry “grapevine”, he felt that the company would not go out into the industry seeking information, but would instead go it alone and make decisions based on “gut feel”. In relation to the development of the business, Boat Builder D did not feel that the information received from suppliers had been helpful.

Overall Assessment of the Production Network Layer

All four case study firms in the boat building sector were attempting to do as many tasks as possible in-house and made use of outsourcing to lower costs or where they lacked internal capacity. The firms used mainly WA-based suppliers, but maintained largely arms-length relationships with the majority of such suppliers. Key suppliers were not likely to provide much influence on product innovation and contracting was frequently based on price.

By contrast with the supplier situation, the customers of the boat builders were mainly located overseas and leading customers played a highly significant role in driving product innovation and quality, particularly at the luxury end of the market. New ideas for product development and improvements were commonly sourced to customers or overseas based distributors. Regular contact, usually of a face-to-face

nature was frequent and supported by emails and telephone calls on a continuous basis.

The Resource Network Layer

Within the WA boat building industry, product development and innovation was strongly driven by customer demand with limited influence by suppliers. Little evidence was found of product research taking place between suppliers and boat builders; however, this was not the case in relation to the customers. The highly customised nature of the luxury-end of the market meant that innovation in design construction and fit-out was a key driver in firms seeking to secure a competitive edge. Innovation in manufacturing process was also being examined to help lower cost.

WA Shipbuilders Association and Government Support

The resource network relationships of the boat builders varied depending on their size and company structure. Boat Builder A, for example, was a small, but highly specialised niche producer with few direct competitors. Privately owned, the firm had not sought external equity funding and had relied upon retained profits for much of its growth over the previous 20 years. The firm's CEO and owner, was an active member of the WA Shipbuilding Association (WASA) and other industry associations. However, the firm had no contact with local or international universities or other research centres and undertook all its own testing. Boat Builder B was also a member of WASA, but its CEO did not feel that the Association had much to offer in the form of commercially useful information or benefits. Informal information channels via other industry networks were viewed as of much greater value and most of these key contacts and relationships were overseas.

In terms of venture financing and government assistance the boat builders were privately owned and secured little assistance from government. For example, Boat Builder A's owner did not seek to dilute his share holding and had largely ruled out venture financing for these reasons. Boat Builder A was also not eligible for many of the government support programs offered to the industry, although it had benefited from AUSTRADE assistance and grants, as well as R&D Tax concessions. In a similar way Boat Builder D obtained little assistance from government agencies, claiming that such help was usually too complex and lengthy. The company had used AUSTRADE to assist it to enter new overseas markets, but the level of support that had been given was considered less than what had been hoped for.

Education and Training Providers and the Labour Market

Few of the boat builders had any links with universities for research activities. Both Boat Builders A and B had no formal association with local universities and their senior managers expressed frustration at the lack of marine related courses offered in Western Australia. If these companies wanted to secure employees they frequently had to search outside the State for suitably qualified people. Boat Builder B did have some links with the local TAFE College to assist it to source trades apprentices, but this relationship was fairly intermittent. Boat Builder D also expressed concern over the insufficient level of marine and shipbuilding education and training in WA and saw local universities and TAFE colleges of limited value for

innovation research. The firm had no links to local universities. Boat Builder D also stated that recent changes to the Workplace Agreements and Awards were a limitation to productivity and growth within the sector. However, due to labour shortages, Boat Builder D would not hesitate to take staff from other firms if it could assist the firm in any way.

Like many of its counterparts, Boat Builder C also expressed concerns over the lack of education and training in marine engineering and related activities in WA. The firm did not hold the local universities and TAFE colleges in high regard as a source of potential innovation and had no links with these institutions over R&D. The company had also found difficulty in securing skilled fibreglass workers. Challenger TAFE was identified as having students enrolled in its shipwright's course, but to date the supply of such people was limited. According to the firm's CEO, there was a problem in the State in finding skilled workers with experience in boat building, lamination, cabinet making, and finishing (e.g. painting and coatings). The supply of experienced workers with marine fibreglass construction experience was also noted as a problem. Discussions between fibreglass suppliers and officials from the State education and training department had taken place, but the outcome of such activities was unknown at time of writing.

A concern expressed by many of the smaller boatbuilding firms was that they were frequently competing with larger local companies for skilled workers during busy production periods. While many employees sought to work for the smaller companies due to a more steady work environment, the larger firms could secure much of the floating labour market during their peak production.

Boat Builder C maintained a number of joint initiatives and alliances and considered these to be most important. However, due to funding restrictions, it could not maintain these. The main focus of Boat Builder C was cost reduction to hold market share in an increasingly crowded and price sensitive local market. Innovation in hull design remained a strong feature of the company's activities and the firm had links to an overseas university to undertake joint research in hull design leading to sea trials. The firm's management saw cost restrictions and funding limitations as key constraints on future R&D efforts. As a fibreglass manufacturer, Boat Builder C had found many suppliers and industry partners in WA to be focused too much on aluminium as a building material. The company had invested in fibreglass design and production innovations, working with local naval architects and designers to enhance the level of fibreglass used in the industry. Fibreglass, was viewed by the company as a luxury product compared to aluminium.

Overall Assessment of the Resource Network Layer

The four cases suggest that there are few joint alliances within the boat-building sector with a tendency for firms to work independently of each other and supporting and related industries. However, there was evidence of some mutually supportive collaboration taking place between Boat Builders A and B. Competition within the local WA market was limited, with most firms exporting almost all their product. However, a chronic shortage of skilled workers affects the majority of firms and they were generally critical of the WA education and training sector for not being able to supply suitable courses to help alleviate such problems. There was little evidence of these boat builders collaborating with third-party organisations in sourcing finance, research or training support. However, several firms had made use of business

consultants to assist in various specialist areas from time to time. Perth's geographic isolation was not viewed as a problem by any of the case study firms, despite the high level of export behaviour.

The Social Network Layer

The social network layer of these four boat builders were largely focused around their CEO who was usually the owner-manager of the business. However, employees also played a role in maintaining useful inter-personal contacts that could be beneficial to the business. For example, Boat Builder A relied upon employees to provide ideas for future innovation. The firm's culture was structured to encourage employees to offer new ideas and think creatively about possible solutions. Personal networks were a major source of maintaining the firm's competitive advantage. This was evidenced in the personal relationship that existed between the firm's CEO and a leading designer who provided sub-contracting design services to the company. The relationship was a source not only of ideas for innovation, but also leads to new market opportunities. This same designer also did work for Boat Builder B and there was a mutually beneficial flow of information between the two boat builders and the designer. While these boat builders preferred to work independently, they had collaborated to supply the needs of at least one customer.

As noted, Boat Builder B had a fairly close association with Boat Builder A, and a local designer. This involved sharing market intelligence, ideas for innovation and even customers. The geography of Perth was viewed by the CEO of Boat Builder B to be a problem with respect to keeping in touch with customers and some overseas competitors. There were demands by customers to monitor each stage of the production process and take a strong interest in how their boat was being made. The company had invested in a web-camera system to allow customers to log into the website and view their boat being made in the factory in real time 24 hours a day. The firm had considered shifting its operations out of WA to relocate in either Europe or North America, but was concerned over the need to secure staff and key suppliers.

Boat Builder C was highly networked within WA via the WASA and Australian Marine Industry Association. The Australian International Marine Export Group (AIMEX) was also mentioned as a useful channel for overseas market intelligence. As with Boat Builder A, Boat Builder C also had personal links via its CEO with Boat Builder B. This involved sharing market information and the services of designers and naval architects. Boat Builder C also had an informal relationship with Boat Builder D and reported having assisted the later firm with export information. Boat Builder C was actively engaged in international boat shows, which they viewed as a good way to keep in touch with the industry and maintain informal relationships with overseas dealers.

Boat Builder D, via its CEO and owner, enjoyed networks with many leading players in the local WA shipbuilding and boat building community, including links to Boat Builder C as already mentioned. Such relationships were informal and difficult to clarify, focusing on exchanges of information and occasional help. Most of the firm's relationships were formal contractual agreements with suppliers and customers. It had strong links to overseas dealerships, which it used for information exchange on international markets. The firm's CEO expressed some disappointment with the WA

Boating Association, which he did not feel was particularly helpful in supplying commercially valuable information. Boat Builder D used a consultant to assist with some aspects of the business.

Overall Assessment of the Social Network Layer

In examining the social network layer of these four boat builders the key role of the CEO, who was also usually the owner, was highlighted. The personal networks of the CEO with other firms, as well as industry support groups and customers or suppliers were a critical element in the company's ability to remain highly networked. All firms believed in a variety of sources of information rather than relying on one or two for their market intelligence or innovation ideas. A common pattern emerged for the creation of new innovation ideas, including use customer feedback, consultants and suppliers, with customers being the most important. There was limited formal research being undertaken by these firms, but all invested in incremental product development and business process development activities. The CEO and their senior managers led these innovative activities.

Analysis of Case Study Findings

The overall pattern emerging from these case studies is of a highly export focused industry that has successfully secured a place within the world's most exclusive markets for high quality and innovative products. In this sense the WA boatbuilding sector has developed a strong reputation for quality. Despite their size, these firms have developed strong international networks of distributors and customers. However, although successful, these firms remain small in scale and are dependent on the entrepreneurial leadership of their owner-manager founders. Most have made little provision for future succession planning and would suffer from the loss of their owner-founders who have established their firm's competitive advantage through their personal networks and industry knowledge. There appears to be a need for additional government assistance to the sector and attention to be given to enhancing the supply of skilled labour via the upgrading of education and training programs within WA.

Western Australia's boat-building sector appears to offer good potential for growth within the luxury-end of the market and has demonstrated its capacity to secure a competitive position in these demanding international markets. However, the shortage of skilled labour and limited investment by the sector in significant innovations remains a cause for concern. The majority of firms appear to be small and lacking in the desire for long-term growth. Their private ownership and preference for organic growth funded by retained profits, suggests that such firms will experience limits to their growth thereby placing restrictions on the capacity of the industry to expand.

SECTION 4

The Offshore Oil and Gas Sector

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The Oil and Gas sector is an important industry that contributes significantly to the Western Australian and Australian economies. In broad terms the sector consists of five distinct phases: i) exploration, ii) production, iii) refining, iv) distribution; and v) marketing. The activities involved within the exploration phase consist of survey and exploratory drilling; production involves the extraction of oil and gas; refining involves the processing of oil and gas to its marketable forms, while distribution transports these end products to the market. The majority of money and effort resides within the exploration and production phases. Specifically the WA Oil and Gas sector comprises at least 50 percent of the value and production of the total Australian Oil and Gas income and output (ABS 1998).

Overview of the Offshore Oil and Gas Sector

Natural gas is found in sedimentary rock and shale deposits usually at significant depth beneath the surface of the earth. Although historical evidence of natural gas being extracted and used dates from 600BC in China, with modern use recorded in the United States in 1821, the advancement of modern technologies capable of extracting and processing this resource did not become available until the later half of the twentieth century. Liquid Natural Gas (LNG) deposits have been estimated to be around 5,500 trillion cubic feet (tcf) on a worldwide basis, with the majority of such reserves found in Russia (31%) and the Middle East (32%), particularly Iran and Qatar (OGJ 2001).

Australia has been estimated to have around 1.7 percent of the world's known LNG reserves and in 1999 was among the top exporters of the product. Japan was the largest net importer of LNG, consuming around 50 percent of the world's production. Together with Korea and Taiwan, Japan consumed 71 percent of global production. In recent years China has also entered the market as a major customer. This places the Western Australian LNG industry in a strong position to secure a major share of the north Asia-Pacific market due to proximity, cost and reliability of supply.

The overall pattern of drilling activity for Australia's Oil and Gas sector is illustrated in Figure 5, which shows the size of the offshore gas fields located in the north west of Western Australia. Similar fields in the Bass Strait and central western Queensland complement this concentration of activity in the State's North West Shelf region. Exploration drilling is a precursor to field development and as such there are still potentially many field developments in the pipeline in the North West Shelf of WA.

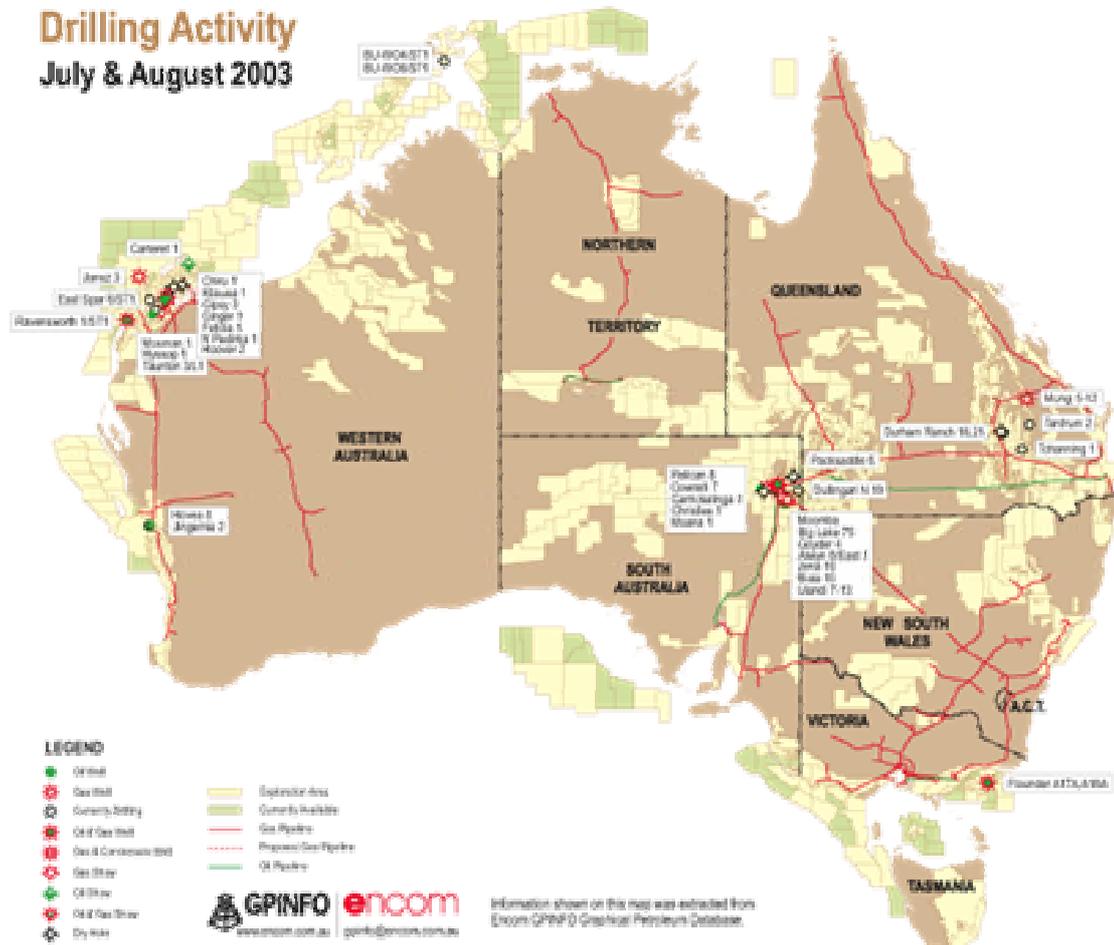


Figure 5: Drilling Activity Australia

Competitive Forces Shaping the Offshore Oil and Gas Industry

Two fundamental drivers that help to build competitive advantage within an industry are domestic inter-firm rivalry and geographic concentration. It is no surprise that within the Perth and WA there are the offices of many of the world’s major oil and gas companies, major project management engineering firms and a range of other supported and related industry representatives. Rivalry between major firms in the LNG sector varies but is generally strong and driven by the large market demand opportunities on a global level, but particularly in the Asia-Pacific region.

The WA oil and gas sector comprises a range of companies and skilled workers able to offer expertise in the fields of exploration, extraction, production and distribution. Key factor conditions include the availability of significant offshore reserves of LNG, well established infrastructure, managerial expertise in the resources sector and a competitive cost structure, assisted to some extent by exchange rates. Government support for the industry, at both state and federal level, has been strong with taxation subsidies, foreign trade agreements and investment in infrastructure. However, this has also been an area of contention, particularly in relation to taxation policy and foreign investment rules.

Rivalry

With respect to the offshore oil and gas marine construction sector rivalry among industry actors is fairly high, primarily between Australia, Indonesia and Korea. Fabricators of equipment in Indonesia and Korea currently enjoy lower labour costs and few issues relating to trade unions. Such competitors have a reputation for speed of construction and reliability.

Buyer Power and Supplier Power

Buyer power is very high with major fabricators experiencing pressure from their customers to lower cost and enhance reliability. This has forced many to look outside the State for alternative suppliers. Due to these pressures, supplier power is fairly low. A type of “food chain” effect appears to exist within the industry whereby buyers heavily control those supplying services.

Barriers to Entry and Substitution Threats

Barriers to entry into the sector are currently moderate. The AMC could assist the entry of smaller firms to establish a presence in the precinct. In a similar manner, the threat of substitutes is also low. New fabrication techniques that offer competitors a distinct commercial advantage via internal substitution are emerging and will need to be monitored.

Business Activity System and Case Studies

Figure 6 illustrates the general business activity system of the offshore oil and gas sector, and also shows the location of each of the four case study firms examined in this research project. It can be seen that the overall value chain of this industry comprises at least seven key components or activities. The first of these is field evaluation to determine the viability of a particular LNG reserve. Second is the project evaluation that assesses the feasibility of the technical and business case. Third the engineering work is undertaken to plan the components required in the offshore platforms and related infrastructure. Fourth, the fabrication work is procured under sub-contracted tender and this is then installed and commissioned in the fifth and sixth stages. Finally, the platforms and related equipment must be maintained over its service life.

In selecting cases for this phase of the study attention was given to Woodside, Clough, Transfield-Worley and AusClad. The first is the core actor within the North West Shelf oil and gas sector. Both Clough and Transfield-Worley are key actors in

the project engineering management, while AusClad is a major fabricator of offshore components. These cases provide a composite picture of the sub-sector.

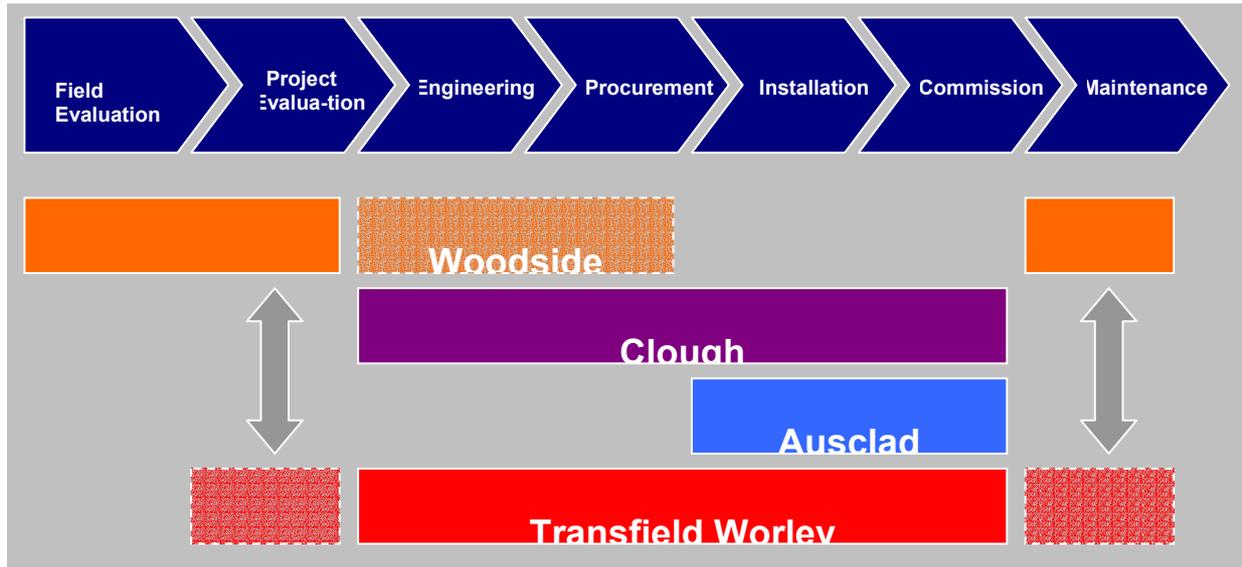


Figure 6: Offshore Oil and Gas Value Chain and Case Study Firms

Woodside

Established in 1954 in Victoria, Woodside is now Australia's largest independent exploration and production firm by market capitalisation. With a strong presence in the WA LNG sector, this firm is focused on the field and project evaluation areas of the value chain. Although Woodside collaborates actively with a range of other larger firms in the development of projects, it has developed a strong level of expertise and is highly self-reliant in many areas, only choosing to outsource those activities where it does not possess strong competencies. This was particularly in the areas of project management, engineering, procurement and maintenance. In these areas Woodside has a list of preferred subcontractors and usually manages such relationships on an arms-length basis. It follows an 80/20 policy that requires it to place 80 percent of its sub-contracting with 20 percent of its suppliers. This strategy is designed to reduce compliance and transaction costs associated with the management of a large number of suppliers, while also rewarding preferred subcontractors for quality.

Woodside maintains a large network of alliance partners such as BHP, BP, Chevron Texaco and Shell. These alliance partners were able to provide the firm with technical and financial resources for the exploitation of the North West Shelf LNG fields. Other partners are MMI, a Japanese holding company for two large Japanese conglomerates; and CNOOC, the national oil and gas supplier of China, and latest addition to the North West Shelf LNG joint venture.

Woodside maintains a range of relationships varying from strong partnerships to fairly weak alliances. The two that have very strong ties with Woodside are Shell and Transfield-Worley. The latter company is strongly tied to Woodside via their collaboration over engineering requirements. This has resulted in Transfield-Worley acting as a de-facto brown-field engineering department. Shell is also closely associated with Woodside through shareholding and is a primary source of technology and technical expertise. Other actors who impact on Woodside include customers and regulators.

Clough

Clough had its origins as a private engineering company in 1919 and has grown into one of Australia's leading engineering and construction contractors. The company is now a diversified public company and has capabilities in the areas of design, engineering, construction, maintenance and operations in on/off shore oil and gas, minerals, infrastructure, manufacturing and property industries. At time of writing Clough employed more than 4,000 people and had an annual turnover in excess of AUD\$1 billion, of which the oil and gas division contributed 68 percent. Headquartered in Perth, the company has divisions in Thailand, Indonesia, Singapore, Pakistan, India, the Philippines and United Kingdom. In 2003 the firm had projects underway in Malaysia, Pakistan and India.

Within the offshore oil and gas sector business activity system, the strategic focus of Clough has been in the engineering and commissioning areas. As a result, Clough has formed strategic partnerships and alliances with other firms on a project-by-project basis to secure access to additional skills in procurement and fabrication. Such alliances are frequently very close, but last only the life of the project (usually 12 months). An important aspect of success within the industry is the firm's track record in delivering on time and budget.

Clough has officially expressed the value it places on collaboration and alliances in business. However, many of these relationships are arms-length to start and can be driven by a desire to reduce costs. Large offshore oil and gas construction projects are generally high risk and Clough needs to out source many floating assets such as barges and derrick ships. Via this need for additional subcontracting, Clough has established close relationships with Mermaid Marine, which provides support vessels and assembly facilities at Dampier.

AusClad Group of Companies

AusClad is a privately owned engineering company based in Kwinana, Western Australia. The company has been operating for over 15 years and recently underwent a restructure resulting in the AusClad Group of Companies. It operates in a number of industries, including refractory, services in maintenance, painting and fibreglass, rural exports, and in fabrication and insulation for the oil and gas sector. As a fabricator AusClad operates mainly in the procurement, installation and commissioning areas of the business activity system. AusClad has grown from a small firm to a major engineering services company, that supplies to larger firms such as Clough and Transfield-Worley. In 2003 the firm had over 600 employees.

Transfield-Worley

Transfield-Worley was established in 1995 as a 50:50 joint venture between Transfield Services and Worley to provide integrated engineering and implementation services to Woodside Ltd. Since 1995, Transfield-Worley has been providing integrated services to support Woodside operate the assets of the North West Shelf joint venture. Tasks performed by Transfield-Worley range from supporting the maintenance function, delivering minor and medium capital refurbishment projects and managing major brown field refurbishments to the existing North West Shelf infrastructure in excess of AUD\$200 million.

Production Network Layer

The production network layers of these four case study firms were examined to provide a picture of the inter-relationships that exist within the offshore oil and gas sector of Western Australia. Each of the four firms provides different activities in the business activity system of the industry and their production layers overlap. As such a detailed analysis was provided for Woodside and Clough, but not the other two firms.

Production Network Layer of Woodside

Woodside's production network layer has been simplified to illustrate only its key suppliers, principal owners and leading customers. Figure 7 shows these relationships. Key suppliers can be grouped into fabricators, engineering and project management categories. As the flowchart indicates, engineering firms such as Clough and Transfield-Worley normally perform engineering services and project management functions. This is representative of Woodside's preference to outsource the project management function as part of an overall "turn-key" contract.

The flowchart outlined in Figure 7 illustrates Woodside's roles as both operator and owner that are functions undertaken by two separate subsidiaries within the company; Woodside Exploration Ltd (WEL) and Woodside Petroleum Ltd (WPL). As an operator Woodside is responsible to its shareholders who in turn sell the LNG as a collective to individual customers. As noted, leading customers from Japan, Korea, and China are joint venture partners in the North West Shelf LNG operations.

The North West Shelf joint venture has been selected as a basis of the production network layer due to its significance to Woodside. The company's role as operator and its other joint venture partners would be subject to change in other joint ventures.

From the perspective of the offshore oil and gas marine engineering sector as it impacts on the AMC, the supplier component of Woodside's production layer is likely to be most relevant. It was for this reason that the current study drew on the case studies of Clough, AusClad and Transfield-Worley.

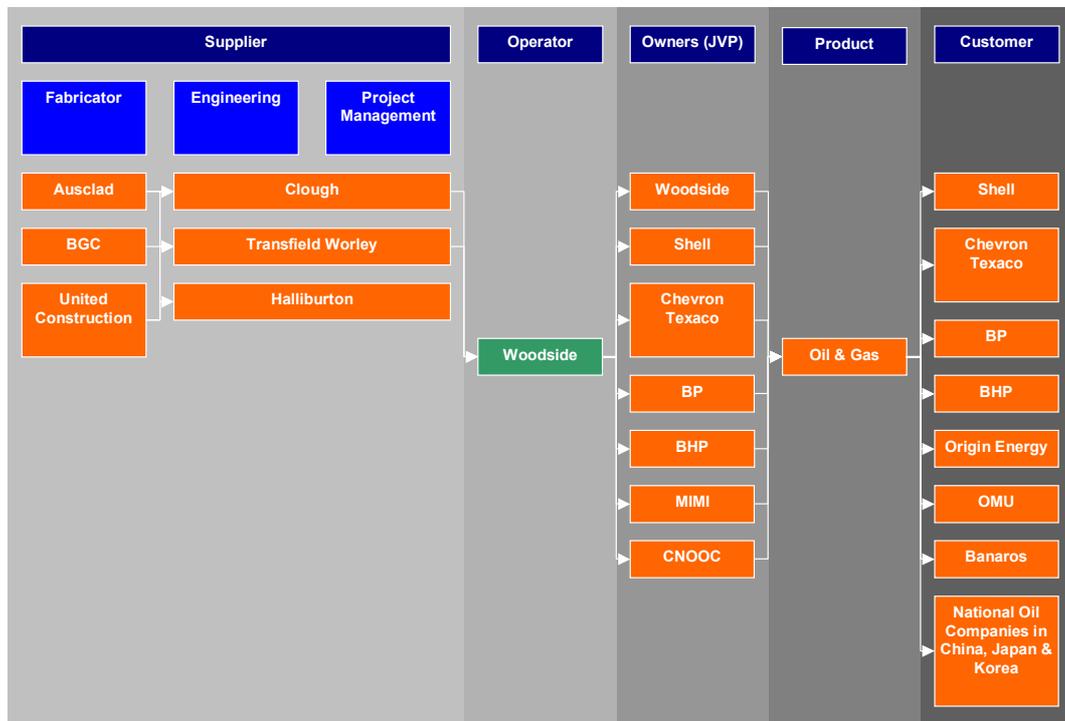


Figure 7: Woodside Production Network Layer

Production Network Layer of Clough

Clough’s production network layer is composed mainly of equipment and materials suppliers, fabricators and transport shipping companies. Clough project manages all these resources to complete projects for end-user clients. Clough has interests in other related construction activities in regions outside the North West Shelf LNG sector. The offshore oil and gas sector within Western Australia is considered too small a market to fully sustain the growth and profitability of the company.

In Figure 8 the production network layer of Clough is illustrated. It can be seen that the fabricators and installers comprise the majority of key suppliers, with key customers being the major oil & gas producers and related industries both within the domestic Australian and international markets. It should be noted that Clough collaborates with a number of other specialist engineering firms to undertake its project work due to the scale and complexity of such tasks.

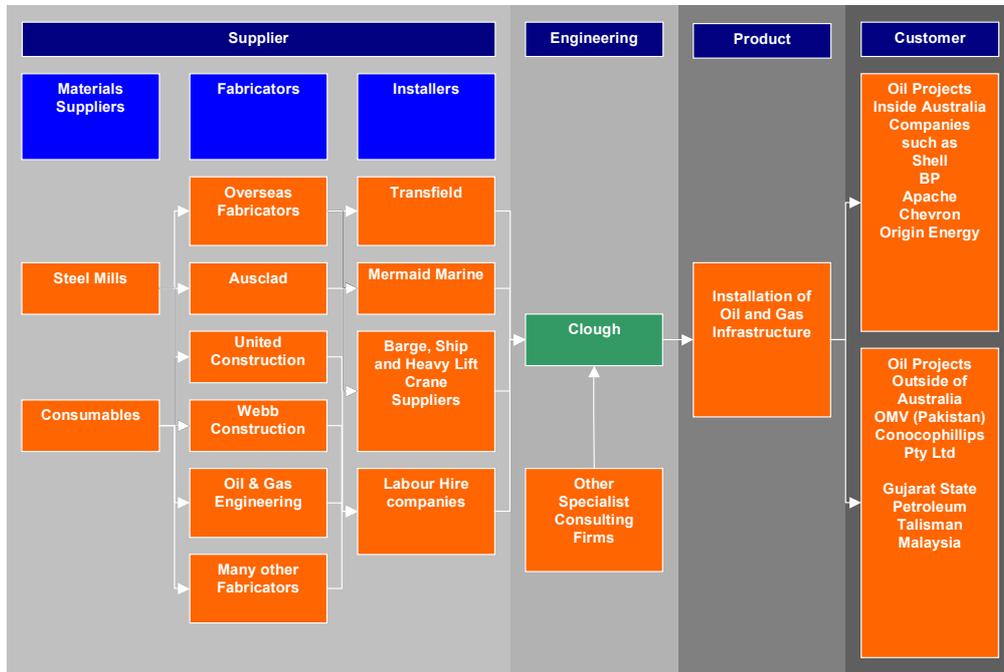


Figure 8: Cloud Production Network Layer

Production Network Layer of AusClad

According to the management of AusClad the fabrication industry in Western Australia is closely linked and networking is an important factor for the company to identify new market opportunities. Relationships within the sector are based around projects and alliances, such as those with Transfield-Worley or Meisei of Japan and are formed to obtain large and lucrative contracts. The nature of alliances formed is based on the financial and other resources provided with the North West Shelf joint-venture arrangements.

Industry newsletters and personal contacts via industry associations and events are a useful source of market intelligence. The monthly meetings of the Petroleum Club, for example, are regularly attended by most of the key actors in the oil and gas industry and are a valuable means of keeping in touch.

The key criteria for success in tendering are price and the ability to deliver on time. Competition among fabricators is tight and suppliers are dealt with via verbal contracts based on pre-agreed scheduled rates. More formalised procedures are used when pricing and assessing the quality of commodities such as steel, depending on the nature of the project.

Senior management drives innovation. Workers are encouraged to find ways to save costs and the company is engaged in process innovations designed to introduce new

automated systems, faster processing techniques and handling. Visits to trade events, conferences and newsletters are all useful sources of information and ideas for new innovations.

The managers of AusClad expressed a positive attitude toward the AMC and regarded its facilities as suitable for undertaking larger projects (e.g. components over 500 tonnes) that could not be fabricated within the firm's existing yards. Transportation to the AMC was viewed as cheaper than using the Dampier facilities owned by Clough. In addition, the high, wide corridors developed for road transport were seen as an added bonus. However, AusClad was constrained to some extent due to low power lines bordering its yards and there was a program being considered to sink these underground to allow easier road access.

Use of the AMC fabrication multi-user facilities was not viewed as entirely without problems. For example, the fabrication of really large components raised the issue of having to take over almost the entire facility space. The charge out rates for hiring the facilities were also seen as rising, as were hiring charges for barges, which had to be brought from Singapore, as the AMC did not have a heavy ship lift capacity.

Resource Network Layer

The resource network layer of the offshore oil and gas sector is particularly complex due to the size of the firms engaged. As with the production network layer, we have focused the analysis on Woodside and Clough with reference indirectly to the other two firms. These other case study firms are part of the resource networks of these two focal firms.

Resource Network Layer of Woodside

Woodside's resource network is quite complex and diverse, as would be expected in such a large and complex organisation. Key resource suppliers are Shell and Transfield-Worley with both providing technical knowledge and personnel. Over recent years the number of Shell employees working within Woodside has decreased, as the level of in-house capability within the company has grown. The firm's equity partners and its internal cash flow supply financial resources. State and federal government agencies are also in regular dialogue with the company's Corporate Affairs Department. Woodside also maintains links to Curtin University and Sun Microsystems. These links are viewed as primarily of benefit to the external network partners as Woodside prefers to provide on-the-job training due to the specialised nature of its work.

Figure 9 shows these links and the different actors that comprise the resource network of Woodside; with division into those providing equity, regulatory controls, technical services, industry advocacy and production links.

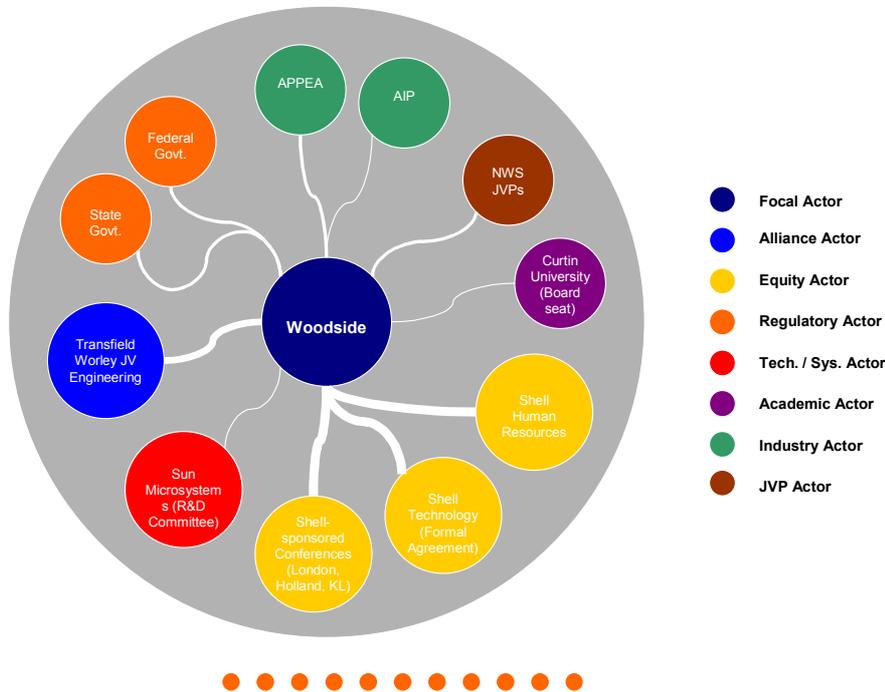


Figure 9: Woodside Resource Network Layer

Resource Network Layer of Clough

Clough’s resource network is diverse and is instrumental for the delivery of projects that can be finished on time and on budget. These linkages are primarily with materials suppliers such as steel mills and fabricators, but also installation contractors. These linkages are formed on a project-by-project basis as outlined in the production network layer. Financial resources are secured via a range of partners including Citibank, Commonwealth Bank of Australia (also a major shareholder), HSBC Bank Australia Ltd, BNP Paribas and the Bank of Western Australia. The company has numerous informal links to local universities via key engineering faculties and offers a scholarship program for university graduates.

Figure 10 illustrates a simplified resource network for Clough showing the various key relationships including regulatory agencies, industry advocacy such as APPEA and the Petroleum Club, and industry partners such as Mermaid Marine and Santos-Haliburton.

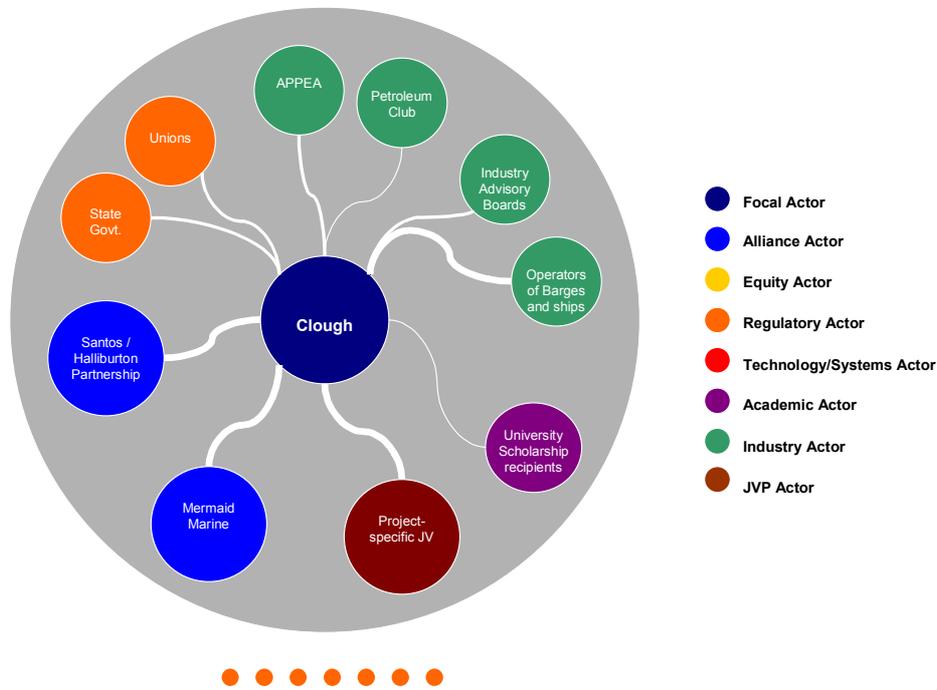


Figure 10: Clough Resource Network Layer

The Social Network Layer

Mapping the social network layers of such large organisations as Woodside and Clough was not possible on any detailed level. However, the study identified some general patterns that are worthy of noting.

Social Network Layer of Woodside

The social network of Woodside is naturally extensive, but appears to manifest itself via industrial events such as those held by the APPEA and AIP. Managers within the company were generally reluctant to speak about their professional industry links, however, it was clear that relationships were maintained within a range of different actors. Woodside's employees have close relationships with their colleagues at Shell as a result of the joint venture. Both companies regularly interchange staff and meet via conferences in London, Holland and Kuala Lumpur. Senior Woodside managers are also well networked among leading customers and with state and federal government agencies.

Social Network Layer of Clough

The social network of Clough was equally complex and manifested most clearly via industry events. Personal relationships and contacts were fostered through staff transfers within the oil and gas industry. For example a link between Clough and Santos-Halliburton was evidenced due to senior management movements. Links with trade unions and state or federal government agencies were also evident but not particularly strong. A weak social network was also to be found between Clough personnel and the various WA universities through their engineering faculties and the graduate scholarship program offered by the company.

Analysis of the Case Study findings

A few large focal firms such as Woodside and its joint venture partners dominate Western Australia's offshore oil and gas industry. As shown in these case studies, the sector is highly competitive and strongly international in focus, with major engineering firms such as Clough viewing the sector as a relatively small market in comparison to their overall business activities. While there is evidence of a strong industry cluster focusing on the North West Shelf LNG production, the evidence of a similar cluster in offshore oil and gas marine engineering centred on the AMC was not found.

While the management of AusClad expressed a generally positive attitude toward the AMC and its potential as the focal point for an offshore oil and gas component fabrication industry, the attitudes of the other firms was less enthusiastic. There was a general indifference expressed toward the AMC as a construction site, with some scepticism over the relative benefits of using the AMC in comparison with foreign fabricators in Korea or Indonesia. The AMC is still relatively new and has yet to fully demonstrate its capacity in this regard. Managers raised concerns over the level of trade union activity within Western Australia, as compared to countries such as Korea or Indonesia. Production costs and production reliability issues were also raised. There was also an apparent lack of appreciation of the overall capacity of the AMC and its role in the fabrication of offshore oil and gas components. Concerns were also expressed over infrastructure capacity and lack of suitable barges and heavy lift equipment.

The offshore oil and gas industry is prone to cyclic fluctuations making it difficult to maintain skilled labour pools with project-by-project relationships lasting relatively short periods of time. While the key actors in the offshore oil and gas sector are not risk adverse, they require a high degree of stability and reliability in their supply chain. The relative novelty of the AMC appears to remain a point of concern.

Competition for large-scale fabrication of offshore oil and gas components is on a global scale, with the AMC having to compete against rival manufacturers in low labour cost countries with stronger track records of on-time and on-cost delivery. The cost of shipping fabricated components to an offshore extraction and or production site from a local supplier was viewed as similar to shipping the same component from a foreign supplier. A lack of suitable barges within the local market was a fault.

The fabrication of offshore oil and gas components is one of the major areas of activity for which the AMC has been designed. It is therefore important that the full advantages of the AMC and its capabilities be promoted to such groups as Woodside

Transfield-Worley and Clough. A number of false or at least misleading perceptions of the AMC and its capabilities were found among many of the managers interviewed. This was most evident in relation to the role of local trade unions. For example, while the larger firms viewed the local trade unions as a possible threat, the smaller fabricator firm held a different view.

Research studies of foreign competitors within the region should be undertaken to fully assess their capacity to threaten the AMC and to identify the points of relative strength that the AMC can offer. This would assist those seeking to promote the AMC to identify its key competitive advantages. The collaboration of local fabricators and installers in bidding for future contracts, supported by the local trade unions, may be a key to future success. Assistance may need to be given to local fabricators in the form of changes to local infrastructure (e.g. underground power lines) to assist them to fully compete within the AMC. The purchase of additional equipment such as heavy lift barges may also be required.

Given the cyclic nature of the offshore oil and gas marine engineering industry, the AMC should be seeking to win contracts from tenders outside Western Australia. This has been the experience of Clough, which has expanded its operations beyond the local market in order to secure sufficient work to maintain capacity and assist growth. This is likely to be particularly important for the maintenance of a pool of skilled labour within the State.

SECTION 5

The Marine Defence Sector

Project Team: Charl Morkel, Brenna Pavey & Keith Howe

The Australian defence industry sector is highly dependent on the Commonwealth Department of Defence procurement system as its key customer. For much of the nineteenth and early twentieth century the majority of Australia's naval equipment was designed and built in the United Kingdom as the Royal Australian Navy (RAN) was viewed as operationally part of the Royal Navy (RN) during times of conflict. With the establishment of the RAN following Federation in 1901 the Federal Government moved within the first two decades to establish a domestic naval shipbuilding program. Following the Second World War, Australia's naval orientation shifted from Great Britain to the United States, with naval vessels and systems increasingly being sourced from America and other countries. Self-sufficiency in defence capabilities has been a key element of Australian policy for many years, leading to a major investment in local naval ship construction.

Overview of the Maritime Defence Sector

The Australian defence sector is worth around AUD\$2.6 billion per annum, comprises over 1,400 companies and employs an estimated 30,000 people servicing the needs of the Australian Defence Forces (ADF) (Austrade 2003). While the majority of firms in the Australian defence industries are focused on servicing the needs of the ADF, the relatively small market opportunities created by the national defence budget mean that many are seeking to export their products to foreign military or police customers, particularly the United States, United Kingdom, New Zealand, Thailand, Singapore, the Philippines, UAE and Kuwait.

Within the Australian maritime defence sector the RAN is the chief customer with locally manufactured destroyers, frigates, submarines, minesweepers and patrol boats comprising the main contracts in recent years. The development of the Fleet Base West, HMAS Stirling at Garden Island, Cockburn Sound in Western Australia during the 1980s has created a major opportunity for naval defence contractors in WA. Under the two ocean basing plan, half the RAN surface and underwater fleet is located at HMAS Stirling.

Construction of RAN vessels has traditionally not taken place in Western Australia. For example, the ANZAC Class frigates were constructed at Newcastle NSW and the Collins Class submarines in South Australia. However, maintenance of the fleet at HMAS Stirling has created many opportunities for the State's local defence sector. The Collins Class submarines were of particular importance as these vessels suffered some costly teething problems during the 1990s, leading to systems upgrades and refits (Commonwealth of Australia 1999).

Primary and Secondary Contractors in Structural and Systems Engineering

Defence contractor firms engaged in the naval construction industry can be grouped into two categories. The first are those that build the hull and propulsion systems for the vessel. The second are those that supply and fit-out the vessels communications and weapons systems. The first group is mainly concerned with structural engineering, while the latter focuses on high technology systems, usually involving electronic engineering. Within Western Australia, these two types of firms are to be found, physically maintaining and repairing the surface ships and submarines based at HMAS Stirling, and repairing and upgrading communications and weapons systems used in these vessels.

The defence procurement system engages a large number of principal contractors and subcontractors who tender for the available work and compete actively for the existing naval budgets. Prime contractors bid for major naval projects and then subcontract the work to other firms to complete the construction or maintenance. These prime contractors generally form relationships with subcontractors according to a tiered system.

Work within the sector can be cyclic and regular fluctuations in local demand place pressures on the local pool of skilled labour. Such work is generally highly specialised and the military requires high levels of compliance to ensure work is performed to standards. The industry can also be subject to trade union pressures as has occurred recently in relation to the negotiation of workplace agreements. Skilled employees with experience of defence contracting are highly valued and it is generally not possible for such workers to learn all that is required through a formal course at TAFE. This also applies to white-collar employees in such fields as naval architecture, marine acoustics, communications, weapons and combat systems.

The Defence Industry and the AMC

The AMC is collocated with HMAS Stirling naval base and should be well placed to concentrate such a skilled workforce. Similar concentrations of this kind can be found in NSW and South Australia. For this study interviews were held with representatives from five companies with operations focused on the naval defence sector in Western Australia. These firms included: the Australian Submarine Corporation (ASC), Austal Ships Ltd, the Tenix Group, Raytheon Australia Naval Systems and Nautronix Ltd.

- **Austal Ships Ltd** – a publicly owned company headquartered in WA engaged in the design and manufacture of surface vessels for the RAN and US Navy.
- **The Tenix Group** – a privately owned company engaged in a range of defence engineering projects including surface vessels for the RAN.
- **Australian Submarine Corporation (ASC)** – a government-owned consortia that has been responsible for the construction and commissioning of the Collins Class submarines for the RAN.
- **Raytheon Australia Naval Systems** – a subsidiary of Raytheon Corporation of the United States, which is engaged in weapons and combat systems.

- **Nautronix Ltd** – a subsidiary of Nautronix Plc of the United Kingdom, which is engaged in the design and commissioning of underwater acoustics and through water communications systems.

Discussions with representatives from these organisations suggest that the industry attitudes toward the AMC are mixed. Major firms such as Austal and Tenix, whose presence in the area pre-dates the AMC, seemed ambivalent toward the concept of a defence cluster focusing on the AMC. These firms were physically located in the complex and made use of its facilities – particularly Tenix with respect to use of the submarine lift equipment. As prime contractors they are responsible for the core activities in many of the major naval contracts. This makes them a high profile focal point for trade unions, government officials and politicians. While they were not negative toward the AMC, they viewed their presence from the perspective of the key focal firms around which the wider complex revolves.

The other firms held views of the AMC that ranged from relatively positive to relatively negative, depending on the level of engagement within the procurement system. For example, the high-value subcontractors were generally positive toward the AMC and saw the idea of an environment supportive of industry networking to be a good thing. These firms saw strategic networking and modern business practice via inter-firm cooperation as a strong element of their business approach. By contrast, the low-value subcontractors generally complained of a lack of perceived support to their industry by government, difficulties in securing contracts and an overall lack of incentives to attract them to the AMC.

Competitive Dynamics and the Business Activity System of the Defence Industry

The defence industry is a natural monopsony in which the government and its Defence Department is the sole customer. For example, the Collins Class submarine contract is the responsibility of the ASC and there are few threats from new entrants or competitors. The Collins Class submarines are among Australia's most advanced weapons systems and form a key strategic defence asset along with the F-111C fighter-bombers of the Royal Australian Air Force (RAAF). Firms seeking to secure contracts to supply or maintain these vessels must possess certification and skills levels that provide a form of entry barrier for new entrants.

Within the surface fleet, the primary defence procurement work within the AMC is focused on routine maintenance work and minor refits. In this area the level of competition is intense as the barriers to entry and level of specialisation required is less than for the submarines. Australian defence procurement policy is based on a system of competitive bidding, with contracts usually being awarded to the lowest bid price. Prime contractors such as Tenix and United KG, for example, compete aggressively for such work and in-turn require their subcontractors to supply at a low price to assist their bids to remain competitive. Discussions with representatives from the subcontractors suggested that some bid pricing was "below-cost" and that the only way to remain profitable was to look for ways to vary the job after the contract had been let, so as to so achieve cost savings. While confirmation of these

claims was difficult to ascertain, there was a perception in the industry that this was a common practice.

Demand Conditions

Since the creation of the two-ocean navy policy in the 1980s and the establishment of the HMAS Stirling facilities, the demand for naval defence work in Western Australia has grown strongly (Tarte, 1999). This has led to prime-contractors such as Tenix, ASC and Austal increasing their role in the State and in-turn generating work for small firms within the subcontracting pool. More recently, the increasing presence of the US Navy in Western Australian waters seeking minor repairs and refit work has raised the prospect of further demand opportunities. In addition to this locally based demand, most firms interviewed were engaged in or seeking defence work overseas, particularly in North America, Asia and the Middle East.

Factor Conditions

As noted above, the defence industry requires a range of highly specialised skills in many areas including precision welding to electronic systems. Western Australia has a pool of skilled tradespeople with experience in the marine engineering and electronics industries. One of the key benefits of the emergence of the AMC has been its ability to concentrate such workforce. However, many industry representatives interviewed for this study expressed a concern over the shortage of skilled tradespeople. Further, there was a view that local TAFE colleges were not able to produce sufficient graduates or graduates with appropriate skills to meet industry demand.

Within the more advanced engineering fields there was also a view that Western Australia needed more skilled people with appropriate levels of expertise. According to industry representatives, there were insufficient numbers of senior engineers with postgraduate qualifications and industry experience in the areas required within the naval engineering industry. Particular shortages were identified in software and acoustic engineering.

In the area of senior management, a similar shortage was also identified. Many of the firms interviewed claimed to have recruited managers from outside Western Australia due to finding no suitable applicants locally. This lack of managerial talent was also impacting on the succession planning with some of the firms interviewed.

Firm Strategy, Structure and Rivalry

As discussed above, the defence industry within the AMC is largely focused on a few prime contractors, particularly for the maintenance contracts on the RAN surface vessels. Competition is fierce and price driven due to Defence Department procurement policies. Competition among subcontractors seeking to secure work via the prime contractors is also intense and highly price driven.

Chance

Some industry participants view the creation of the two-ocean navy policy as a process of chance due to the presence of Australian Labour Governments in Canberra during the 1980s. The technical problems experienced by the Collins Class submarines during the early 1990s were also an unexpected problem that has

generated additional work. Finally the recent threat of global terrorism and the conflict in Iraq has increased the level of US Navy activity in Western Australia creating the chance for more maintenance work for the AMC.

Government

As noted earlier, the role of government in the defence industry is significant. Given the strategic nature of the defence sector and the number of jobs involved, it is not uncommon for decisions relating to defence procurement to be strongly influenced by political forces. The location of defence industries in various parts of Australia is as much driven by politics as by military strategy. This level of political interference in defence industry matters also extends to export restrictions that are placed on items considered to be particularly sensitive. Sales to some foreign buyers can be impeded either by a reluctance on the part of the Australian Government to allow such products to be sold due to their technology, or because the end-user is not viewed by Canberra as a suitable recipient.

Defence procurement policy in which price is a major criterion for the selection of successful tenders is also likely to shape the long-term direction of the AMC. Some of the subcontractors interviewed for this study expressed concerns over the impact that such cost cutting might have on quality and safety. They also held negative views toward the high compliance costs associated with defence tenders, particularly the time and associated paperwork required to secure payment for work completed. These delays in payment were impacting upon the cash flow of some of the smaller subcontractors and causing concerns.

State Government activity within the AMC via the Department of Industry and Resources (DOIR) was generally well received by those interviewed. The State's support for and promotion of the AMC was well recognised and the investment of some AUD\$200 million from both State and federal sources in the Common User Facility was viewed by many as a much needed boost to the Jervis Bay site.

The defence policies of foreign governments were also seen as impacting on the AMC. Of these the most important was that of the United States. Concerns were raised over the ability of the AMC to secure maintenance and minor refit work for the US Navy given the restrictions imposed on foreign sourcing of defence material under the Jones Act (1920) and also the Passenger Services Act and Voyage Repairs Act. All these US Federal Government legislations served to restrict the level of foreign participation in the building repair and fit-out of US Naval vessels (Maritime Administration 2003; Government of Hawaii 2003).

Related and Supporting Industries

The wider development of ship and boat building and offshore oil and gas platform fabrication within Western Australia over past decades, has enhanced the overall concentration of related and supporting industries within the State and AMC in particular. This has benefits for the naval shipbuilders such as Tenix or Austal that also engage in the construction of commercial vessels. Firms in such areas as sonar and radar technologies, seabed mapping, through-water communications and precision welding have located within WA and are to be found in the AMC.

The long life cycle of naval vessels (e.g. 20 to 30 years), offers sustainable opportunities for subcontractors that specialise in repair and maintenance work for the RAN. However, while local firms can undertake most routine maintenance, highly specialised tasks may still require firms from out of state to send their own technicians and engineers to Perth from time to time.

Selected Case Studies

A total of five firms engaged in the AMC defence sub-sector were examined for this study. However, not all could be fully profiled. We have highlighted the Australian Submarine Corporation, Nautronix and Raytheon to offer a cross-section of firms represented within the AMC.

Australian Submarine Corporation (ASC)

Formed in 1985 to tender for and construct a new fleet of submarines for the RAN, the Australian Submarine Corporation (ASC) began as a consortia between four major shareholders: i) Kockums Submarine Systems AB of Sweden; ii) the Australian Industry Development Corporation (AIDC); iii) Wormald Ltd; and iv) CBI Constructors. Of these Kockums was the designer for the Collins Class boats, AIDC was the primary source of financing and Wormald and CBI were major contractors and project managers.

In 1987 the ASC was awarded the contract to build six Type 471 “Collins Class” conventional submarines of 3,051 tonnes displacement. Wormald and CBI sold their holdings in ASC to Kockums and AIDC in early 1990. Later that year James Hardie Industries Ltd acquired a small shareholding to ensure 51 percent Australian ownership of ASC. In November 2000 German interests acquired Kockums and the Australian Federal Government purchased the remaining shares from Kockums to make the ASC fully Australian owned.

Headquartered in Adelaide, the ASC was contractually committed to achieve a high level of Australian industry participation (70%) in the submarine project. While this was achieved for the hull construction, the more complex weapon and combat systems fit-out has involved only around 45 percent local content commitment (ASC 2003).

The first keel was laid in February 1990 and the lead boat launched on 28 August 1993 with sea trials taking place in 1994. However problems emerged with the combat systems software causing a delay until July 1996 before the HMAS Collins was commissioned into the RAN. The submarines continued to be troubled by a series of mechanical and systems deficiencies causing significant delays in their becoming fully operational, and raising strong media criticism of ASC and the viability of the Collins Class boats. Despite these problems the sixth vessel was launched in 2001 and commissioned in 2003. All six boats are home-based at HMAS Stirling and have been subject to a systematic upgrading and enhancement to allow them to become the strategic weapon system they were originally designed to be.

The ASC provides training services at the Submarine School HMAS Cerberus to train RAN crews and maintenance staff. Federal Government policy has been to bring all

six boats up to full operational standards and the ASC has been closely associated with this. It is understood that the longer-term plan is to privatise the ASC (Commonwealth of Australia 1999).

Nautronix Ltd

Based in Fremantle, Nautronix Ltd is one of the world's leading providers of through-water communications and positioning technologies, with interests in both commercial (mainly oil and gas) and defence sectors. With increased competition and reduced budgets among oil and gas firms, Nautronix has capitalised on its chance entry into the defence industry in 1994. Since then it has derived increasing revenues from military applications.

Now owned by United Kingdom based shareholders, Nautronix is no longer traded on the ASX. The company has undergone several restructures and acquisitions to position it as a specialist in its field. While its Fremantle office serves as the hub for its R&D operations, Nautronix maintains operations in Santa Barbara, California USA, where it services the US Navy, and has its Head Office in Aberdeen, Scotland in the UK. In 1990, the Nautronix Plc Group acquired oil and gas services firm Honeywell in the US, Scottish Helle, in 1994, Seismic in 1997 and First Tech in 2002.

Raytheon Australia Naval Systems

Raytheon Australia Naval Systems is responsible for providing the RAN with many of its command, control, communications and information (C3I) systems. Its primary activity is combat systems integration for the Collins Class submarines, a project worth AUD\$54 million as part of the RAN replacement combat system project. The focus of Raytheon Australia is to expand its share of the Australian defence market and explore opportunities in other countries.

As a systems integrator, Raytheon Naval Systems serves as a processor of many third-party components, such as radios and other communications equipment. Its suppliers are classified into two tiers, based on the parent company's supplier rating system. In 2000 Raytheon acquired a division of Boeing Corporation and added a team of naval experts to its roster for the submarine combat system project. It also divested an aerospace division in 2002 to allow it to focus more on the naval work. The decision by Raytheon to move its operations from North Ryde, NSW to Western Australia reflects the shift of naval activity from the east coast to the west under the two-ocean policy and the superior facilities offered by the AMC.

Production Network Layer

Within the AMC the RAN and Australian Defence Department dominate the production network of the defence sub-sector. The roles of primary and secondary contractors are also key elements in understanding the overall production network with the prime contractors holding dominant positions and influencing the general nature of work within the sector.

For example the production network of the ASC within the AMC is focused almost exclusively on the Collins Class submarine contract providing day-to-day repairs and maintenance at HMAS Stirling, intermediate docking for scheduled dry dock

maintenance. The first level of work is undertaken within the naval base while the vessels remain in the water. The second makes use of the heavy ship lift dry docks provided by Tenix within the AMC at Henderson. Longer scheduled maintenance is also undertaken within the AMC in mid-cycle docking, while extensive work (full-cycle docking) requires the submarines to be moved to Adelaide.

The Australian Submarine Corporation

The ASC is the prime contractor to the RAN for the Collins Class submarines and acts as its own project manager. Submarines consist of two broad engineering elements; those associated with the basic platform and those associated with the combat systems. The vessels combat systems include weapons and electronics, weapons discharge and sonar equipment. Other firms such as Raytheon, Strachan & Henshaw and Thales are responsible for the provision and fitting of these systems. These secondary suppliers were selected individually by government tender to provide their respective systems, with ASC ensuring overall project outcomes. The original designer of the Collins Class submarines, Kockums is no longer associated with the project, leaving the ASC with ultimate responsibility for the vessels equipment. It has out-sourced most of the work associated with outfitting, mechanical and structural maintenance activities to local subcontractors.

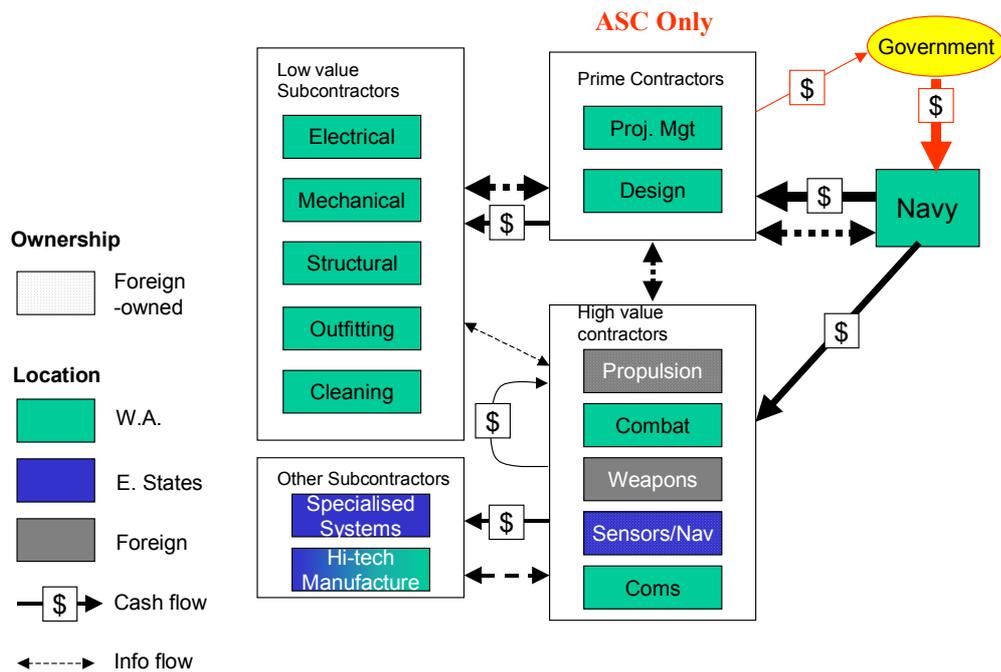


Figure 11: Production Network Layer of ASC

Figure 11 shows the production layer of the ASC where it can be seen that there are a number of subcontractors engaged in the process, including those considered to offer high and low value depending on their level of specialisation and skill. Some of the high-value subcontractors engaged in the submarine project are Jeumont Schneider of France which supplies propulsion systems, Raytheon for combat systems, Strachan & Henshaw UK for weapons, Thales Underwater Systems, France for sensors and navigation and Nautronix for communications. The ASC is continuously upgrading its business plan to take into account the changes that occur within the business and performance. This allows the company to implement any strategic changes on an ongoing basis.

Nautronix

Nautronix supplies through-water communications; acoustics digital spread spectrum technology, underwater battle space management, signature measurement ranges, maritime test and evaluation ranges, surveillance systems and global 24x7x365 technical support for such products. The company has many of its specialist engineering and scientific staff involved in R&D. Nautronix also networks to secure work and market its services. A collaborative alliance has been formed with Perth firm Ocean Industries that manufactures many of the company's machine parts. It sources printed circuit boards from another supplier based on the east coast of Australia and also from Thales and US firm ITC for some components. Nautronix undertakes its own in-house assembly of components.

The strategic alliances developed by Nautronix have included suppliers of technology as well as those engaged in R&D work. Such alliances have included Thales from France, MariPro of the United States; Acoustic Tech of Sydney and Zylotech of South Australia. Such alliances also assist the company to find work within overseas markets with foreign defence sectors. The unique nature of Nautronix work means that it has relatively few direct competitors and its battle-space management technology NAS-HAIL has become a key strategic technology for the RAN. The demanding nature of the submarine contract has led ASC to specify precise requirements for subcontractors to ensure that all work meets the standards set by the RAN. This flows into the contracts and work undertaken by engineers and technicians employed within the program. Paperwork is considerable, as all work must be carefully documented to ensure that any subsequent problems can be checked and traced back to their origins. The sub-contract supervisor must approve each job, along with the prime contractor supervisor and then the RAN before the submarine can leave the wharf or dock. Each subcontractor must be ISO-9001 certified.

Raytheon Australia Naval Systems

The role of Raytheon in the submarine project has been mentioned in the context of the ASC. It is the task of Raytheon to design, test and support all the combat systems its parent firm supplies to the RAN. Key activities include systems integration of conventional submarine combat systems, sensors and weapons engagement systems. These include sonar, intelligence, communications, navigation and weapons management systems. The torpedo and missile systems upgrades and maintenance and future weapons systems design and development are also part of the firm's role. Via its links to the US Navy, Raytheon can provide access to international leading-edge weapons and combat systems developments.

Raytheon will engage in naval systems' contract tenders and is active in its marketing to raise its corporate profile in Australia. The majority of Raytheon's workforce in the AMC is engaged in software and hardware engineering. Project managers, engineers and technicians collaborate to deliver the task of maintaining the Collins Class submarines.

Resource Network Layer

The resource layer within the AMC defence sub-sector is complex and difficult to readily map. Most of the primary contractor firms are of substantial size and have the ability to draw upon the resources of their parent corporations for financial and technical support. As already noted, the significant use of subcontractors within the production network also allows the firms to call upon a wide network of collaborative alliances for additional resources when required. For example, ASC uses the dry dock facilities operated by Tenix within the AMC for maintenance of vessels.

Labour skills and TAFE training

The cyclic nature of the industry means that most subcontractors maintain a pool of temporary and casual labour or a "floating" workforce. This comprises skilled tradespeople who also work within the offshore oil and gas sector and shipbuilding sector. Wage rates are high although work can be uncertain with many workers being either single or younger in age. Many of the firms interviewed for this study expressed concerns over the availability and quality of local skilled labour. Some were critical of the local TAFE colleges for not adequately training apprentices in the type of skills needed for the military. It was felt that the training was not sufficiently complex and focused too much on basics with insufficient problem solving. Nautronix, who indicated that they had found a shortage of specialists within the local workforce, highlighted this lack of skilled employees, particularly in such areas as acoustics engineering. Finding suitable management staff with appropriate skills was also seen as being in short supply.

Raytheon's experience of skills shortages when it moved its offices from North Ryde, Sydney to Western Australia is an interesting case and is far more positive. Initially only six of the firm's key staff was prepared to move from Sydney to Perth. This required Raytheon to undertake a major recruiting drive in Western Australia with some success. When it had first located to WA the company advertised for new engineering staff to get a feel for the local labour pool. It was pleasantly surprised to find that 70 percent of the applicants were from people already located within WA and of these 80 percent was suitable for the positions advertised.

Raytheon also indicated that it used the services of local personnel recruitment and selection agencies to assist it to find new staff. Staff numbers have grown from 12 to over 61 and at time of writing the company had plans to expand its workforce to around 200, to be focused on its new offices within the AMC. Raytheon had also collaborated with other firms such as IBM and Motorola in meetings facilitated by the State Government DOIR, to develop strategies to build up the local workforce in the defence technologies area.

University collaboration

Links between the AMC defence sector and local Western Australian universities were found to be weak. For example, the ASC has well-established links to universities in South Australia, but has not developed similar links here in WA. The ASC has offered a graduate engineering program since 1989 that provides a four-year scholarship in engineering at the University of Adelaide for family members of ASC employees. The company also employs scholarship recipients during summer breaks and recruits qualified graduates for its two-year graduate program. This rotates these candidates through the various divisions within the company. Upon completion, seven or eight new applicants are offered full-time positions. This program is advantageous to workers based in Adelaide but does little for those in Western Australia.

Raytheon had links to a number of local universities primarily to secure a constant flow of suitable graduates to assist its expansion plans. This included UWA, Curtin and Murdoch Universities. The company also participated in postgraduate research projects to encourage R&D, innovation and teamwork among its potential recruits.

Government support

All firms who participated in this study had extensive dealings with government agencies and officials either at the state, federal or foreign level. Raytheon, for example, described its approach to government as “apolitical” and aimed at understanding the needs of the government as a client or customer. Its products were sold to governments and as such the government was its principal customer. The company spent a lot of time seeking to learn about the requirements of the local defence sector and also of those at State level. When it first moved to Western Australia, Raytheon admitted that it had only limited knowledge of the policies of the State Government in the defence sector. The company has subsequently worked to establish its networks among State politicians and Government departments to expand its own knowledge and educate the State authorities of the company’s role and capabilities. Support from the State Government to Raytheon was described as positive and beneficial to its aim of becoming a key provider of technologies to both military and civilian industries.

The role of Raytheon within the Australian defence sector was both enhanced and constrained to some extent by the company’s roots in the United States. As a subsidiary of a major defence contractor employing over 75,000 people worldwide, Raytheon Australia could draw upon the expertise of this vast network of expertise and resources. However, its American origins could also serve as a constraint due to the policies of the United States Government. For example, the International Traffic in Arms Regulations (ITAR) was strongly enforced by the US State Department and Raytheon found itself constantly facing problems in exchanging information from the US parent to the Australian subsidiary. US employees were prohibited from discussing weapons systems with their Australian counterparts if these systems were not registered on the Technical Arms Agreements. Raytheon was also constrained in some of its dealings with local Australian small firm suppliers. If such firms could not show that they had sufficient financial resources to withstand potential lawsuits they were unable to supply to the company under its procurement policies.

The Social Network Layer

As with the resource network the social network of the firms operating with the defence sub-sector of the AMC is complex and difficult to map with precision. Given the size of these firms and the confidential nature of much of their work, it was only possible to provide a general picture of the social inter-relationships existing between these companies and their network partners.

The ASC Social Network

The ASC is a member of the American Chamber of Commerce and the Shipbuilding Industry Association. Its CEO attends meetings and functions held by these two organisations on a regular basis. At its board level the company has such key people as former BHP-Billiton Chairman John Prescott and links to the Federal Government through Federal Finance Minister Nick Minchin, a South Australian. Within the firm's lower ranks the company has a wide range of personal networks with subcontractors, RAN personnel and other key contacts.

Nautronix Social Network

As a small firm, Nautronix's social network is focused via its senior managers. For example, the firm's CEO had a 23-year career in the RAAF specialising in communications and also worked with private technology firms prior to joining the firm. Both he and his senior management team are actively engaged in networking to assist Nautronix to better understand their industry and expand their markets. This includes maintaining contacts with military personnel and associations in the defence sector including industry actors, educators and foreign defence attachés.

The centralisation of defence procurement decision making in Canberra, requires the CEO of Nautronix and his senior staff to make weekly visits to the national capital to negotiate contracts. Visits to the United States take place at least monthly to keep in direct contact with the firm's US Navy contracts. Since its UK-based parent purchased Nautronix, the company's senior managers have had to make more frequent trips to the United Kingdom. A wide range of foreign defence attachés have also been included in the Nautronix social network and the company's senior managers enjoy close contact with their counterparts in Raytheon. Key supplier Ocean Industries is also a close social network actor with engineers from Nautronix and Ocean frequently engaged in discussions over production issues designed to enhance innovation or reduce costs. The company also maintains regular contact with managers from Thales and ITC who provide key components for the firm's products. The firm makes use of email, video conferencing and other systems for maintaining its network contacts.

Nautronix management encourages a very open and collegiate work environment and supports the creative input of employees. The company has been asked to move its operations within the AMC, but has resisted. Fremantle's hotels and cafés are viewed as an attractive environment for its employees and have generated many good ideas. The company is supportive of the AMC and the idea of clusters, but has not yet seen sufficient incentives to move its operations down to Henderson.

Raytheon Australia's Social Network

Raytheon has many senior managers who have military backgrounds. Former naval officers with direct experience in the type of vessels and systems that they are selling or servicing are essential to the company's ability to secure contracts and deal with customers. It is important for staff to speak the language of defence and possess a deep knowledge of warfare systems and their application. This offers the company a competitive edge in its markets.

Within the AMC Raytheon sees itself as something of an underdog, despite the vast scale and success of the parent company globally. Its image as a large American or multi-national corporation is frequently a source of negative attitudes within the local community. For this reason Raytheon is active in the community supporting local charities and maintaining a positive image.

The company makes use of its senior managers' social and professional links to access a flow of useful information on industry trends and competitor activities. An unwritten agreement appears to exist between competitors in the AMC not to poach key employees, although movement of technical staff from one firm to another was not restricted, creating an employment and knowledge loop among firms in the AMC. Raytheon was also in regular contact with the Western Australian divisions of IBM and Motorola in relation to employment and technology issues.

Raytheon was highly supportive of the AMC and the cluster concept. When the State Government first approached Raytheon to move into the AMC it had not considered clustering, however, it now felt that the Government was correct about the advantages of the AMC as a support precinct and network environment. Links between Raytheon and other key firms such as Tenix and Austal in the defence sector were generating potential new opportunities.

Raytheon was also active in the Australian Industry Group (AIG), the Australian Industry Defence Council (AIDN) and the South West Group's Industry Direct program. This helped the company to raise its profile within the local business community. Its senior managers also made regular visits to attend meetings in Perth, Canberra and Sydney to expand its network of second and third-tier suppliers.

One key criticism of the AMC voiced by Raytheon was the current lack of social infrastructure such as cafés and restaurants. To compensate it had formed alliances with Fremantle restaurants and conferencing sites to facilitate information seminars. This was a problem also recognised by others in the AMC.

Analysis of the Case Study Findings

The companies interviewed for this study illustrate the range of firms engaged in the AMC defence sub-sector. The ASC as a government owned entity is something of an exception, but the other firms fall into those comprising high-value and some offering low-value products or services. High value firms such as Raytheon, Nautronix, Tenix and Austal are internationally focused and offer sustainable growth oriented business models. Low value firms, such as the subcontractors, which provide maintenance work for the RAN surface vessels, are in a different category.

The low value firms tend to suffer from resources and clear points of competitive advantage. They are purely focused on local demand and work for both the defence and civil contactors. Cost is a primary driver for these firms and proximity to their customers is one of their key competitive advantages. Smaller WA firms serving the defence sector are likely to secure contract work for maintenance of naval vessels but may experience skills gaps as technology advances within the sector at a rapid rate and local training schemes seem inadequate in some areas.

Levels of Innovation Intensity

Innovation within the sector is intense in some areas (e.g. Nautronix), but is not uniform throughout all firms. The ASC, for example, is focused within Western Australia on maintenance rather than research with cost, rather than innovation as the primary focus. The bureaucratic nature of defence tendering and slow approvals process may also impede innovation within the sector. High value contractors such as Nautronix and Raytheon are dedicated to developing and delivering innovative new technologies. These firms depend on highly skilled employees and their management teams are forward looking and highly networked. They actively seek to use networks to access new knowledge and ideas for innovation.

Knowledge transfer between companies in the defence sector can be restricted due to security and commercial in confidence issues, however, most defence material is highly differentiated and competition among the high value, prime contractors is low. Most firms secure access to new ideas and technology via a process of acquisition and merger.

Labour Skills Shortages

A major concern for many firms was the shortage of skilled labour. Despite the apparent success of Raytheon in finding its workforce, most of the firms interviewed for this study expressed problems finding skilled technicians, university graduates and senior managers. Austal, for example, could not find naval architects within WA due to the lack of courses at the universities and recruited them from either the University of NSW or the Australian Maritime College, in Launceston. Collaboration with Challenger TAFE had been undertaken to enhance the flow of graduates with suitable technical skills as shipwrights. Curtin University of Technology has sought to expand its course offering via its Centre for Marine Science and Technology with plans to launch a naval architecture degree by 2005. The University had also commenced discussions with DOIR over the formation of a cooperative research centre based on the AMC.

An Emerging Marine Defence Cluster

Overall the picture that emerges of the AMC defence sub-sector is of an emerging cluster with strong breadth, depth and reach in technology and maintenance work that compares favourably with the naval construction activity to be found in South Australia. At the international level the AMC is only a small player that is geographically distant from key markets and based on a relatively thin industry base. However, the success of such firms as Austal and Nautronix suggest that local firms can secure a place in the global defence industry, and the presence of such firms, as Raytheon within the AMC are likely to assist in this globalisation.

More Attention Needed for Small Firms

Future strategies targeting the AMC defence sub-sector need to give more attention to the needs of small firms in securing access to tenders. Price driven tendering is common within the sector and this inhibits communication and technology transfer between the prime contractors and their subcontractors who are generally small. These small subcontractors consider such price-based contracts as detrimental to the long-term quality and safety within the industry. Such firms have diversified their customer base to ensure that they are not dependent on any single prime contractor and most work in both the defence and civil sectors.

Enhance the Social Infrastructure

The social infrastructure within the AMC could also be enhanced with inadequate facilities such as hotels, cafés and restaurants locally available. As one interviewed manager said of the facilities at Henderson, “The pub down there is too grotty for my guys.” Another said, “It’s not on the way home.” Better facilities for eating, drinking and socialisation within the AMC or its immediate proximity would assist the social network activity of the complex and improve the attractiveness of the AMC to new firms, particularly those in the more highly technical side.

Enhance Local Research and Education Linkages

As discussed above, the interviews with defence related firms found that links between the AMC and the universities and TAFE colleges could be improved. Skills shortages in such key areas as acoustics engineers, naval architects or shipwrights were reported and did not seem to be adequately addressed by local universities and colleges. This was a similar pattern that emerged in the ship and boat building sub-sectors and suggests that a major gap in the long term growth of the AMC as a world class industry cluster is the nexus between the industry and local research, education and training centres. While the development of the MITP within the AMC is moving forward, there continues to be a need to better engage the local universities with the industries via research and teaching programs that can have mutual benefit.

SECTION 6

A Survey of the WA Marine Industries

Project Team: Tim Mazzarol & Douglas Adam

The survey undertaken as part of this study involved a mailed questionnaire sent to 1,500 firms identified by DOIR as represented in the AMC or Western Australia maritime engineering sector. The survey examined the role of lead customers, key suppliers and the importance of joint initiatives and alliances. Also examined by the survey were the process of technology transfer and innovation within the sector and the level of export activity.

Sample Demographics

As noted earlier in this report the survey generated a poor response rate with a final sample of only 41 companies returning usable questionnaires. This poor response rate was due in part to the poor quality of the sampling frame used to generate the sample. This comprised a database supplied by DOIR and the shipbuilding and boat building associations that appeared to have many false or incorrect addresses, due to the high number of survey forms returned to sender and marked as being sent to the wrong address. Despite the low response rate the range of firms captured by the survey remains indicative of the sector and is consistent with the findings generated by the case study research outlined elsewhere in this report.

Sectors and Activities

The sample comprised firms from a wide cross-section of areas associated with the marine industry. Tables 3 and 4 show the number of firms who indicated the areas in which they operated with many involved in manufacturing of ships or boats.

Table 3: Marine Industry Representation in the Sample

Key sector in which the firm operates:	Number of firms ¹	% of sample
Manufacturing of marine equipment	22	55.0
Production of marine software	6	15.0
Distribution of marine equipment/software	11	27.5
Production of marine services	11	27.5
Provision of marine services via technology	9	22.5
Commercialisation of marine technology	4	10.0
Tertiary education institution	2	5.0
Other	7	17.5

¹ some double counting.

Table 4: Marine Industry Representation in the Sample

Key sector in which the firm operates:	Number of firms ¹	% of sample
Marine engineering	7	17.5
Marine salvage and or equipment	2	5.0
Marine contractors	10	25.0
Marine consultants	7	17.5
Boat and yacht equipment	5	12.5
Boat and yacht designers/planners	4	10.0
Boat and yacht builders and/or repairers	5	12.5
Shipbuilders and/or repairers	14	35.0
Ship equipment	6	15.0
Export agents	2	5.0
Other	13	32.5

¹ some double counting.

Size of Firms

The firms in the sample ranged in size from small to large, with the average number of full-time employees being 46. Of the total sample 25 percent had fewer than 7 employees and 50 percent had less than 12 employees. About 25 percent of the sample was larger firms with over 80 employees. These firms varied in terms of how long they had been in business, with the range from around one year to up to 100 years. The average length of time the firms had been in business was 23 years. Annual turnover also ranged from less than AUD\$100,000 per annum to over AUD\$50 million per annum, with 65 percent reporting annual turnover below AUD\$5 million. This suggests that the industry is comprised of relatively established firms of some size.

Sales Generation

Seventy-nine percent of the firms' annual sales were generated within the domestic market, with around 22 percent of sales generated via exports. Only a small proportion (0.6%) of annual sales was produced through offshore production. This was a pattern that had remained constant over the previous three years and indicates that many of the firms were highly dependent on the domestic market despite the high level of international orientation within the sector.

Ownership and Structure

On average 76 percent of the firms' equity was owned within Western Australia, with 23 percent held by overseas shareholders. Shareholders elsewhere in Australia held an average of only 6 percent of the equity in these firms. Around 24 percent of the firms reported having an overseas parent. Of these firms 56 percent were regional headquarters and 33 percent were R&D centres. These figures suggest an industry that is strongly WA owned and seeks its equity shareholding from offshore rather than via national partners.

The Importance of Lead Customers

The survey asked firms to indicate how many lead customers they been involved with in Western Australia, elsewhere in Australia and overseas. As shown in Table 5, there was a relatively high proportion of firms (32%) with greater than six lead customers located in the State. These figures suggest that around 88 percent had lead customers located in Western Australia, 72 percent had lead customers located elsewhere in Australia, and 64 percent had lead customers located overseas

Table 5: Number of Lead Customers by Location

	Nil	1-2	3-4	5-6	>6
	%	%	%	%	%
Customers in WA	12.2	22.0	29.3	4.9	31.7
National Customers	27.5	35.0	15.0	5.0	17.5
Overseas customers	35.9	20.5	20.5	7.7	15.4

The Role of Lead Customers

As suggested in the case studies of the ship and boat builders, the role of lead customers in the enhancement of the firm's overall performance was found to be significant. The majority (76%) of firms indicated that they had worked closely with their lead customers to develop or improve their products and services.

When asked to describe their lead customers 70 percent of respondents considered their customers as market opinion leaders who assisted them to gain credibility for their products. A further 73 percent considered their lead customers to drive their firm to improve its performance by demanding high quality and service. Just over half (52%) considered their lead customers to be important as development partners for ideas the firm had initiated. However, only 45 percent felt strongly that their lead customers were a major source of new ideas or new opportunities.

When asked if their lead customers had played an important role in driving enhanced performance over the past 5 years, 70 percent considered that lead customers in Western Australia had been critical to driving such performance enhancements. By comparison 58 percent felt that this was true of customers elsewhere in Australia, and 66 percent considered this to be the case for their overseas customers.

Despite the importance of lead customers to the development of performance the nature of such relationships was as much informal as formal. For example, 51 percent of firms reported that they had no formal agreements with lead customers in Western Australia, 66 percent had no formal agreements with customers elsewhere in Australia, and 67 percent had no formal agreements with overseas customers.

Among those firms that did have formal agreements with customers most had only one or two such agreements, a pattern that was found consistent regardless of whether the customer was located in Western Australia, elsewhere in Australia or overseas.

Relationships between the Firms and Lead Customers

When asked to describe their relationships with their lead customers and how they had changed over the past three years the majority of firms indicated that they had experienced a significant improvement in such relations. Around 40 percent considered their relationship with lead customers to be strongly partnership like and this situation was found to have strengthened significantly over the previous three years from only 26 percent.

As was shown in the case studies, the most important means of communication in relation to working successfully with lead customers was face-to-face contact between the customer and the firm's senior managers, regardless of the geographic distance that had to be travelled. Email was the next most important means of communication according to the firms surveyed followed in turn by telephone and fax and face-to-face contact between customers and employees, either sales or marketing staff or technical staff. Of significantly less importance was customer contact at trade shows or via videoconference facilities.

Personal contact between the senior managers of these firms and their lead customers was reported to take place on at least a monthly basis by around 51 percent of firms. Such contact between customers and sales or marketing staff was reported to take place on at least a monthly basis by some 64 percent of companies, and 63 percent for technical staff. Seventy-one percent of these firms also reported being in telephone contact with lead customers on at least a weekly basis and 78 percent were in email contact on a similar frequency. Around 66 percent reported meeting customers annually via trade shows and the majority (88%) made no use of videoconferencing.

These findings are consistent with the evidence generated by the case studies. This suggests that the senior management of these firms is frequently engaged in direct dialogue with lead customers, often requiring long-distance travel to maintain such contact. This level of contact is costly in both time and money, but essential if the firms are to forge the level of relationships that they need with customers to win and retain the business.

The Importance of Key Suppliers

While lead customers played an important role for many of the firms surveyed in enhancing their performance and innovation the impact of key suppliers was also significant. For example, the majority of the firms in the survey (58%) considered that their key suppliers based in Western Australia had had an important impact on their firm's performance over the previous 5 years. However, only 46 percent of firms felt that their key suppliers located elsewhere in Australia to have played an important role in enhancing their performance. This was even less for overseas based key suppliers where only 32 percent of firms considered such suppliers had played an important role. This suggests that geographic proximity between the firms and their key suppliers may be important. The pattern that emerged from the case study evidence is supportive of this and highlights the potentially important role that local production networks can play within industry clusters.

Formal Supplier Agreements

Formal agreements with key suppliers were highly localised. For example, the majority of firms had no formal agreements with either with overseas suppliers (80%), or national suppliers (61%). By comparison around half of the sample (54%) had formal agreements with key suppliers located in Western Australia. Most had between 1 and 4 formal contracts with locally based suppliers. For those firms that had agreements with national or international suppliers, the number of such agreements was generally between 1 and 2.

Key Suppliers as Source of Information and Innovation

When asked about the importance of key suppliers as sources of information and innovation ideas the help to raise the firm's overall performance, only 45 percent of firms considered that suppliers based in Western Australia and 40 percent of suppliers elsewhere in Australia were important in this regard. However, only 33 percent considered that overseas suppliers were important in this context. It will be remembered from the case study analysis of the shipbuilding and boat building sectors that suppliers, particularly foreign suppliers of key components, were represented locally by agents, who did not always form strategic partnerships with the manufacturers. While there was some evidence of this taking place, the more common pattern was a supplier who delivered a standard component at a competitive price that was integrated into the design in accordance with the customer's specifications. The findings of this survey also suggest that locally based suppliers may be in a stronger position to offer firms new ideas and innovation opportunities that those geographically more distant. As noted above, this is consistent with the theory that local production networks are a potentially important component of industry clusters.

Relationships between the Firms and their Key Suppliers

In keeping with the trend among these firms and customers, the survey discovered that the relationship between these firms and their key suppliers had strengthened over the previous three years. A significant improvement was found between the firms and their key suppliers moving from arms length to a partnership relationship over the time period. While only 28 percent of firms reported that they enjoyed a partnership like relationship with their key suppliers three years previously, this number had increased to 56 percent by the time of interview. This suggests that while the relationship between key suppliers is not as strong or perceived to be as important as that with customers, it has apparently strengthened over recent years for most firms.

The Importance of Joint Initiatives and Alliances

The firms were asked to indicate the nature of their joint initiatives and alliances over the past 2 to 3 years, including the use of distributors, and the level of importance such alliances had upon their firm's performance. Tables 6, 7 and 8 show the results of this inquiry in relation to joint ventures and alliances in WA, Australia and internationally. These findings highlight the importance of locally based alliances and those related to marketing and production.

Nature of Joint ventures and Alliances

As shown in Table 6, the most common type of alliance or joint venture with local Western Australian partners was to be found in product development, marketing and promotion and product research. Product development-based alliances were also the largest in overall number with some firms having up to 10 alliances of this kind. However, when asked to rate importance of such alliances to their firm's importance, those associated with marketing and promotion were considered to be the most important by those firms that had them, followed by production and then product development alliances. It is noticeable that venture capital alliances were largely non-existent and the majority of firms did not view these as of importance.

Table 6: Number and Importance of Joint Ventures and Alliances within WA

Type of alliance:	Alliances	Min-Max	Important	Neutral	Not important
	%	N	%	%	%
Product research	34.1	1-4	50.0	15.0	35.0
Product development	46.3	1-10	56.5	17.4	26.1
Process R&D	24.4	1-5	50.0	11.1	38.9
Production	29.3	1-4	61.1	5.6	33.3
Export distribution	14.6	1	37.6	-	62.5
Marketing & promotion	36.6	1-4	80.5	19.0	38.1
Venture capital raising	-	-	30.0	-	70.0

Table 7: Number and Importance of Joint Ventures and Alliances within Australia

Type of alliance:	Alliances	Min-Max	Important	Neutral	Not important
	%	N	%	%	%
Product research	34.1	1-9	55.5	11.1	33.3
Product development	31.7	1-10	55.6	16.7	27.8
Process R&D	14.6	1-2	23.5	17.6	58.8
Production	17.0	1-2	33.3	6.7	60.0
Export distribution	12.2	1-9	28.6	7.1	64.3
Marketing & promotion	29.7	1-9	50.0	11.1	38.9
Venture capital raising	4.9	1-9	15.4	7.7	76.9

Table 8: Number and Importance of Joint Ventures and Alliances Overseas

Type of alliance:	Alliances	Min-Max	Important	Neutral	Not important
	%	N	%	%	%
Product research	19.5	1-3	42.9	7.1	50.0
Product development	26.8	1-5	52.9	17.6	29.4
Process R&D	9.7	1-5	23.1	15.4	61.5
Production	14.6	1-3	41.6	16.7	41.7
Export distribution	12.2	1-5	38.5	23.1	38.5
Marketing & promotion	5.9	1-4	64.3	7.1	28.6
Venture capital raising	2.4	1	20.0	-	80.0

An examination of Tables 7 and 8 suggest a similar pattern for alliances with both national and international partners. Product research and product development are the most common form of alliance, although marketing is viewed as among the most important along with product development. It can also be seen that most firms did not seek venture capital based alliances and viewed them as of limited value. However, it is note worthy that those firms that did have venture capital alliances had these with national or international partners, rather than local ones.

Constraints to forming Joint Ventures and Alliances

When asked to indicate the importance of various constraints to the future formation of joint ventures and alliances, the most common concerns were the problems associated with managing overseas partnerships. As shown in Table 9, just over 62 percent of firms viewed this as a critical constraint to the development of future joint ventures and alliances. A relatively high proportion of firms (46%) also indicated that they felt a lack of skills to set up and manage alliances was likely to be a major constraint for them in the future.

Table 9: How significant are constraints to Joint Ventures and Alliances

Type of constraint:	Little or no problem	Neither good or bad	Critical constraint
	%	%	%
Locating potential partners	29.3	26.8	43.9
Skills to set up & manage alliance	26.8	26.8	46.3
Potential to lose control of business	26.8	29.3	43.9
Difficulty of managing overseas partnerships	20.0	17.5	62.5
Set up costs	27.5	30.0	42.5
Lack of industry cohesiveness	30.0	27.5	42.5

These findings suggest that the challenge of managing overseas partnerships may be a key problem for many firms in the sector. It has already been noted that senior managers from these companies have to make regular and frequent long-distance trips to meet with international customers and suppliers. The more complex such networks become, including equity partners in other countries, the greater the burden is likely to be. The case of Nautronix is a possible example where it will be recalled the firm's top managers had to make trips to Canberra, the United States and United Kingdom on a frequent basis to maintain their expanding global network.

The need to maintain a large and geographically dispersed network of alliances has the potential to create a potential management bottleneck where the firm's senior staff are so busy engaged in the maintenance of their network that they may experience excessive stress and distraction. For the larger companies, the size of the management team may allow such a global alliance network to be readily handled. However, for the smaller firm, the burden of managing such a network is likely to fall upon the shoulders of the founder-entrepreneur(s)/CEO. Such people will need to be supported and possibly enhanced via training in management skills.

Technology Transfer within the Sector

The survey also examined the process of technology transfer within the marine engineering sector. Firms were asked to indicate whether their access to key technology placed them at an advantage or disadvantage relative to key competitors in the pursuit of market opportunities. Forty-seven percent of firms indicated that they felt their access to technology placed them at an advantage relative to their key competitors. A further 42 percent considered they were on an equal footing with key competitors in relation to access to technology. Only 10 percent viewed their access or lack of access to technology placed them at a disadvantage relative to key competitors.

Sourcing of Key Technologies

Technology was sourced from both within Australia and overseas. When asked to indicate the proportion of key technology that was sourced from either overseas, nationally or at the State level an average of 36 percent was sourced from overseas, 34 percent from within the State and 22 percent from elsewhere in Australia. This suggests that while international suppliers and alliance partners remain an important source of technology transfer, this can also be accessed locally to a fairly large extent. Key suppliers were the most important source of new technology. Of least importance were the CSIRO and local universities, although overseas universities were also viewed to be of little importance. Table 10 shows these findings.

Table 10: How important are the following as sources of key technologies?

Domestic Technology Sources:	Not important	Neither good or bad	Critically important
	%	%	%
CSIRO	82.5	10.0	7.5
Universities, technical institutes	67.5	20.0	12.5
Parent/Sister company	66.7	5.1	28.2
Other companies in your industry	37.5	30.0	22.5
Companies in other industries	40.0	35.0	25.0
Lead customers	35.0	27.5	37.5
Key suppliers	40.0	55.0	45.0

Overseas Technology Sources:	Not important	Neither good or bad	Critically important
	%	%	%
Universities, technical institutes	77.1	13.8	9.2
Parent/Sister company	74.3	5.5	20.2
Other companies in your industry	48.6	20.2	31.2
Companies in other industries	64.2	16.5	19.2
Lead customers	58.7	17.4	23.8
Key suppliers	44.5	9.1	46.3

The findings outlined in Table 10 support the pattern of evidence generated from the case study research. It suggests that the marine engineering sector is not research intensive and does not rely strongly on R&D links with formal research centres. Technology transfer is most likely to flow from key component suppliers and through inter-company links between firms both within the industry and across industries. An examination of the relative differences between firms that manufacture vessels (e.g. ship and boat builders) and their suppliers (e.g. designers, engineers, contractors) and other firms (e.g. marine salvage), using chi-square tests of significance failed to find any significant relationships between access to technology and the role played by the firm within the industry as measured at the 0.05 level of confidence.

Information sources used for gathering ideas about new technologies

The survey examined the importance of different information media used by the firms in gathering information and ideas for new technology and innovation. The most important of these was considered to be informal meetings such as casual discussions and personal networks). This was followed in-turn by the Internet and formal literature (e.g. scientific or trade journals). Table 11 shows these results where it can be seen that formal literature and informal meetings were viewed as being of equal important by the majority of firms, with formal research also playing an important role.

Table 11: How important are the following Information sources for key technologies?

Information Sources:	Not important	Neither good or bad	Critically important
	%	%	%
Formal literature (e.g. scientific journals, trade publications)	17.5	25.0	57.5
Informal literature (e.g. mass media, unpublished reports)	25.6	35.9	38.5
Internet or web-based searching	15.0	35.0	50.0
Formal meetings (e.g. conferences or seminars)	20.5	33.3	46.2
Informal meetings (e.g. casual discussions, personal networks)	7.5	35.0	57.5
Formal research (e.g. field tests)	27.5	25.0	47.5

The evidence from the case studies gathered for this research highlighted the key role that personal networking played within the sector in the dissemination of new ideas. From these survey findings the impact of this social network layer can be seen in relation to the relatively high importance placed on informal meetings as a source of information about new technologies or innovations.

Among the benefits that have traditionally been advocated for industrial clusters has been the capacity for such networking to serve as a conduit for the flow of ideas from one actor to the next (Echeverri-Carroll 1999). This interpersonal channel for ideas has been viewed as highly important to the enhancement of innovation (Senker & Faulkner 1996).

The Value of Alliances and Networks

Firms were asked to indicate the overall benefits that they felt they had received from being engaged with alliances and networks of various kinds. This was measured in terms of the financial benefits rather than other less easily measured outcomes. In relation to their access to financing the survey examined whether they felt that their access to financing placed them at an advantage or disadvantage relative to key competitors in pursuing market opportunities.

Debt Financing Access

The first area of interest was the firms' perception of how their access to debt financing (e.g. via banks), was in some way an advantage or disadvantage relative to key competitors. Only 26 percent of firms felt that they were disadvantaged by their access to debt financing, while 41 percent considered that they were advantaged. The remainder were equivocal. Chi-square tests of significance failed to find any differences between firms over this issue with respect to whether they were a manufacturer of vessels, a supplier of services or components or a third party distributor.

Equity Financing Access

By comparison with debt financing only 23 percent of firms felt they were advantaged in terms of their access to venture financing. The remainder were evenly divided between feeling disadvantaged or not advantaged or disadvantaged over their access to venture capital financing. It is worth noting that most firms in the survey were not using venture capital and as shown in the case study research, while venture financing funded some of the ship builders, many others were not and there was a preference among some of the boat builders to retain more private control. Furthermore, the larger firms secured their financing from corporate parents.

The Financial Benefits of Linkages

In terms of the financial benefits that the firms' derived from different types of linkages, the most valuable was considered to be working with lead customers. As shown in Table 12, over 80 percent of the firms in the sample considered that this type of linkage was valuable. The next most valuable was working with key suppliers, followed by linkages to government support schemes.

It is not surprising to find that customers and suppliers are viewed as financially valuable alliance partners. These actors are core members of the firm's production network. Government support was less unequivocally viewed as beneficial with almost as many firms viewing this as valuable as of little value.

It is notable that research collaboration was viewed as of much less financial value to these firms than might be the case in other industries. This may reflect the relatively low level of R&D that takes place within the sector and also the nature of the sector with respect to its production network. This, as outlined in the case study evidence, is focused strongly on the customer and suppliers to deliver a competitive product into what is increasingly an international market. For this reason the customer, followed by the key supplier are likely to be the most valuable linkages, with government support for exporting in third place.

Table 12: The Financial Benefits of Specific Linkages

Type of linkage:	Of little or no value %	Neither good or bad %	Extremely valuable %
Working with lead customers	4.9	14.6	80.5
Working with key suppliers	17.1	29.3	53.7
Joint research projects	46.3	24.4	29.3
Joint product development	43.9	26.8	29.2
Joint production	65.9	17.1	17.1
Joint distribution	53.7	22.0	24.4
Joint marketing & promotion	39.0	26.8	34.1
Obtaining technology externally	36.6	29.3	34.1
Government sponsorship & support	39.0	19.5	41.5

The Importance of Innovation

As noted above and outlined in the case studies, innovation within the sector varied in intensity, but was on average more incremental than fundamental, with relatively limited investment in major product or process innovations by many firms. In the survey the importance of innovation within the sector was examined. This looked at the importance of different types of innovation activity, its impact on the firm's performance and the nature of innovation within the firms.

Types of Innovation

The most important types of innovation to the firms in the survey were the development of unique or better products or services, after sales service and management methods. As shown in Table 13 these were all rated as of importance by over 80 percent of the firms. Innovation in labour productivity was also rated as important by 78 percent of firms. These findings are consistent with the case study evidence that highlighted the need for firms to secure a competitive advantage through differentiated products and services.

Table 13: The Importance of Different Types of Innovation

Type of Innovation:	Not important %	Neither %	Important %
Unique, better products & services	-	12.2	87.9
Management methods	2.4	17.1	80.5
After sales service	4.9	14.6	80.4
Labour productivity	12.2	9.8	78.1
Marketing and promotion	14.6	24.4	61.0
Production processes	14.6	26.8	58.6
Distribution	22.0	19.5	58.5

The high importance placed on management methods as a means of securing success within the industry and after sales service of the product, is worthy of further discussion. As shown in the case study findings, the production process of many ship and boat builders required them to engage in a significant level of after sales service of their products. This was sometimes outsourced, but given the complexity of the products it remained an area that could absorb a good deal of time and cost. However, it was also an area in which future business opportunities might also be found. With respect to the importance placed on management methods as a source of success, this may reflect the overall complexity to be found within the industry. Large scale, design and engineering projects of this kind are likely to benefit from advanced management techniques.

The Impact and Frequency of Innovation on the Firm's performance

In relation to how these various innovations impact on the firm's overall performance, it was not surprising to find that new products and services were considered to be important for around 78 percent of the firms surveyed. As shown in Table 14 this was followed closely by innovation in new processes.

Table 14: The Impact of Different Types of Innovation on Firm Performance

Type of Innovation:	Not important	Neither	Important
	%	%	%
New products & services	7.3	14.6	78.1
New processes	9.8	26.8	63.4
New organisational structures	2.4	39.0	29.3
New work place practices	24.4	36.6	39.1

Given the importance of new product or service innovations to these firms it was again unsurprising to find that 71 percent of the firms surveyed indicated that they were frequently or very frequently engaged in innovation activities targeted at the development of new products or services. By comparison the frequency of new process innovation activities was less common with only 46 percent of firms indicating that they were frequently engaged in such activities.

Innovations in the creation of new organisational structures were much less common and only 20 percent of firms indicated that they engaged in such activities on a frequent basis. Finally, only 36 percent of firms indicated that they were frequently engaged in innovation activity targeted new work place practices.

Type and Overall Success of Innovations

An average of 14 percent of the annual turnover of the firm's surveyed was reportedly reinvested into R&D and innovation activities. While this is at a level significantly above that found in most industry averages (Evangelista, Sandven, Sirilli & Smith 1998), it is less than that found in more innovation intensive sectors (e.g. biotechnology or ICT) (Mazzarol 2003). When asked whether the level of innovation taking place within the firm was small and incremental or large and significant, 66 percent of firms indicated that their activities focusing on new product or service innovations were generally large and significant. This was not the case with other

areas of innovation. For example, 70 percent of firms did not view their process innovations to be large and significant. In terms of new organisational process innovation, 56 percent considered that their activities were small and incremental in nature, with a similar proportion (46%) having a similar view of work place innovations.

In terms of the success of these innovations 76 percent considered that their work in product or service innovations had been successful. By comparison 61 percent of firms did not view their work in new process innovations to be successful. A similar view was held in relation to organisational structure innovation by 76 percent of firms. Further, 80 percent of firms also considered that their innovations in work place practices had not been highly successful.

With respect to the impact that these innovations had had on their overall performance, 71 percent of the firms felt that their innovations in the development of new products or process had had a very high impact. This was much less so for process innovations or those targeting new organisational structures and work place practices where around 70 percent of firms did not view these as having a high level of impact.

The Process of Innovation

Just under half (46%) of the firms surveyed claimed to have a formal or well-defined process for commercialisation and new product development. However, 67 percent of those firms that had such formal processes considered that they had been effective. Senior management as the key generator of new ideas led the process of innovation with the firms with 76 percent indicating that top management was frequently or very frequently the originator of new innovative ideas. After senior management, the most important source of new ideas was the customer. Sixty-one percent of the firms reported that customers or the market were the key sources of ideas for innovations. Employees were also an important source of new ideas for innovation with around 46 percent of firms indicating that employees were frequently involved in generating new ideas. Other sources of innovation such as special task forces or 'product champions' were less common with most firms indicating that these approaches were less frequently used to generate new ideas.

Export Orientation

As has been well described in the earlier sections of this report, the Western Australian marine engineering sector is highly international in its focus. Sixty-one percent of the firms in the survey sample were actively engaged in exporting. The average length of time the firms had been engaged in exporting was 15 years with at least 25 percent of the firms having started exporting during the period 1970 to 1985. Export markets targeted by these firms ranged widely, but included such countries as the United States, United Kingdom, Malaysia, Singapore, Thailand, China, Taiwan, the UAE, Indonesia, Dubai, New Zealand, Brazil, Japan and the Netherlands.

Doing Business in Western Australia

Finally the firms were asked to indicate their perspectives on their ability to manage a competitive and innovative firm within Western Australia. Table 15 shows the results of a series of questions relating to different aspects of doing business in Western Australia. It can be seen from these results that just over half the firms did not consider that it was easy to access a workforce with the necessary skills and education they desired. Further, 73 percent of firms did not agree that it was easy to find high quality managerial staff within the State. These findings are consistent with the evidence from the case studies that indicated many firms were concerned over their ability to access skilled staff and to secure appropriate level management staff.

Table 15: Doing Business in Western Australia

	Disagree or strongly disagree %	Neither agree or disagree %	Agree or strongly agree %
It is easy to access a workforce with the necessary skills and education	56.1	22.0	22.0
The cost of doing business is low in comparison to other policies	43.9	31.7	24.4
Having a similar time zone to Asia is convenient	12.2	41.5	46.4
Geographic isolation is not a problem for our business	31.7	24.4	43.9
There is sufficient venture capital in WA to fund our future growth	35.0	42.5	22.5
It is easy to find high quality managerial staff	73.2	19.5	7.3
The lifestyle in WA enhances our business	9.8	36.6	53.7
It is easy to access high quality research centre locally	42.5	30.0	27.5
Government support for local industry is strong	65.9	22.0	12.2

It is to be noted that nearly half (46.4%) the firms felt that having a similar time zone to Asia was convenient, but only 44 percent considered the geographic isolation of Western Australia was not a problem in doing business. While just over half the sample agreed that the lifestyle in WA was a positive for business, only 22 percent agreed that venture capital was easy to access in the State, and only 27 percent held a similar view over the accessibility of high quality research centres. Finally, despite the high level of government interest in the AMC and support for the sector the majority (66%) of firms did not agree that government was strongly supportive of local industry.

SECTION 7

Conclusions and Recommendations

This study has provided an overview of the marine engineering industries within Western Australia with specific focus on how these are engaging via the Australian Marine Complex (AMC) to form a potential industry cluster. The findings from this study suggest that the significant capital investments made in the AMC over past decades are now bearing fruit. The AMC has begun to concentrate an above average number of businesses in such areas as marine engineering and naval architecture within the State.

The study highlights the success of the WA shipbuilding and boat building industries in securing a strong international market share within selected niche markets. These industry sub-sectors have emerged since the 1970s as highly successful and strongly export focused. Led by a relatively small number of key manufacturers, a network of suppliers and subcontractors has formed a series of local production networks in which personal connections are serving to enhance innovation and drive competitiveness.

In addition to these currently flourishing industry sub-sectors, the AMC has also become the focal point for a growing naval defence industry that has emerged in response to the two-ocean naval policy established in the 1980s. The requirements of the RAN and its surface and submarine fleets have encouraged the concentration of a range of primary and secondary contractors within the AMC to provide systems and maintenance services for these vessels. Recent contracts for new RAN patrol boats have also enhanced the level of defence related shipbuilding in the AMC.

The pattern that emerged for the offshore oil and gas sub-sector was less positive, with some scepticism being expressed by some of the major industry actors over the competitiveness of the AMC as a site for the fabrication of offshore components. More confidence building in the capabilities of the AMC for offshore oil and gas fabrication work appeared necessary among some industry groups.

The AMC as an Industry Cluster

Analysis of the characteristics of successful industry clusters suggests that they have at least eight common features (Rosenfeld 1997; Isaksen 1996). Each of these is examined the following sub-sections with reference to the AMC as a potential industry cluster.

Concentration into a few specialised industries

First, successful clusters are usually concentrated into a few *specialised* industries that can compete well in international markets. With respect to the AMC this can be satisfied. The marine engineering industry in Western Australia is focused on a few key industry sub-sectors, specifically high-speed aluminium hulled vessels, high quality luxury yachts in aluminium or fibreglass, defence systems (particularly those associated with conventional submarines and high-speed patrol craft) and offshore oil and gas platforms and associated equipment. Concentration of businesses appears to be strong and significantly above the national average.

Possess effective local production networks

A second characteristic of successful clusters is the presence of well-established *local networks* that unite firms' supply chains and production networks for enhanced efficiency and productivity at the production network layer. Local production networks (LPN) that operate successfully in industry clusters are frequently concentrated around *focal* firms. Such firms are usually large in size and serve as lead customers for smaller supplier firms. The focal firm serves as a strategic centre and generates opportunities for small firms by serving as a lead customer and a generator of innovation within the strategic network that surrounds them (Lorenzoni and Baden-Fuller 1995). There is evidence within the AMC of strong LPN within all the key industry sub-sectors examined by this study. Key suppliers of components, design, engineering, fabrication or fit-out services were generally local and there was evidence of effective knowledge sharing and collaboration for mutual benefit and competitive advantage.

High levels of innovation

Third, successful clusters have high levels of *innovation* due to the transfer of ideas and knowledge. While the firms within the AMC could not be seen as lacking in innovation in product design or construction, the overall level of innovation intensity within the sectors was incremental rather than radical and the pattern of innovation was mixed. The findings from this study suggest that some firms and sub-sectors are strongly engaged in new product development, with significant investment in leading-edge research. This was evidenced in a firm such as Nautronix, or some of the ship and boat builders. However, not all firms are innovation intensive and cost remains a key driver of competitive advantage for many manufacturers, subcontractors and suppliers rather than innovation.

Active participation of research institutions and universities

Fourth, successful clusters have the active participation of research centres and universities at the resource network layer. As noted earlier in this report, the level of collaboration and linkage between firms within the industry and universities or the CSIRO was low. While evidence of collaboration between firms and local universities was found, these were more the exception than the rule. Further, there was a high level of criticism by firms within the industry over the lack of relevant educational programs or research activities specifically targeted at this sector. The decision by some firms to seek such collaboration with universities outside the State should be cause for concern.

Possession of a skilled and production workforce

Fifth, successful clusters possess a well-educated, skilled and productive workforce. The evidence from this study points to WA having a strong concentration of highly skilled and productive workforce in the relevant trades and professions. However, there were many notable gaps in this skills base. For example, fibreglass workers, acoustics engineers, shipwrights and some specialist defence contractors were all identified as potentially in short supply. The evidence from the case studies and the survey suggests that more attention needs to be given to local TAFE college and university programs in relevant areas so as to ensure that the industry is well supplied with the skilled workforce that it needs for long term growth. It would seem that many of the firms in the AMC rely upon a floating pool of skilled labour to ensure they can complete their projects on time but without the need to carry large staffing

formulas during slow periods. Larger firms are apparently absorbing much of this labour pool during their busy periods to the disadvantage of smaller manufacturers.

Presence of competent financial institutions

A sixth characteristic of successful clusters, is the presence of *competent financial institutions* comprising banks and venture capital funds that can provide investment capital for growing industries. As noted in the report, while some firms had secured venture financing to assist their growth, most of the firms surveyed considered venture financing to be difficult to access within the State. Further, most of these firms, as well as those examined in the case studies did not seek such financing.

Close cooperation between firms

Seventh, within successful industry clusters there is usually a *close cooperation* between cluster firms and organisations within other clusters or industries. The case study evidence suggested that there was a good level of cooperation and collaboration between firms in the AMC. Most firms were not in direct competition with each other and many of the CEO from these firms were in contact with each other, or via the industry associations. Links between firms and their suppliers at the local level also indicated good collaboration.

Networks to other knowledgeable milieux

Finally, a further characteristic of successful clusters is their capacity to develop links to other *knowledgeable milieux* in which the social interaction between individuals encourages high levels of innovation. As shown in the case study and survey data, there is strong evidence of firms in the AMC being well connected via customer, supplier and industry networks to other knowledgeable milieux, primarily via social networks. Lead customers and key suppliers serve as a major source of new ideas for firms in the AMC. In addition, the movement of staff from one company to the next was clearly demonstrated. This was shown in the defence sector via the cases of Raytheon, ASC, Nautronix and Tenix who all had national and international networks via parent firms and various production, resource and social networks. The links between Woodside and Shell in the oil and gas sector with staff exchanges also illustrates this. As a highly internationalised industry sector, the Western Australian marine engineering industries are strongly linked to the world's markets.

Recommendations for future action

The analysis outlined above suggests that the AMC has successfully created a focal point for a state-wide industry cluster containing a series of sub-sectors within the shipbuilding, boatbuilding, defence and offshore oil and gas fabrication sectors. As this study has indicated, each of these four sub-sectors has slightly different industry dynamics and is facing different challenges. Future government and industry policy should seek to address some of these industry challenges as discussed in the following sections.

Shipbuilding Sub-sector

From the findings of this study the WA shipbuilding sub-sector is well established and strongly entrenched within the AMC. Its successful growth over the past thirty years

has been driven to a large extent by a handful of key “focal” firms (e.g. Austal Ships Ltd), who have been led by a small number of founder-entrepreneurs who have steered their companies through their growth phase to early stage maturity. As noted in this report, the key challenges facing this sub-sector are the succession plans of these founder-entrepreneurs, who are often the firm’s CEO and who continue to lead the company’s innovation and strategic growth. Looking forward over the next twenty years, the transition of these firms from relatively modest large companies, to potentially bigger firms, is likely to pose significant strategic issues for the AMC. It is difficult to predict the future of these firms, but attention should be given to how the AMC might retain them as key actors over the long term when through globalisation they may find their natural growth more oriented toward sites located elsewhere in the country or overseas.

In addition to the issue of company strategic growth and management, the shipbuilding sector appears to be facing some gaps in the availability of skilled trades and professional workers. This skills shortage has been mentioned earlier, but may benefit from a coordinated strategy designed to match the needs of the industry to the courses being offered by the State’s training and education sector. We are aware that such discussions have been undertaken, but further research may be needed to fully identify the extent of the problem and the likely responses that can be made. Such programs, particularly at university level, should be examined in terms of their ability to provide a framework for the development of research activities within the local higher education sector designed to support the industry.

Boat Building Sub-sector

In comparison to the shipbuilding sub-sector the pattern that emerges over the boatbuilding sub-sector is significantly different. While the shipbuilding sector is dominated by a handful of medium to large firms, the boat builders are mostly small to medium in size. At the luxury-end of this market the basis for competitive advantage among firms is more likely to be based upon product differentiation and innovation in design than cost. However, this sub-sector is relatively poorly understood in comparison with the other three sectors that enjoy greater profile. There appears to be an absence of solid data on the size, production output and value of this sector. As an industry dominated by small firms relatively little seems to be known of their problems. While some of these firms are engaged directly with the AMC, many are not and do not feel that the AMC is easily accessible for them.

Government industry support activity should focus more on the boatbuilding sub-sector with further research to provide a better picture of this industry and its needs. Such policy and support programs need to be focused on small to medium sized firms and are likely to require different approaches from those currently developed for the shipbuilding sector. Among the findings emerging from this study were the skills shortages within the fibreglass construction area and also the lack of profitability of many boat builders facing increasing costs and squeezed margins. Technical skills training for the boatbuilding sector was identified by many firms in the study as deficient within the State’s TAFE system. Further investigation into these claims seems appropriate.

As shown in this study, the need for the entrepreneurs that own these boatbuilding firms to devote significant time and expense to making frequent overseas trips to secure and maintain market share is a major challenge. Schemes designed to assist

such firms with management and international market development should be explored and if required considered as part of a wider industry support package.

Marine Defence Sub-sector

The marine defence sub-sector has emerged as a strong contributor to the AMC and one that has attracted several substantial actors (e.g. Raytheon, Nautronix). Its development has been driven by the two-ocean naval policy of the Australian Government and the originally unforeseen problems associated with the introduction and commissioning of the Collins Class submarine fleet. Although the construction of new RAN patrol vessels is now taking place within the AMC, the longer-term outlook of the defence sector will depend upon government decision-making.

As outlined in this study, the defence sub-sector is comprised of prime contractors who have high levels of innovation and competitive advantage and subcontractors that are less able to demonstrate a key point of differentiation. While the prime contractors are high profile, the subcontractors are frequently smaller firms with fewer resources. It appears that subcontractors within this sector are experiencing severe pricing pressures and that this may have a negative impact on the quality and profitability of their businesses. Such price-driven activity is also detrimental to the creation of enhanced innovation within the sector. Attention should be given to this subcontractor group of firms within the AMC defence sub-segment, to identify its specific needs and develop strategies to assist in sustainable business growth.

Offshore Oil and Gas Sub-sector

Western Australia's North West Shelf LNG industry is a major industry concentration and has created its own apparent cluster based on such focal firms as Woodside and Shell. This study has indicated that the capacity of the AMC to fully capture the work that might be possible through this industry may be contingent on its ability to win the support of prime contractor firms such as Cough or Transfield-Worley. While the smaller fabricator firms such as AusClad may view the AMC as a good idea, this was less likely to be the case for the larger prime contractors. More work may need to be undertaken to make the business case for the AMC as the location of choice for the fabrication of major offshore oil and gas platforms and components. The AMC will be competing against existing competitors in Indonesia and Korea. Future industry policy targeting the long-term growth in this sub-sector is likely to benefit from a package of measures that delivers a "risk-free" environment for major construction projects. This will involve securing not only suitable infrastructure at a competitive price, but also trade union agreements and the marshalling of subcontractors and their pool of skilled workers to undertake the work in a competitive manner.

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