Marine Engineering, Technologies and Services Cluster Analysis

Report for

Scottish Enterprise

Frontline Management Consultants & Ron Botham Associates
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Executive Summary

The purpose of this project was to consider the potential use of a cluster methods approach in the development of marine engineering and service industries in Scotland, and make appropriate recommendations for possible Scottish Enterprise activity.

The project comprised desk research, interviews with industry participants and database analysis from which the findings and recommendations in this report were drawn.

The DTI Marine Technology Foresight Panel estimates that marine related activity accounts for 4.8% of UK GDP in an array of activities from basic manufacturing to knowledge-rich applications of technologies and science. The Foresight Panel has recommended four UK task forces in:

- aquaculture
- shipping and shipbuilding
- offshore energy
- resource management products and services

Scottish employment and company data for 1997 identifies 44,000 marine related jobs. Significant employment relates to oil and gas services, shipbuilding and repairing, but it is declining in almost all marine related industries. From 1991-1997, numbers declined by 35% in the UK and by 21% in Scotland.

Dun & Bradstreet data suggests that Scotland has 12% of the UK marine related companies and 23% of its employment. Comparing Scotland with the South Coast of England identifies strength in Scottish shipbuilding in contrast with diversity in boat building and marine equipment on the South Coast. Scotland has a small number of larger organisations.

In addition to Scotland's two major activities of shipbuilding and suppliers to the oil and gas industry, there are three areas of potential:

- science base
- renewable energy
- aquaculture

Scottish participation in marine science and technology ranges from biological and environmental sciences to offshore engineering and ship design. As well as basic science, there are design, materials, modelling and test capabilities in several institutions. The extent to which different organisations and disciplines can be brought together to tackle the opportunities and problems facing Scotland's marine industries requires detail examination and action.

Scotland has a number of marine renewable energy pilot sites, but these technologies are at an early stage of development. This may be an important long term economic development opportunity and should be analysed in more detail.

Aquaculture is a significant Scottish industry and is part of the food cluster. Marine related knowledge inputs include engineering for deeper water applications and Scottish bio and environmental sciences.

The global trends in shipbuilding and ship repair have seen shifts in the patterns of demand and areas of supply, and the European industry has been moving into smaller and specialist niche markets.

Internationally competitive European shipbuilders tend to specialise in vessels with high knowledge content in their design, materials, production processes and end purpose of the vessel e.g. warships, specialist chemical carriers, large cruise liners.

The UK industry no longer has the capacity to compete in many large market segments, it faces significant challenges in price competitiveness because of UK productivity, age and size of the yards, lack of series production, limited investment in equipment and automation, and failure to adopt best management practices.

DTI Shipbuilding Forum benchmarking work has identified a range of areas for development based on comparisons between UK and Holland.

Shipbuilding and repair employs approximately 10,000 people in Scotland and is a core part of the marine industry. The core Scottish industry comprises three large facilities, two small shipbuilders and a number of repair yards. There is a range of small marine engineering 'boat garages' around the coast, and under-used or unused assets e.g. dry docks on the Clyde.

A major part of Scottish shipbuilding is in warship and fleet support vessels and is now dominated by BAE Systems. The industry is based on steel with a limited expertise in aluminium and glass fibre technologies. Ship repair work is largely for locally based and small North Sea based vessels. There is a range of supporting and related industries including manufacture of marine equipment and marine design services. Given a long history in marine industries, Scotland has factor conditions of labour, management experience and supporting research and development.

Analysis of Scottish shipbuilding and ship repair identifies a number of actions that could stimulate future competitiveness and development:

a) establishing a shared long term vision of 'the possible' for the Scottish industry. This should be facilitated by the public sector but owned by the companies as a shared agenda for their future development;

b) proactive networking that combines:
    - broadening the understanding of competencies and capacities within Scotland
    - benchmarking and learning from competitors e.g. Holland, Germany, Italy
c) Babcock at Rosyth may offer a unique and strategic opportunity for step change development in the industry in Scotland at the levels of the:
    - company
    - supply chain
    - role as an exemplar within the Scottish industry
d) support development of individual companies which have, as 'survivors' of a previously competitive Scottish shipbuilding cluster, been successful in innovating and competing globally.

North Sea oil and gas has been a key stimulus to innovation in marine engineering technology in Scotland. As the drivers of technology, i.e. deeper water and continuously improving equipment reliability, shift from the North Sea to the Gulf of Mexico and Brazil, there is a risk that the technological advantage of Scottish based companies may be eroded.

The report concludes that there is not a single Scottish marine industries cluster. However, there are a number of sub-clusters where appropriate activity may generate significant economic benefits. The overall objective should be to focus on those sub-clusters and on relevant activities within the science base that enables and supports innovation and sustainable international competitiveness.

Suppliers to the oil and gas industry present important opportunities for development as emergent sub-clusters that Scotland could achieve world class competitiveness. These include:

- ROV and related companies
- decommissioning
- marine environmental science

There is future demand for many of the products and services provided by companies in the Scottish marine related industries and companies. A key task for the Scottish industry, and for Scottish policy makers, is to focus on those areas where a knowledge-based added value can create and sustain internationally competitive advantage.

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1 Purpose and Method

The purpose of this project was to consider the potential use of a clusters approach in the development of the marine engineering and service industries. It also examined the possibility of using clusters as the basis for developing Scottish Enterprise and other public sector activity, and as a means to engage the industry community in a process of longer term, imaginative and pragmatic thinking about:

a) the industry in Scotland;
b) the international context and what Scotland could learn;
c) how appropriate interventions could accelerate the development of the industry and its contribution to the Scottish economy.

1.1 The cluster approach

The cluster concept, created by Michael Porter, is a way of analysing the sources of international competitiveness of industries by understanding how a nation's attributes, both individually and as a system, constitute a 'diamond' of competitive advantage. The attributes are:

a) factor conditions – e.g. high level skills, related academic research;
b) demand conditions – e.g. local customers that specify products and services to world class levels;
c) related and supporting industries – e.g. suppliers that are innovative and work closely with their customer;
d) firm strategy, structure and rivalry – e.g. the way firms compete, or collaborate, the numbers and scale of companies in an area.

Clusters have value in helping understand the sources of competitiveness within an industry; the strengths and vulnerabilities in that competitiveness and any 'gaps' that policy makers could help address. The analysis also gives a sense of the 'connectedness' of organisations within a cluster and where changes in perceptions and practice may create opportunities for business development and economic benefits for the area.

The benefits of a cluster approach became evident in this project as, in taking a wide and exploratory interpretation of 'marine', the process:

a) avoided taking a 'usual suspects' approach starting from well established industries e.g. shipbuilding and oil and gas, and working through those supply chains;
b) gives an indication of where assumed local linkages, for example 'local designers will *probably* be working with local shipyards….' may be valid or not;
c) enables a better view of critical gaps;

d) identifies possible opportunities to be considered by taking a different perspective, for example:
    - oil and gas industry as *consumers* of ROVs, is very different from
    - ROV industry as competitive *suppliers* to a range of industries e.g. defence, telecoms and oil and gas.

The final benefit of clusters is as a framework from which to define shared ground from which common benefits might be developed.

Within this project a cluster approach has been successful in identifying a series of possible actions that a conventional sectoral approach may not have revealed.

1.2 Method of working

The project had the following steps:

a) desk research;
b) industry interviews;
c) draft cluster mapping;
d) database analysis;
e) further industry interviews;
f) recommendations and reporting.

It is important to note that this work did not include new primary market research on demands on the industry. The desk research drew on:

a) existing Scottish Enterprise (SE) material;
b) local enterprise company material where marine engineering has been a priority;
c) the DTI Foresight Panel;
d) published industry source material;
e) internet-based search data.

A first draft of the 'possible' industries within a marine cluster was prepared to use in early stage interviews. Interviewees are listed in Appendix 1. A list of potential products and services then was developed as in Appendix 2. This material was used as the input data for the database search for companies conducted by Trends Business Services in Newcastle. The final diagram of that 'possible' industries in a marine cluster is in Appendix 3.

The Trends research compared the numbers of businesses in these products and services between Scotland, the South Coast and the UK. Interviewees recommended that the South Coast be used as the comparator region as it is the other significant area of wide ranging marine related activity in the UK. Whilst the North East has a strength in shipbuilding and repair, it lacks breadth in other sectors, for example research.

1.3 Cluster mapping

Applying the Trends results to the draft cluster diagram made clear the fragmented nature of the Scottish presence in the marine related industries. While this data questioned the concept of a Scottish cluster in its widest sense, when combined with interview material, it highlights areas where further activity may have economic development potential and these are presented in this report. Further interviews addressed these areas in detail to consider the scope for additional research work, and these are presented in this report.

1.4 Reporting

This report presents the research findings and recommendations on the way forward. It is structured as follows:

- Section 2: Introduction – sets out the UK context and presents the work of the UK DTI Marine Technology Foresight Panel as a backdrop for future technological development that addresses global markets.
- Section 3: Marine Industries – presents the array of marine activities considered and offers comparative data on Scotland and the South Coast.
- Section 4: Other Marine Activities: An Overview – considers the marine science base and potential related industries such as wave and wind power generation, and aquaculture.
- Section 5: Shipbuilding and Repair – presents the research findings on this sector and discusses the Scottish industry 'diamond' for these parts of the industry.
- Section 6: Naval Architecture – presents the findings and discusses the Scottish industry 'diamond'.
- Section 7: Suppliers to North Sea Oil – discusses the importance and impact of this sector on the Scottish marine engineering industry.
- Section 8: Issues and Strategic Options – summarises the findings of this work and sets out a number of proposals for further development and action.

2 Introduction

As a starting point for this study, this chapter sets out how the DTI Marine Technology Foresight Panel and our interviewees define marine engineering, science and technology, and marine related industries. It also describes the factors that differentiate marine from other aspects of technology and economic activity, and the emerging societal needs that will create future market opportunities.

2.1 Definitions

For many, marine engineering has a very specific meaning relating to the science and technology of marine engines. However, the Foresight Panel uses a much wider definition:

> '*Those activities which involve working on or in the sea together with those activities that are involved in the production of goods or the provision of services that will themselves directly contribute to activities on or in the sea*' (p.16).

On this basis, the Foresight Panel estimates that marine related economic activity employs around 800,000 people in the UK and generates approximately 4.8% of GDP. The industries generating this GDP are summarised in Figure 2.1 and the considerable breadth of their definition should be noted.

At this stage, it should be noted that this listing of industries cannot be taken to represent the concept of a cluster. Using Michael Porter's definition, a cluster is:

> '*(A geographically concentrated) group of inter-related industries whose linkages mutually reinforce their competitive advantage*'.

It is important to emphasise 'linkages', for example, having an offshore oil and gas industry may have little impact upon the competitiveness of the local fishing industry and vice versa, location in the same area does not make a cluster.

Marine Industries Contribution to UK GDP **Figure 2.1**

Industry Sector	£m
Oil and Gas	10,740
Leisure	5,964
Defence (i.e. Navy etc)	2,350
Shipping Invisibles (e.g. Lloyds)	956
Shipping Services	2,015
Shipbuilding	1,630
Marine Equipment	1,250
Fishing and Fish Farming	715
Environmental Industries	400
Port Operations	798
Construction	201
Research (e.g. Universities, Government)	269
Telecommunications	200
Safety	120
Crossings	87
Aggregates	76
Education	24
Total	**27,795**

2.2 Science and technology

The UK research system does not specifically recognise marine science and technology. Our discussions with Scottish marine related researchers suggested that they draw on work from many disciplines throughout the research system. While the Foresight Panel offers no discussion on the factors that integrate marine science and technology, our interviewees suggested the following:

a) water motion and forces e.g. waves;
b) corrosion e.g. due to the effects of salt water;
c) integration of electronics and water;
d) effects of underwater pressure;
e) environmental science;
f) marine life science e.g. fish nutrition, disease and medicines;
g) effects of marine life e.g. on the performance of equipment such as sensors, vessel performance etc

The linking theme is therefore deploying science and technology in the marine environment in ways that add capability and value. For example, taking established camera technology and then making it function in 3000m of salt water.

2.3 Market drivers and opportunities

The Foresight Panel identifies a number of major societal needs that could create future market opportunities. These will require ongoing technological and commercial developments for their successful exploitation. They are:

Offshore Energies. These are well understood in Scotland and require little further elaboration. They relate to two areas:

a) deep water offshore oil and gas exploration, to the extent that North Sea oil is no longer seen as a 'deep water' environment;
b) offshore wave and wind energy production.

Although the emphasis is firmly on oil and gas, some of the interviewees believe Scotland is well placed to exploit the wind and wave energy opportunity in the longer term.

Demand for Fish. With growing world demand and the limits on natural fish stocks, the focus is on aquaculture (fish farming). In the Scottish context, our interviewees emphasised the need to overcome disease related issues. Engineering is a constraint to placing fish farms in the deeper and more exposed marine environments. Additionally, there is ongoing research into onshore facilities using recirculation techniques. It is likely that innovation in fish farming will see new species such as halibut, Dover sole and cod introduced. Marks and Spencer's are currently test marketing farmed cod.

Marine Transport and Construction. There is growing demand for shipping services and, therefore, ships. In particular there is demand for:

a) specialist vessels e.g. for survey and research;
b) fast freight and fast ferries for coastal and short sea crossings;
c) all electric and clean ships with an emphasis on safety.

The issues facing shipbuilding are discussed in more detail in subsequent chapters.

Remotely Operated Vehicles (ROVs) and 'disposable' autonomously operated vehicles, that having done the job, will not be recovered. Our interviewees identified the growing need for submersibles that will replace divers to reduce cost, eliminate risk to life and enable more technically complex operations in increasingly deeper water.

Port Development. An implication of the introduction of fast freight and fast ferries is the need for more effective and time efficient inter-modal port integration. This will require major investments in port design and development and the pressure for such investment will be greatest in the UK's South Coast ports.

Maritime Leisure and Management of Coastal Zones. Growing demand for maritime leisure sailing is expected. This will increase the need for products and services that improve the management and sustainable development of coastal zones. Environmental protection e.g. pollution control and sewage disposal, as well as rising sea levels due to global warming will generate new demands.

Electronic Navigation. Digital global mapping is underway and will lead to the introduction of new electronic navigation systems replacing the traditional navigational charts.

Instrumentation and Sensors. Successful exploitation of many of these marine opportunities, linked to environmental issues, will generate demand for marine related instrumentation and sensors that will service the need for improved monitoring, forecasting and environmental management.

Demand for Fresh Water. While not identified by the Foresight Panel, the growing demands for fresh water and related opportunities. For example, water management and desalination were identified by our interviewees.

2.4 Proposed action and priorities

The priorities identified by the Foresight Panel and its current activities are summarised in Figure 2.2. The proposals relate to a number of generic, marine related research themes, and four specific industry or cluster related 'Task Forces' to take their work forward into implementation. The four industry clusters are:

- aquaculture;
- shipping and shipbuilding;
- offshore energy;
- resources management products and services.

While the four clusters draw on some common marine related science and technologies, these have only limited impact for each cluster's commercial developments.

Marine Foresight Panel: Recommendations **Figure 2.2**

1. Generic Research Priorities

- Acoustic, optical, chemical and biological sensors;
- Biotechnology for new product development;
- Design and system integration for ships and offshore platforms;
- Marine applications of digital technology;
- Dynamics of marine ecosystems;
- Environmental and climate forecasting;
- Environmental impact assessment;
- Integrated electrical systems for marine vehicles;
- Integrated marine transport systems;
- Material properties and adhesives;
- Miniaturisation and nanotechnology;
- Numerical modelling and simulation;
- Safety management and risk assessment methodologies;
- Sub-surface automation;
- Subsea communication.

2. Task Forces to create industrial competitiveness

- **Aquaculture**. Aims to establish a 10-year strategy covering common goals for UK producers, manufacturers and retailers making aquaculture more competitive. Focusing on:
  - Increasing supply;
  - Environmental protection;
  - Fish welfare.

  Also, to improve the worldwide productivity of aquaculture via the application of UK science and technology expertise.
- **The Marine Transport Chain**. Aims are to:
  - Draw together all players in the supply chain i.e. suppliers, manufacturers, operators/owners.
  - Re-establish the UK as a major force in the design, construction and operation of specialist ships including high-speed craft.
- **Offshore Energies**. To establish an R&D plan to achieve a step change in the recovery of reserves from deep, hostile waters including:
  - Improved survey and construction technology;
  - Improved yields from reservoirs by reducing residuals by at least one half;
  - Capability for total subsea processing.

  Also, demonstration projects for renewable energy.
- **Management of Marine Resources and the Marine Environment**. An industry lead group to identify the research needs to establish the capacity to exploit the emerging market for marine monitoring, forecasting and decision support for sustainable utilisation.
  - Marine information systems;
  - Marine sensors;
  - An industry body for companies operating in the area of marine information systems.

2.5 Conclusions

From this summary of the Foresight Panel's work a number of conclusions can be drawn:

a) marine related industries and technologies are not a single cluster in Michael Porter's terms;
b) UK marine science, technology and know-how underpin a range of possible industrial clusters in a variety of ways;
c) future global trends in terms of climate change, energy demand, trade, food production and sustainable development all impact on marine related technologies and industries. As such, they will drive demand and innovation in the world's marine related industries.

A focus simply on their marine, science or technology components will not, for example, create a commercially successful aquaculture or shipbuilding industry. Many of the sources of competitive advantage for these industries arise from non-marine related factors, e.g. management skills, vision, entrepreneurship and market presence.

3 Marine Industries

This chapter sets out some basic employment and company data on Scotland's marine related industries. This is a more focused definition than that used by the DTI Foresight panel e.g. this excludes the military. It provides a starting point for the cluster analysis presented in subsequent chapters.

3.1 NOMIS employment data

Employment for a number of marine related four-digit Standard Industrial Classification (SICs) is presented in Figure 3.1. This data covers activities e.g. water transport, outwith the DTI Foresight work.

Scottish Employment (1991 and 1997) By Four-Digit SIC Figure 3.1

	Employment		% of UK	
	1991	**1997**	**1991**	**1997**
Fishing	1,550	1,300	46.2	44.4
Fish Hatcheries/Farms	2,225	2,050	74.6	57.3
Extraction of Oil/Gas	9,715	7,970	53.7	61.5
Services to Oil/Gas	12,825	12,355	67.9	77.4
Manufacture of Engines/Turbines	3,955	4,450	12.7	22.9
Shipbuilding and Repairing	15,160	9,765	36.5	30.7
Boat Building and Repairing	550	190	6.5	2.6
Construction of Water Projects	125	705	8.1	19.4
Sea and Coastal Water Transport	5,210	2,000	15.8	10.9
Inland Water Transport	-	205	-	12.0
Other Water Transport Authorities	4,560	2,860	15.3	12.4
Renting of Water Transport Equipment	120	125	6.8	12.0
Total	**55,995**	**43,975**	**29.3**	**31.0**

Before drawing out some general observations, a few comments on each of the industries can be made:

a) **fishing**. Although Scottish employment has declined by 16% since 1991, it accounts for almost 45% of the UK employment. While fishing outputs are an input to the food cluster, it is also a potential customer for shipbuilding and other marine related industries e.g. marine engineers, sonar systems and academic research;

b) **fish farming**. This is also part of the food cluster but is a potential customer for other marine related industries. While employment has grown by 20% in the UK between 1991 and 1997, it has declined by 8% in Scotland. Nevertheless, Scotland still accounts for 57% of the UK industry employment but 90% of production. Research commissioned by the Scottish Executive in 1999 calculated total direct and indirect employment in Scotland at 6335 full time equivalents.;
c) **extraction of oil and gas**. Although total employment in the UK has declined by 18% since 1991, Scotland accounts for a large and rising proportion (61%) of UK employment in the extraction of oil and gas. This represents a major market and customer for marine related industries;
d) **services to oil and gas**. Scotland accounts for 77% of UK employment (12,400 employees) within this industry. The companies provide a wide range of products and services, some of which incorporate marine related skills and technology. Official data does not differentiate marine from non-marine related services;
e) **manufacture of engines and turbines**. This has been included because Scotland has almost 23% of UK employment and the industry that has grown by 12.5% during 1991 to 1997. Some of this could be marine related though much will be power generation equipment for non-marine environments;
f) **shipbuilding**. This includes building, repairing and conversion of 'large' ships. In terms of employment, Scotland retains a significant but declining representation (35% between 1991 and 1997), which accounts for over 30% of current UK employment;
g) **boat building**. This covers the building and repair of smaller pleasure boats and Scotland has almost no presence in this industry. Between 1991 and 1997, UK employment (which is currently only 7,260) fell by 15%. In job terms, there is no evidence that this is a rapid growth industry;
h) **construction of water projects**. This is a small and growing industry (having grown from 125 to 705 since 1991) such that Scotland has almost 20% of UK employment. The nature of companies in this industry is examined further below.
i) **water transport**. A variety of water transport services (i.e. shipping and supporting services) provides almost 5,200 jobs in Scotland. These represent a potential market for shipbuilding and other marine related products and services. To understand in more depth how this industrial sector might contribute to a potential marine cluster, the Dun and Bradstreet database was used to identify the companies in the sector. This analysis is used in subsequent chapters.

Based on these industries, Scotland has a disproportionately high share (31% or almost 44,000 jobs) of UK employment. In almost all industries employment is declining, the UK by 35% and Scotland by only 21%.

Official SIC data has serious limitations as a method of identifying the nature and size of any potential 'marine technology' cluster in Scotland. Outwith ship and boat building and construction of water projects, there are no specific SICs for marine products, for example, marine related engineering companies are part of a variety of engineering SICs. Nevertheless, the following important points emerge from Figure 3.1:

a) the data show the existence of some over-represented markets in Scotland including the oil and gas industry, fishing, fish farming and shipping services;
b) shipbuilding remains a significant, if declining industry;
c) Scotland has almost no presence in the building of small leisure craft;
d) oil and gas is the major source of employment that can be identified from the official data.

However, to identify a further range of marine related companies and employment, additional data sources are required.

3.2 Dun and Bradstreet data

To identify both the number of companies and marine related employment in industries not included in the NOMIS analysis, Dun and Bradstreet (D&B) data has been used by Trends. This has been complemented by data drawn from the Yellow Pages and trade journals. The analysis compares Scotland with the English South Coast (defined as West Sussex, Hampshire, Isle of Wight, Dorset and Devon), which was identified as one of the UK's main marine regions during the interviews.

Dun and Bradstreet provide a very large sample of company specific information. However, it is not comprehensive with missing records generally relating to:

a) a few branch plants i.e. establishments which are not formal subsidiaries of larger companies. The most significant missing records we are aware of is DERA in both Scotland and the South Coast and BAE Sema in Scotland;
b) small businesses, especially the self-employed.

Despite these missing records, the Scottish database contains information on 125,919 businesses employing just over 1.7m; it therefore covers most of the corporate economy.

The main advantage of D&B is that it records a 'line of business' for each company which is the company's own description of its business. To identify marine related companies the database was searched using the large number of key words listed in Appendix 2 that companies might use to describe their business. This was done for Scotland, the South Coast and the UK as a whole.

Before presenting the results, a number of points should be noted:

a) the search procedure will have missed some companies that undertake marine related work because the range of key words was not sufficiently comprehensive or because the company did not emphasise marine related products in its line of business description; however, the degree of under-recording is likely to be similar in all three areas;
b) those companies that serve oil and gas or shipbuilding, but which do not perceive marine related issues as sufficiently important to mention in their line of business will not be identified. Consequently, the search did not (nor was it designed) to identify all potential suppliers to oil and gas or shipbuilding for example, steel makers;
c) the results cannot be interpreted as a measure of an oil and gas or shipbuilding cluster, rather they provide an order of magnitude indicator of companies and employment that describe themselves as being in marine based industries.

To keep the search within reasonable proportions, the analysis focused on potential core marine cluster industries. In other words, no attempt was made to search the database for oil and gas companies, fishing and fish farming companies and shipping lines, which are adequately dealt with in the official employment data. Furthermore, a detailed listing of Scottish fish farms, fishing companies or oil companies would not add to our understanding of any marine cluster.

A comparison of marine related companies and employment in Scotland and the South Coast is presented in Figure 3.2. Having identified the companies, the data was then aggregated and presented in terms of two or four-digit SIC codes allocated by D&B. Their allocation may not always be the same as that in the official government data; consequently, some differences in the data can be expected.

Excluding the main markets for marine goods and services, (i.e. fishing, fish farming, shipping, oil and gas and defence) the search found just over 1,000 Scottish companies employing 45,130 people. This represents 0.8% of all Scottish business on the Dun and Bradstreet database and 2.6% of corporate employment. As a proportion of the UK, the analysis suggests Scotland has 12% of UK marine related companies and 23% of its employment. The high job share arises largely from its strength in services to oil and gas and continuing size in shipbuilding.

The South Coast has 400 more companies but substantially less employment. The companies represent 1.1% of all South Coast companies while the 21,700 jobs account for 1.6% of its corporate employment. Compared to Scotland, the South Coast has many more small companies serving marine related markets.

Scottish and South Coast: Companies and Employment 1998 Figure 3.2

SIC		Scotland		South Coast	
		Companies	Employment	Companies	Employment
1120	Services to Oil/Gas (Exc. Surveying	40	10,050	14	49
17	Manufacture of Textiles	3	11	2	83
18	Manufacture of Clothing	1	90	1	5
24	Chemicals/Chemical Products	1	5	-	-
25	Manufacture of Rubber and Plastic Products	2	34	2	115
27	Manufacture of Basic Metals/Fabrication	1	20	47	472
28	Manufacture of Fabricated Metals	16	1,080	101	1,422
2952	Manufacture of Machinery for Mining	41	4,255	6	155
29	Other Machinery/Equipment	25	1,136	50	2,035
31 - 33	Manufacture of Electrical/Optical Equipment	14	378	37	1,332
34	Manufacture of Vehicles	2	41	5	34
3511	Shipbuilding and Repairing	98	9,880	79	3,926
3512	Pleasure Boat Building/Repairing	40	305	204	4,294
36	Other Manufacture n.e.s.	6	245	7	38
4524	Construction of Water Projects	103	2,580	79	1,610
45	Other Construction	20	474	108	983
50	Sale/Repair of Vehicles	5	33	9	38
51	Wholesale Except Cars	234	2,863	258	2,046
52	Retail	34	302	89	354
60/62	Non-Water Transport	5	165	8	48
65/67	Finance	13	95	3	15
71	Equipment Renting	15	237	-	-
72	Data Processing	1	2	10	40
7414	Business and Management Consultancy	34	4,690	16	352
7420	Architecture/Engineering Services	200	3,768	232	1,201
Rest of 74	Consultancy/Business Services	41	2,326	65	320
75	Naval Training	-	-	1	600
80	Education	3	25	16	50
90	Social and Personal Services	-	-	1	25
92	Recreation and Cultural Services	4	41	9	53
Total		**1,002**	**45,131**	**1,459**	**21,695**

3.3 The industries

Marine related companies are found throughout the official Standard Industrial Classifications (SICs), such that companies were identified as 99 separate four-digit codes. Similar companies e.g. ship designers were also found in a number of different codes. For example, a company that undertakes pure consultancy is in SIC 7420, but could be in 7414 if it adds significant management consultancy to ship design, or it could be in 3511 or 4524 if it contract manages the construction of projects.

To give a better understanding of what there is in Scotland and how it compares with the South Coast, a brief description of the companies and industries in each of the main SIC codes is presented.

Services to Oil and Gas (SIC 1120). The 90 companies in this industry are mainly various forms of drilling contractors and offshore engineers. The largest companies include Kvaerner Oil and Gas Ltd with 2,300 employees, KCA Drilling Ltd with 1,150 employees and Transocean Offshore (UK) Ltd with 600 employees. It also includes a few small specialist service companies such as crewing and staffing services, inspection and safety services, geological consultants and pipeline coating services. This type of industry is almost completely absent on the South Coast, as most companies require proximity to the oil fields.

Shipbuilding and Repair (SIC 3511). In addition to the well-known and larger yards such as, BAE Systems, Babcock, Ailsa and Ferguson's, the industry has a substantial number of smaller specialists repairing and building vessels e.g. Fleming's and Ferguson's. However, there is not critical mass in these specialist areas.

On the South Coast, the largest yard is Vosper Thornycroft with almost 1,300 employees. The main commercial yards are medium sized including Appledore and FBM Ltd, which is the UK's leading producer of high-speed ferries. Throughout the South Coast's many small companies, the lines of business include a range of words such as yachts, aluminium boat builder, sailing ship and ROVs.

Boat Building and Repair (SIC 3512). This industry builds and repairs pleasure boats and is small in Scotland with no companies having over 50 employees. It is largely based in the west coast with much of it in the repair of small sailing and motorboats. With the exception of one large company in Cowes manufacturing components, the South Coast industry is made up of many small companies, producing yachts, cruisers and sailing boats other leisure craft such as canoes, powerboats, fibreglass and lifeboats. The South Coast dominates this industry.

Manufacture of Fabricated Metals (SIC 28). In Scotland this industry relates to:

a) basic products for oil and gas including offshore accommodation units and cables (accounting for much of the employment);
b) ship related products such as anchors, fire doors, and containers.

There is a surprisingly long list of South Coast companies. The majority describe themselves as steel fabrication and may have only a tangential link to marine industries. However, there is a small group of companies explicitly focussing on marine equipment and shipbuilding e.g. piping, decks.

Manufacture of Equipment for Mining (SIC 2952). All the companies identified in this industry primarily make machinery for the oil and gas industry, with a few making machines and equipment for other marine (or indeed other) markets. While supplying the North Sea, it is not obvious how much 'marine' technology these companies need. This industry barely exists on the South Coast.

Other Machinery and Equipment (the rest of SIC 29). The 25 Scottish companies are a mixture of:

a) equipment for ships such as gears manufactured by Reid Gears Ltd, and engine parts, winches and other marine products manufactured by for example Brown Brothers and Simpson-Lawrence Ltd;
b) equipment for North Sea Oil such as subsea control systems, underwater connectors and instruments.

The South Coast has more, but on average smaller, companies focussing mainly on hydraulic equipment, marine pumps and valves, marine engines, electric submersible pumps, propulsion equipment, underwater weapons and desalination equipment. In addition, it has one large company Hamworthy KLS with almost 1,200 employees manufacturing a wide range of equipment for the shipping industry including boilers and waste processing equipment.

The D&B data suggests very little of Scotland's significant share of the UK's manufacture of engines and turbines (shown in Figure 3.2) is marine related.

Electrical Equipment (SICs 31 - 33). In Scotland, there are two small groups of companies producing:

a) underwater equipment such as connectors, lighting, control and survey equipment;
b) navigation equipment.

The South Coast has a larger industry making similar products but with a greater emphasis on 'scientific' equipment such as ultrasonic testing systems.

Naval Architecture/Engineering (SIC 7420). Scotland has both a large number of companies and significant employment compared to the South Coast under this SIC. It includes a variety of activities that can be broadly categorised as:

a) hydrographic surveyors and geological consultants;
b) ship designers/naval architects;
c) marine engineers/consultants;
d) marine services;
e) oil and gas related 'marine', subsea consultancies;
f) other specialist consultancies for diving equipment, offshore chemistry and sonar detection.

A rough estimate suggests that in Scotland 55% of the companies and 80% of the employment relates explicitly to oil and gas. The remainder are shipbuilding and repair, and maintenance related. The South Coast lacks Scotland's oil and gas related presence in hydrographic and geological surveying. The overwhelming majority in this category are marine engineers, marine services and naval architects.

Throughout the database, mainly but not exclusively, in SIC 7420 are 26 small companies stating some form of ship design as their main line of business. They employ 180 people, with just 5 employing between 15 and 30. While identifying rather fewer companies, the Yellow Pages listings suggest Scotland has 38% of the UK's naval architecture business.

D&B data identifies 75 companies involved in marine engineering. The large companies merge into ship repairers, and unlike the naval architects, the marine engineers are not involved in export markets. They are scattered around the coastline providing a form of 'garage' repair service for local boats and small ships.

Business and Management Consultancy (SIC 7414). While a few marine consultants are listed under this SIC in Scotland, the companies work almost exclusively for the oil and gas industry. Over 90% of the employment is in five large companies consulting (and contracting) to the North Sea oil industry. The South Coast companies are in ship/boat building and marine construction.

Other Business Services (the rest of SIC 74). This is made up of a variety of industries. In Scotland the main ones can be identified as:

a) diving related services, including the supply of ROV services, account for 60% of the jobs but only 15% of the companies;
b) maritime and oil and gas recruitment and labour supply services (largely but not exclusively for oil and gas). Within the industry, these recruitment agencies account for almost all the remaining employment, outwith diving services;
c) a variety of oil and gas related services such as pipeline, and rig underwater inspection services, rig design and supply chain management.

While the South Coast has some oil and gas related companies e.g. oil and gas analysts, well data analysis, 60% of the companies are yacht brokers with a few yacht insurers.

Wholesale Services (SIC 51). Of the 234 companies, 199 (accounting for 93% of the 2,860 jobs) explicitly supply to the oil and gas industry. The remainder are suppliers to shipbuilding and marine engineers/services. The South Coast has a much wider range of wholesale services with a stronger focus on the shipping industry.

Construction of Water Projects (SIC 4524). With just over 100 companies and nearly 2,600 jobs, this appears somewhat larger than in the official NOMIS statistics. While there are many small companies involved in irrigation, drainage, piling, foundation work and civil engineering, the industry is again dominated by subsea work for the North Sea including Coflexip, Stena Offshore and Rockwater Ltd, which employ over 1,250 between them. A number of other large civil engineering contractors were identified in the search, which, when checked, undertake only a small amount of marine related work. They were not included in the analysis as most of their employees are engaged in land-based construction.

The Scottish companies elsewhere in SIC 45 are smaller and more specialist contractors including painting, electrical installation, hydraulic systems, offshore welding, wellhead refurbishment; again dominated by the North Sea. No evidence of companies explicitly engaged in port development and construction was found in the data search.

The South Coast companies do not mention oil and gas in their 'line of business'. The larger companies include piling contractors, irrigation, dredging and pipe work.

3.4 The importance of oil and gas

Of the 1,002 Scottish companies identified in the data search, 443 (44%) explicitly mention the oil and gas industry in their line of business. These companies account for 27,980 (62%) of the employment. This leaves 559 companies and 17,150 jobs not explicitly mentioning oil and gas. However, it should be noted that some of these, e.g. diving services, almost certainly supply the oil and gas industry as well as other markets.

Suppliers to oil and gas accounts for the greater size of Scotland's marine related industries relative to the South Coast.

3.5 Marine related manufacturers

It is generally believed that the remaining UK manufacturers of marine equipment for the shipbuilding industry are internationally competitive. Excluding the manufacture of mining equipment, the data search found just 71 marine related manufacturing companies employing 2,800. Perhaps, surprisingly, the South Coast has more companies (252) with slightly more employees (5,536) than Scotland.

While only supporting data, membership of the UK Marine Equipment Association seems to confirm the relative strength of the South Coast. Scotland has 8 members compared to 24 located on the South Coast. Appendix 4 summarises the activities of these companies to give a sense of the diversity and breadth of technologies in these companies. A number of those on the South Coast are also main defence contractors, e.g. Marconi, suggesting that the South Coast companies has more manufacturers that may be rather more sophisticated in terms of design and development capability.

3.6 Shipping and related transport services

The NOMIS data suggests there are almost 5,200 employed in shipping and related water transport services in Scotland. The D&B data has just over 140 companies in Scotland employing 6,100. A review of this data shows the companies subdivide into:

a) port operators and authorities. These account for most of the employment;
b) ship owners and operators. These include companies such as Caledonian MacBrayne, the Ben Line and a large number of more specialist operators/leasers for vessels such as ROVs, oil/gas standby vessels, tugboats, towage and salvage operators etc;
c) stevedores and other port services;
d) a small group of ship management companies such as Denholm's with 90 employees and B.U.E. Caspian Ltd with 20 employees;
e) a number of small tourist and leisure related companies such as marinas and boat hire/leasing etc

The absence of large ship owners and operators is notable. This has implications for local demand for both shipbuilding and marine equipment producers. The South Coast has a larger industry with a few large shipping companies and many more small firms involved in the operation of marinas and yachting.

3.7 Conclusions

The DTI Foresight Panel's definition of marine related industry (more or less any economic activity in or on water, and equipment which goes in or on water) would include fishing, fish farming, oil and gas, services to oil and gas, ship and boat building, construction of water related projects, shipping and related services and the marine related industries identified in Figure 3.1.

However, it is evident that this is not one single cluster. While both operate on and in water, the extraction of oil and gas and the fishing and fish farming industries are not in the same cluster and have little relationship in stimulating competitiveness.

The data presented in this chapter is at a high level and should be interpreted as orders of magnitude. Nevertheless, important conclusions emerge:

a) in the oil and gas and fishing industry, Scotland has major industrial markets for marine related products;
b) the ship owning industry appears to be a significantly less well represented market in Scotland. Scotland does have a number of significant ship managers e.g. Denholm's, however most of their vessels operate globally and were not built in UK and may never come to the UK ports for repair;
c) shipbuilding remains a substantial industry, but Scotland has little presence in pleasure craft boat building and repair;
d) ship design and other marine related consultancies have a significant presence in Scotland, with a substantial number of consultancies related to oil and gas; [1]
e) equipment, services and suppliers for North Sea Oil dominate the Scottish picture. An important question is how many of these companies could diversify competitively into non-oil and gas markets;
f) manufacturing of marine related equipment in Scotland is not particularly strong.

The data analysis has not identified any products or industries in which Scotland is well represented outwith the well-known ones e.g. subsea for oil and gas, shipbuilding and fishing. The possible exceptions are ship design and related consultancy, navigation equipment, and civil engineering and water related construction.

[1] From other work Ron Botham Associates are doing, these contribute to what appears to be a significant Scottish presence in environmental consultancy and related services.

4 Other Marine Activities - An Overview

The previous chapter demonstrated that Scotland's two major 'marine related' areas of economic activity are shipbuilding and suppliers to North Sea oil and gas. Before examining these in more detail, this chapter presents some brief observations on some of Scotland's other marine related activities:

a) the science base;
b) renewable energy;
c) aquaculture.

4.1 The science base

Marine related science and technology is not recognised as a distinct subject in official statistics, therefore it is not possible to identify precisely relevant university research undertaken in Scotland. However, an earlier study for Scottish Enterprise identified 58 university research centres (i.e. 'self-financing' research units outwith formal departmental structures)[2]. Of these, the following have a marine focus:

a) Institute of Aquaculture and the NERC Aquatic Biodiversity Unit linked to Biological and Molecular Science (with a marine specialism) at Stirling University;
b) The Scottish Institute of Maritime Studies at St. Andrews. This is a small unit specialising in the culture of seafaring communities, wrecks and archaeological diving;
c) The Gatty Marine Laboratory (including the NERC Sea Mammal Research Unit) with around 80 staff at St. Andrews University. It specialises in marine environmental research, water pollution and marine biology;
d) Heriot-Watt's Institute of Offshore Engineering. With around 90 staff and both wave tank and natural test facilities. This has wide ranging offshore R&D capacity, although it has been mainly concerned with oil and gas but could operate in other marine related markets;
e) Glasgow University's Marine Technology Centre that includes research on new materials, biofouling resistant materials, adhesive bonding and marine energy technologies.

There are two RAE 4 rated Departments of Naval Architecture at Glasgow and Strathclyde. These are described in more detail in Chapter 6.

In addition, Professor Mike Cowling's recent review of higher education institutions research identifies marine related research being undertaken in a variety of departments across Scotland. Examples include:

a) Aberdeen University: lasers for the fishing industry, welding, deep sea survey technology and acoustics for seabed mapping and submarine detection;
b) Dundee University: coastal hydraulics and remote sensing for water quality monitoring, hyperspectal imaging spectroscopy;

[2] Firn, Crichton & Roberts Scottish Universities Centres of Excellence, 1996.

c) Edinburgh University: wave power via a variable pitch turbine and wave modelling and experimental fluid dynamics;
d) Napier University: reclamation of near shore areas and marine waterways.

There is a considerable range and volume of research. While there are important links with industry, many of the 'traditional' constraints on commercialising the research were identified.

In addition to university research, there are a number of government funded research institutes in Scotland undertaking marine related work. The main facilities are:

a) DERA which has small units located at Rosyth and Aberdeen, and testing facilities in the Western Islands and Luce Bay;
b) The NERC Dunstaffnage Marine Laboratory near Oban with around 50 employees undertaking marine science of particular relevance to Scotland;
c) Fisheries Research Services includes the Aberdeen Marine Laboratory, focusing on the fishing industry, as well as a significant fish farming research programme and the Pitlochry Freshwater Laboratory:
d) The Fish Health Inspectorate which carries out statutory inspections for the industry.

The focus of the government laboratories in Scotland is agriculture and the environment rather than marine technology. The larger government marine laboratories including the Plymouth Marine Laboratory and the Proudman Oceanographic Laboratory are located in England.

Within this project it is not possible to assess the 'global quality' of the marine related science base. However, Scotland does conduct a significant proportion of the UK's university research. As well as basic science and technology, it provides significant design, materials, modelling and test facilities. In addition to DERA's facilities, Glasgow, Strathclyde and Heriot-Watt Universities have significant test tanks, which are all partly industry funded.

The impending privatisation of DERA is driving a much more commercial approach to the exploitation of its technologies. This may be a timely issue for marine industries where application of these technologies might enhance competitiveness.

Our interviewees suggested the following points about the current research being undertaken:

a) some believe there is a mismatch between the current research and industry need. For example, much university research is concerned with the basic biology of marine organisms while industry's needs relate to sensors, acoustic engineering and navigation systems, remote sensing, and submersible designs. However, Scottish universities are undertaking some, if not enough of this type of 'needed' research;
b) there are strong international centres around the world. In this context, it was suggested that we are perhaps not as good as we sometimes think we are;
c) while there is a diverse marine related science base, it is perhaps thinly spread, with the various elements not as well networked as they might be.

Finally, from the academic community, there was an argument that different disciplines could be brought together to tackle more effectively specific problems facing the individual marine industries including aquaculture, shipbuilding and ROVs.

The research base has only limited linkages with the industry at this time. This position reflects the absence of a co-ordinated strategy within Scotland and the relatively few Scottish customers for this research.

4.2 Renewable energy

Through the Scottish Renewable Obligation (SRO), Government policy has sought to promote the development of alternative energy sources. Essentially the SRO subsidises the development of demonstration projects and guarantees a market for their output. The main developments under the SRO programme have been the generation of electricity from wind. Of all the renewable technologies, land based wind power is the nearest to being able to generate electricity at competitive costs and this has resulted in a significant number of turbines operating in Scotland. However, equipment manufacturers are dominated by Danish companies and there is a minimal indigenous Scottish capacity, with the exception of Aeropac (a Danish company) that manufactures the fibreglass blades in Scotland.

The UK established a strong position in wave generation R&D during the 1960's and 1970's, but with little prospect of wave generation being able to compete commercially, funding in the UK dried up during the 1980's. Other countries still invest significantly.

Recently, wave power has re-established its position and, in March 1999, was included in the third SRO programme. To date, three wave projects have been awarded under SRO 3. These are:

a) Wavegen Ltd The project is located on the coast of the Isle of Islay. It uses the motion of the waves to drive wind into a shoreline 'cave' which, in turn, drives the turbines. Generating up to 500 KW, this is the UK's first (subsidised) commercial wave generation project. The project builds on an earlier demonstration project developed on Islay by Queens University Belfast. The technology is perhaps best suited for meeting local demand in remote areas. It may also have desalination applications. To produce and sell this type of 'power station' requires the ability to manufacture the equipment e.g. Wavegen's proprietary items such as the generator, brake, transformer and electronic controls; rotating components such as the turbine, valves and motor bearings; and developing innovative installation techniques;
b) Ocean Power Delivery Ltd In contrast to other SRO projects, the funding is to develop the actual equipment[3]. It is currently at the prototype scale, has undergone wave tank tests, and will begin sea trials off Islay in mid-2001. A 300 KW capacity is planned.
c) Sea Power International Ltd This is a Swedish company developing a moored barge-generating device with 1.5 MW capacity off Shetland. Initial prototyping has been undertaken in Sweden.

These projects make it clear that the technology is at a very early stage and is small-scale. The level of risk should also be noted given the failure of the Osprey wave power project off Dounreay. Nevertheless, via the Green Peace inspired 'Commission for Wave Power in Scotland', there is a political as well as economic context. Renewable energy is also a key component of the global warming issue and therefore has international significance and market potential. Currently, much of the concern is on generating electricity with less focus on manufacturing the equipment. However, Wavegen, a Scottish company, use English suppliers for machining and fabrication despite significant additional transport and inspection costs, as Scottish companies were not price competitive.

A major constraint to the future UK development of wind power is the perceived environmental problems e.g. noise and aesthetics, created by large wind farms. For many, the solution is offshore wind farms, but this technology is at an earlier stage than wave power and it was not included in SRO 3. It should be noted that countries such as Sweden, Holland and Denmark are already undertaking a considerable amount of research and small-scale generation is underway. It is argued that Scotland's offshore skills should be applicable to the development of this industry. However, while North Sea skills relating to platform construction and installation could, in part, be transferable, there is no indigenous capacity in manufacturing the higher value generating and power transmission equipment.

[3] In other cases the generating equipment already exists. The aim of SRO is to enable it to be brought into use.

In theory, much of the construction and installation skills of the North Sea are relevant to renewable energy projects, but one difficulty is that the 'gold plated' culture of the North Sea does not transfer to renewable energy projects which need to be much more cost conscious. It is also worth noting that offshore wind, if it does not run up against the same environmental constraints as land based projects, may be constructed in Southern England rather than Scotland, to be closer to the bulk of demand.

In considering the potential contribution of marine related renewable energy to Scotland's economic development, the following points are worth noting:

a) to date the focus has been on the development of renewable generating capacity in Scotland i.e. the production of electricity;
b) little equipment manufacturing capacity has been developed in Scotland for equipment that is exportable and can underpin significant economic development;
c) generating electricity from renewable sources in Scotland will not be a source of long-term economic development, since electricity is not readily transported. Consequently, the industry's growth (unless new transmission technology reduces the cost of distance) will remain constrained largely by local demand;
d) electricity from renewable sources will not be sufficiently cheap to offer electricity intensive industries e.g. steel and semiconductors competitive advantage in Scotland;
e) assisting the generation of electricity from renewables in Scotland could contribute to economic development substantially if it enabled local companies to develop generating equipment and installation skills that could serve global markets. To date, there is no evidence of this happening, and this does not seem to be a central element in policy thinking.

One example of the links between marine and power generation skills potentially producing exportable products was the idea behind the creation of Scotia Energy i.e. barge mounted power stations that could be 'sailed into' remote areas in developing countries. However, our understanding is that the cost of assembling the product in Scotland, compared to a site nearer the market was not competitive. For this type of project to be viable, both competitive power generation equipment and ship or barge building industries are required.

How wave and offshore wind electricity generation can most effectively contribute to Scotland's long-term economic development is worthy of further consideration. Currently, both the Industrial Power Association and the Scottish Renewable Energy Forum are involved in the area.

4.3 Aquaculture

Aquaculture is a significant Scottish industry and as a producer of farmed fish, it is logically part of the food cluster. Marine related knowledge is, however, an input to the industry and the following points emerged during the interviews:

a) the importance of high quality 'marine engineering' has not been adequately recognised or utilised. Several of the industry's recent problems e.g. escaping salmon, are at least partly due to poor marine engineering. Improved engineering may also help address the fish disease problems in the industry. However, the full range of technical factors effecting this industry are beyond the scope of this report;
b) the industry would benefit from moving further offshore into more exposed water, which would generate the need for more sophisticated equipment. Lithgow's have made a few offshore systems with accommodation;
c) as noted previously research is being conducted on onshore production facilities using water recirculation processes;
d) compared with Norway, the industry is not highly competitive preferring to stick to the technology it knows and, consequently, profits have been squeezed. As a result, the industry does not have the investment resources for expansion and significant development;
e) sonar technologies have been developed to count and measure fish without inducing the stress and cost of physically handling them. Most of this equipment is Norwegian;
f) the focus is on cost cutting and efficiency within existing farms, which includes plastic cages and mechanisation. New feed and control systems are being brought in from Norway;
g) new species such as cod, trout and a variety of shellfish are being introduced;
h) companies such as Lithgow's have established an international presence in the salmon breeding industry (see Figure 4.1).

Lithgow's: From Shipbuilding to Fish Breeding **Figure 4.1**

21 year-old William Lithgow (with two partners) set up the company to build ocean-going sailing ships in 1874. It became one of the Clyde's main yards. It was nationalised in 1977.

The company now has several small yards around the Scottish coast:

- Campbeltown Shipyard specialising is fishing vessels.
- Buckie Shipyard
- Malakoff & Moore in the Shetlands
- J. Fleming Engineering in Stornoway

The yards build and repair small boats for the fishing and North Sea Oil industries and local fish farms.

In 1980, Landcatch was set up as a vertically integrated salmon farm from eggs to kitchen ready salmon.

- Ova, fry, parr and smolts are bred in land-based tanks.
- Its own hydro electricity is used to pump sea and freshwater into the tanks.
- To improve stock and ensure traceability, detailed breeding records and health checks are used. 'Micro-satellites' are inserted into each fish to enable individual recognition.
- DNA testing is a key technology.
- The aim is now to reduce the breeding cycle time by 50%; apply their technology to other breeds and sell their know-how around the world.
- A proportion of the stock is reared in its own fish farm.

Knowledge of husbandry, engineering, biotech and the marine environment have been combined to create a new business within the Lithgow Group.

Through Aqua Services, the Group provides a full procurement and supplies services to fish farmers. Using its own shipyards, this includes:

- A variety of fish farming systems.
- Small boats including well boats (for delivering live fish) and feed barges.

The Group illustrates the potential synergies within a marine cluster.

Much of Scotland's aquaculture is in the Highland and Islands Enterprise area, however, it should logically be considered within the context of a Scottish food cluster strategy. This raises the question of whether and how aquaculture is being dealt with in the food cluster strategy and, more specifically, whether or not the required marine and biotechnology inputs have been adequately considered. Anecdotal evidence suggests the Norwegians, in recognising aquaculture as a long term strategic national industry, have made these connections more effectively and have driven up their competitiveness as a result.

5 Shipbuilding and Repair

Shipbuilding employs around 10,000 in Scotland. In both the UK and Scotland, there is currently political interest in the possibility of regenerating the industry.[4] Following a review of the UK industry, this chapter sets out an analysis of the Scottish shipbuilding 'cluster'. It is based on recently published material from the DTI's Shipbuilding Forum and interviews with representatives from some of the Scottish shipyards. Given the breadth and resources of this study, no analysis of statistical sources has been undertaken. Consequently, the findings represent a preliminary assessment rather than a definitive analysis.

5.1 Industrial context

5.1.1 Global trends

The following observations provide a context for the discussion of Scottish shipbuilding:

a) despite a serious downturn in the early 1980's, world demand has continued to grow, but the structure of that demand has changed significantly;
b) with the continuing growth in world trade, world fleet ageing and interest in faster freight vessels, demand is expected to continue to grow and change over the longer term;
c) Japan, a high wage economy with 40% of world output, remains the world's leading producer. South Korea has increased output dramatically over recent years and now has 39% of world output. Both these countries have the competitive advantage of scale and strong shipbuilding clusters;
d) with 2% of world output, China is establishing an industry position;
e) the European industry has been pushed into smaller, specialist niche markets. The Dutch are now major players in Europe;
f) business practice has changed dramatically. Historically yards undertook most work 'in-house', but outsourcing to smaller, specialist suppliers has become more common. For example, around 90% of the value of a ship is now outsourced in Holland compared with around 50% in the UK;
g) other 'Japanese' working practices e.g. team working, multi-skilling, improved supply chain management, continuous improvement are now widely applied in the industry outwith the UK;
h) there continues to be ongoing innovation within the industry, for example, fast ferries have been researched and developed in Australia, while fast freight vessels are now being designed and developed in San Diego. Rather 'mundane' technologies continue to have a significant impact on design and construction e.g. adhesives, welding, new materials;

[4] For example, the 1998 Scottish Shipbuilding and Marine Sector Seminar and the DTI's UK Shipbuilding Forum.

i) globally, shipbuilding is not a declining industry; innovation continues and high wage economies continue to compete successfully in a variety of high value market segments.

5.2 The UK industry

Scotland accounts for around 31% of the UK's shipbuilding employment (this falls to 25% if boat building is also included). Consequently, many of the issues facing the UK industry apply equally to Scotland. Despite growing demand, both the UK and Scottish industry has experienced a prolonged period of decline. In contrast to many manufacturing industries where employment has declined while output has increased, both employment and output have fallen dramatically. From its once dominant global position, by 1997 UK shipbuilding accounted for just 0.7% of global tonnage. The UK industry is now restricted mainly to the production of defence vessels and smaller, one-off specialist ships.

Reflecting elements of a cluster perspective, the DTI's Shipbuilding Forum has brought together the shipyards, ship owners and equipment manufacturers in an attempt to overcome the divisions within the production chain that are believed to be partly responsible for the industry's decline. The Forum has identified a large number of initiatives relating to partnerships, training, supply chain management, benchmarking and the adoption of best practice. However, much of the discussion continues to focus on low wage competition, the placement of the next government order, unfair competition especially, but not exclusively, from South Korea and the value of sterling and the Euro.

5.3 UK competitiveness

The UK industry no longer has the facilities that would allow it to compete in many of the larger market segments. However, even in the market segments for which it has facilities, the industry is facing major problems. Figure 5.1 shows the number of ship orders placed in EU yards in the first 6 months of 1998.

New Orders Placed in the EU: January/June 1998 **Figure 5.1**

	No. of Vessels
Netherlands	179
Spain	61
Germany	41
Other EU	51
UK	2

Source: DTI Shipbuilding Working Group, 'Current Position', Final Version, December 1998

The inability to compete with other European countries, let alone the dominant global shipbuilding nations of Japan and South Korea, is not due to high wage rates. Indeed, the UK is a relatively low wage cost location in a European context (Figure 5.2). Despite this, First Marine International's Benchmarking Study (which included the BAE Systems Govan, Ailsa and Craig group yards in Scotland) notes that a '*10 - 15 % improvement in (labour) productivity would allow some smaller yards to become price competitive with leaders in Europe*'. (p. 5). Such an improvement would involve a considerable effort. The report also notes '*that leaders in Europe are not standing still*'.

Shipbuilding: Total Wage Costs Per Hour **Figure 5.2**

	Labour Costs per Hour ($)
Northern Europe	25
Mediterranean	20
USA	20
UK	15
Far East (Excluding Japan)	8

Source: First Marine International, Benchmarking UK Shipyards. DTI and Shipbuilding and Ship Repairers Association, January 2000

Essentially the lack of price competitiveness is because UK productivity is below the EU average. The magnitude of the problem is illustrated in Figure 5.3, which compares the UK's productivity with that of Japan and South Korea. While the low level of productivity compared to Japan might have been expected, the basic issue is that the South Koreans also produce ships much more efficiently than UK shipyards.

Comparative Labour Productivity **Figure 5.3**

	Man Hours Required to Produce One Compensated Gross Tonne
UK	39+
South Korea	20 - 25
Japan	13 - 16

Source: First Marine International, Benchmarking UK Shipbuilding and Ship Repair. DTI and Shipbuilding and Ship Repairers Association, January 2000.
Note: A compensated gross tonne is a statistical mechanism for allowing for the different types of ship produced i.e. the higher South Korean productivity is not due to the fact that it produces large and simple ships while the UK builds small and difficult vessels.

Low productivity is due to several factors and, while much progress has been made in recent years in terms of labour flexibility, the following areas need to be addressed:

a) many yards are old, their physical size and layout excludes them from some market segments and impedes the efficient organisation of the production process. There has been no investment in greenfield facilities;

b) the absence of series production with yards constrains developing specialism i.e. one-off production does not tend to drive up productivity;
c) limited investment in equipment and automation. To some extent this reflects low profitability and the UK's low wage costs;
d) failure to adopt innovative management and production practices resulting in less efficient working and organisational methods.

Figure 5.4 shows First Marine International's assessment of UK shipbuilding yards against current best practice (best practice scored as 5). The average score for Japanese yards is 4. A score of 3 is equivalent to 1970's best practice. As can be seen, UK performance is poor, suggesting that UK yards are not good at building ships. Fundamental, rather than marginal, improvements are required to match world-class performance.

Best Practice and UK Shipbuilding **Figure 5.4**

	UK Yard Score	
	Average	**Best**
Steelwork Production	2.3	2.9
Outfit Manufacturing and Storage	2.6	3.6
Pre-erection	2.2	3.1
Construction and Outfitting	2.6	3.2
Yard Layout and Management	2.8	3.3
Design, Engineering and Production Engineering	2.6	3.7
Organisation and Operating Systems	2.8	3.8
Human Resource Management	2.8	3.9
Supply Chain Management	3.6	3.1
Marketing and Commercial Management	3.5	4.3

Source: First Marine International, Benchmarking UK Shipyards, p. 8

In addition, the UK industry has been slow to adjust to changing market demand and new opportunities. For example, it has done little to establish a presence in fast ferries, fast freight or, until recently, ship conversion. The industry is only now beginning to look at long established Japanese practices relating to, for example, supply chain management and the benefits of increased outsourcing. While the industry is now looking at means of improving productivity, First Marine International comments that there is still no widespread recognition of the need for continuous improvement within the UK industry.

There are approximately 65 significant ship repair yards around the UK coast. Ship repair is more labour intensive than shipbuilding and, therefore, the UK's low (European) wage rates are a greater advantage. First Marine International's assessment is that ship repairers are somewhat closer to international best practice. Nevertheless, ship turnaround times, an important indirect cost for ship operators, are longer than in other North European yards. As with shipbuilders, some of these yards are now trying to move into ship conversion.

The industry has expressed concern that UK ship owners are increasingly looking overseas and that the decline of UK shipping has further reduced demand for vessels produced in the UK. Over recent years, UK ship operators have purchased around 90% of their tonnage overseas. However, the 10% they purchase within the UK, mainly small and specialist ships, represents 50% of the UK's merchant ship output. The future of UK shipping matters to the industry, but it is only relevant if UK shipbuilding is more competitive.

Much of the value of a new ship and major repair or refit is in the equipment that goes into the vessel. Purchasing decisions are made by shipyards, owners and designers. As the UK shipbuilding and shipping industry has declined, the equipment manufacturers have faced increased difficulties and consequently their industry has contracted. The remaining companies are believed to be internationally competitive, with most relying heavily on export markets. However, as marine equipment industries are now developing in newer shipbuilding nations such as Korea, UK companies are questioning how long they will be able to sustain competitiveness. Given the benefits of proximity to the shipyard, the UK industry will face increasing competitive pressures. From the perspective of the marine equipment manufacturers, the UK merchant shipbuilding industry is no longer seen as a major asset[5].

[5] One of the purposes of the DTI Forum is to generate better feedback between the shipbuilders, owners and equipment manufacturers. Better and more systematic potential customer feedback should enable them to improve their performance.

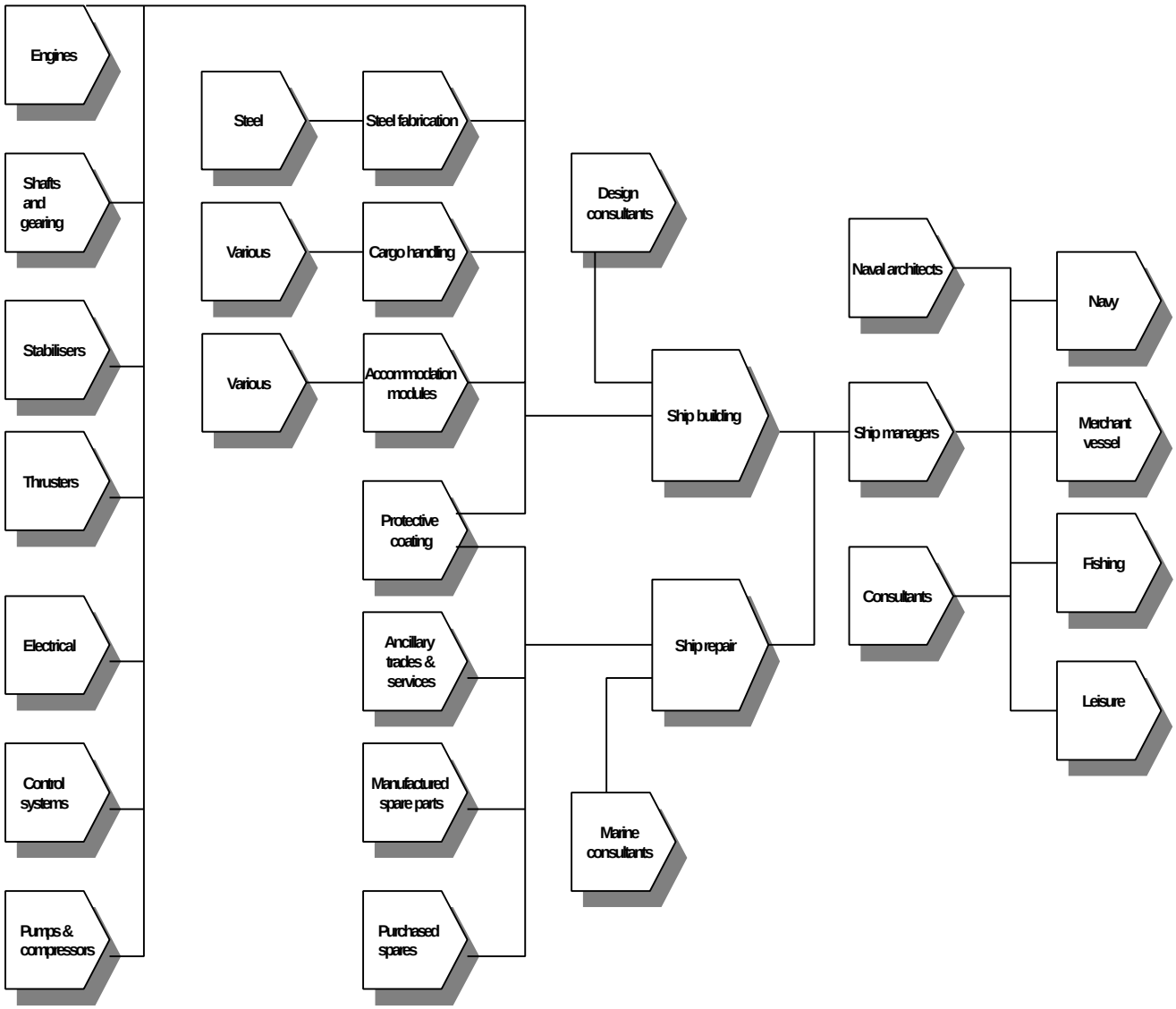
5.4 Scotland's shipbuilding and repair

5.4.1 Firms, strategy, structure, rivalry

A summary of the main elements of a shipbuilding and repair cluster is summarised in Figure 5.5.

As detailed below, Scotland now has very few of these components in which there are any firms.

Shipbuilding and repair – 'model' cluster **Figure 5.5**



The core industry consists of:

a) three large yards employing between them around 7,300. These are:
   - BAE Systems (ex Yarrows) serving defence markets. The nature of its facilities, i.e. long, narrow docks, limits its ability to diversify into commercial vessels as commercial vessels are much broader than military;
   - Babcock at Rosyth. This is still largely a naval repair yard that is diversifying into commercial markets;
   - BAE Systems (ex Kvaerner Govan). Historically this was a commercial yard with a specialisation in chemical and gas cargo vessels. However, with the acquisition by BAE, it will move into the defence arena in, for example, naval support and transport vessels.
   - in addition there is a submarine repair capability at Faslane;
b) two relatively small commercial yards (Ailsa and Ferguson's) employ between them around 550 people. Both yards are reported to be successful in terms of order books but they both depend on UK government contracts in defence, survey and state owned ferries for significant volumes of work. Ailsa has two dry docks that provide the physical and commercial flexibility to undertake repair work, but the sites have little capacity for expansion, and as a result are limited to vessels of up to around 100 metres. Ailsa's recent output consists of small vessels such as fishing boats, patrol craft, landing craft, ferries, survey vessels, tugs, small dredgers and North Sea supply vessels. With no series production, they produce small, essentially customised, and specialist vessels.
c) 20 ship repair yards (some also build small boats) are located around the coast employing around 500 people plus a significant number of contractors. Several of these yards are part of the Semple Cochrane Group (e.g. Garvel Clyde, Engineering and Midland Ship Repair) and Lithgow's. Of the yards, two have a comprehensive capability including capacity for ships of over 200m^2 and four can deal with ships between 80 and 200m. The remainder are smaller regional or local yards. Lithgow's, for example, has a number of 'local garages' around the Scottish coast for vessels up to 35 m in length;
d) a substantial number of small marine engineers which merge into ship repair located around the coast;
e) a few small companies producing or repairing leisure craft. As already illustrated, this industry is not well developed in Scotland compared to, for example, the English South Coast;
f) there is considerable under-used capacity in the industry along with a variety of more or less un-used assets such as the UIE and BAE Systems Scotstoun dry docks.

The largest part of the Scottish industry is now heavily defence orientated in both warship and support vessels. The main customer is the MoD, though some export markets are served. Govan was involved in export markets particularly in specialist vessels such as gas and chemical carriers where stainless steel work was significant. The two smaller commercial yards and the ship repairers are more or less exclusively focused on the UK and, more specifically, the Scottish market. In contrast, the South Coast boat building industry has a significant export orientation.

In addition to competing amongst themselves, the main competition for the type of vessel made by the two smaller shipbuilders comes from elsewhere in the UK (e.g. Appledore's on the South Coast) and Europe. The Dutch are a strong player in most of their product markets. Until recently, competition from the Far East was minimal, however, the South Koreans are now moving into these product areas.

The Scottish industry has established only a limited presence in the production of small leisure craft and has no real presence in emerging areas such as fast ferries, fast freight, luxury yachts and ship conversion. In addition, the Scottish industry is primarily based on steel, whereas many of these new areas involve different technologies including materials such as aluminium and composites.

The D&B data shows no new business births in the industry over the past five years with the exception of the Craig Group's re-use of the Hall Russell repair facilities in Aberdeen. In contrast, the South Coast's industry continues to generate a few new entrants.

5.5 Markets and local demand

In addition to the MoD, there are a number of 'new build' local customers, which are the source of most work for the smaller commercial yards. The main markets are:

Fishing industry

The industry has been declining with many vessels being laid up. Reflecting both limited fish stocks and the EU regulatory environment, there has been limited investment. The Scottish fleet is old with only a few boats purchased each year. It is thought demand could increase somewhat in the future but Scottish orders are now being won by yards in Norway, Spain and Poland.

Shipping industry

This includes the Port Authorities and associated activities e.g. occasional purchases of tugs, dredgers and local ferry operators such as Caledonian MacBrayne and P&O. While both are subject to EU procurement rules, they have often purchased in Scotland, but there is continuing pressure to open up these markets to further European competition. There are continuing links between these local shipping lines and the shipbuilders.

The local commercial shipowners are reported to be placing an increasing number of orders in overseas yards and interviewers attributed this to a mix of price and exchange rates. At a UK level, engaging UK ship owners in the wider industry debate is seen as an attempt to reverse the flow of orders for commercial vessels now being placed in Europe and the Far East.

North Sea oil

The oil industry has generated demand for many small supply and safety ships. Currently many are tied up and under-used. The most significant recent demand has been for tanker conversion into floating production, storage and offloading vessels but this work is not being undertaken in Scotland, i.e. a significant BP contract was placed at Harland & Wolf in Belfast. Subsea installation service companies purchase and operate a variety of larger, highly specialised vessels with extremely sophisticated and complex equipment eg cable laying. Many of these have been built and are repaired in Holland. This appears to reflect their facilities (e.g. craneage) combined with their hydraulic, electronic and mechanical engineering skills, which produce customised 'solutions' to customer requirements.

MoD and public sector

The MoD is Scotland's main market such that their orders are crucial for the future at BAE's facilities i.e. Scotstoun and Govan. While the production of fighting vessels will remain in the UK, the market is being opened up to increased competition. MoD also purchases significant amounts from the smaller yards, for example, Ailsa has a long-term MoD contract to repair powerboats as well as build small landing craft. The Scottish Executive also has a role in a small number of purchasing decisions for ferries and specialist craft, such as survey and fishery protection vessels.

While the local market is currently sustaining the smaller commercial yards, it is unlikely to be sufficient to maintain the industry in Scotland or stimulate recovery and development. We found no evidence that local customers are stimulating innovation and encouraging the industry to produce vessels that could compete in international markets.

Ship repair

For smaller-scale, routine maintenance and repair, demand is essentially local or derived from 'passing trade'. A yard requires a very large price advantage or very rapid turnaround times to make it worthwhile for a ship to divert from its routes or normal area of operation. For major refit or conversion, the yard's location becomes a less serious constraint on the operators or owners choice of yard, i.e. such projects are more internationally mobile. To attract these projects, yards have to be highly competitive to offset the additional cost of sailing the ship to a more distant location.

The Scottish yards have not attracted internationally mobile business and their main markets are local shipping. These include fishing vessels, North Sea supply vessels, harbour craft, small MoD vessels and coastal shipping with the possibility of attracting vessels involved in North Sea trade and on Scandinavian and North Atlantic routes. However, the industry is not sufficiently competitive to win local orders for major refits and conversions. For example, a recent Halliburton conversion for one of its North Sea vessels to add 20 m to Rockwater II went to Singapore, which has a strong position in this industry. The lack of facilities excludes Scotland from many market segments such as very large tankers should they be in a Scottish port.

Aquaculture

Aquaculture generates a small demand for some of the repair yards that have moved into making cages, small boats and other equipment for the industry. For example, Lithgow's has made a few offshore systems with accommodation. However, as a source of work, aquaculture will only become more significant if there is substantial investment in more exposed offshore waters.

5.6 Supporting and related industries

Much of the value of the ship is its content and this is becoming increasingly important in higher value vessels. At the same time, yards elsewhere in the world are outsourcing more, making the yard an assembly rather than production site.

Around 40% of the Scottish industry's purchases are made within Scotland, with most of the remainder coming from England. The most significant local purchases include:

a) services from subcontractors such as outfitting, painting etc The repair yards buy in a significant amount of subcontract labour;
b) design services, which are the most significant local purchase in terms of their impact on competitiveness;
c) a variety of individual products such as windows, fire doors, anchors, cabling, stabilisers and valves. There is also some high tech equipment for defence vessels.

In Figure 5.5, the significant point is the absence of any substantial strength in the supply base, with major items such as engines and gearboxes no longer produced in Scotland. It is interesting, for example, that of the 150 entries in the Scottish Trade International Marine Equipment Directory only 56 supply shipyards. Almost all of these provide small items that are not critical to the competitiveness of the industry. What remains of the supply base for traditional shipbuilding is therefore no longer a source of competitive advantage.

Other local markets such as North Sea oil and the engineering industry mean, in theory, that wider demand and expertise exists to support a variety of equipment manufacturers and suppliers. Indeed, many major suppliers to shipbuilding e.g. Weir's, Howdens, also serve other markets. There are a number of engineering companies supplying specialist inputs to shipbuilding. For example, Caley Ocean Systems Ltd supplies a variety of marine markets including:

a) davits (safety equipment) for ferries and platforms;
b) equipment for diving support vessels;
c) ROV handling systems for vessels and oil platforms;
d) storage carousels for vessels involved in cable laying operations.

Caley Ocean Systems also serves a number of non-marine markets. Much of the remaining expertise appears to be in 'one-off' engineering solutions involving design and installation for specialist vessels and platforms. However, there are relatively few internationally competitive companies such as Caley or Brown Brothers. Furthermore, it is suggested that many Scottish engineering companies are not cost competitive, especially for smaller-scale, higher value work.

The industry has a wide range of 'knowledge workers' that add value through know-how rather than product. Scotland has a significant number of these. Nevertheless, the evidence from the interviews suggests that some of these organisations derive a lot of work through individual contacts built up from many years of industry experience. Long term sustainability will therefore depend on these individuals, and this may ultimately lead to decline within this sector as they retire.

5.7 Factor conditions

Given the industry's long history in Scotland, self-evidently Scotland has the basic factor conditions for shipbuilding.

Labour force

There is a large, relatively low cost labour force with experience of shipbuilding, which has become more flexible with better industrial relations and increased multi-skilling. However, much of this workforce is no longer in full-time employment in the shipyards. One consequence is that ship repairers have few problems bringing in workers on a temporary basis to deal with fluctuations in the workload.[6] The following points concerning labour emerged from our discussions:

a) the workforce is ageing and, given that shipbuilding remains a strenuous occupation, it is 'too old';

[6] This is an approach which South Coast yards, for example, are less able to adopt. Essentially casualised labour is not locally available.

b) the training infrastructure has deteriorated significantly. The old apprenticeship system has declined, although more recently some of the larger companies e.g. BAE Systems, Babock, Ailsa and Ferguson's have been increasing their number of apprenticeships;
c) compared to best practice, there is still a relatively low level of multi-skilling;
d) the decline of the UK shipping industry has reduced the supply of experienced marine engineers coming ashore and available to work in the industry.

Management skills and experience

There are a significant number of people in Scotland with senior and middle management experience. However, the following comments were made by our interviewees:

a) existing management is ageing with the industry finding it difficult to attract high quality graduate entrants and future management;
b) there is limited knowledge of the global industry and limited working experience of the industry outwith the UK;
c) there is inadequate entrepreneurial drive and commitment to innovation;
d) for many, there remains a need for ongoing, significant culture change within management and the industry.

Research and development

In addition to the corporate R&D in, for example, BAE Systems, the R&D infrastructure includes:

a) DERA in both Rosyth and Aberdeen;
b) Two RAE 4 rated departments at Glasgow and Strathclyde Universities with almost 50 research active staff:
   - Glasgow's research focuses on ship safety, environmental issues, ship economy, RO-RO stability, materials and adhesives
   - Strathclyde focuses on stability, safety and ROV related issues
c) a number of other departments and research centres e.g. Glasgow's Marine Technology Centre.

These departments receive a significant amount of work from both the shipbuilding and offshore industries. Nevertheless, we do not believe these departments represent a comprehensive or cohesive R&D base for shipbuilding. From our interviews, there was little immediate evidence of R&D that could help the industry move into a new age of growth and development.

5.8 Governance

Role of industry

There are several UK associations such as the Shipbuilders and Shiprepairers Association and the Association of Marine Equipment Manufacturers, which have begun to work together, focusing more on assisting the industry to improve its efficiency and innovation. The recent benchmarking studies between the UK yards and a Dutch study tour have had a significant impact. However, only a minority of Scottish companies are members of UK associations. Apart from the rather 'public' Scottish Forum held to discuss the issues facing the industry, there are no Scottish mechanisms through which the industry (defined from a wider cluster perspective) can meet to exchange ideas, present and hear current research results or co-operation towards a shared vision of the industry's future.

While recognising that any specific Scottish organisation or 'industry governance' would need to take into account the UK associations and the DTI Forum, several interviewees expressed interest in some form of Scottish industry body or networking mechanism. For this to make a positive contribution, it must focus on improving efficiency and innovation, rather than lobbying for overt or hidden protection.

Government

The public sector has had a major influence as an industry customer and has provided, within the EU regulatory framework, contract related operating aid. The aid regime is being changed such that:

a) operating aid will be terminated at the end of 2000;
b) some of the restrictions on the application of regional aid to shipbuilding will be removed;
c) a specific shipbuilding scheme to assist innovation offering up to 10% of project costs is to be allowed.

This new EU regulatory system enables, not obliges, governments to offer these forms of assistance. Assuming the UK Government does offer such assistance, the new policy approach focuses aid on investment (within the Assisted Areas) and innovation. Consideration should be given to how this new policy package can be used most effectively.

5.9 Diversification

Figure 5.6 presents a case study of Babcock's diversification plans at Rosyth. Their aim is to move into both commercial ship repair and the production of luxury yachts. These plans are one of the most ambitions attempts to diversify and bring something new to Scottish shipbuilding and ship repair. The case study is presented in some detail to illustrate the point that, even for a business the size of Babcock's, change of this magnitude is a major challenge. It is worth stressing the following points:

a) the opportunities for diversification are constrained by the site's facilities. For example, the size and especially the narrowness of the indoor bays restricts the type of vessel, i.e. they are not large enough for some types of commercial work;
b) the company is having to develop a new culture and business approach for the commercial market. This is very different to what was successful in the defence market;
c) it will also need to develop new cultures and business methods to produce super yachts. These success factors bear little resemblance to those needed to refit warships;
d) it will need to combine these cultures as defence work and commercial repair and conversion will also have to sit alongside those needed for super yachts;
e) super yachts involve fundamentally different design, materials, technology and marketing strategies than the yard's traditional work;
f) the process of change is being undertaken within a local business environment which is not 'geared up' to this type of business. Therefore, the yard is unlikely to learn much from its local environment or be able to draw on existing local resources e.g. skills, suppliers, designers;
g) while elements of the industry exist in Southern England e.g. designers, yacht leasing companies and skippers who influence purchasing decisions, there is no developed Scottish expertise, or sources of competitive advantage. For example, there are few super-rich Scottish customers, and these yachts rarely visit Scottish waters;
h) there are already strong established players in the industry, many of them in Holland, who have the advantage of operating within an established cluster.

There can be no guarantees that this type of fundamental transformation will be successfully achieved, nor it is clear whether Scotland could create the critical mass in super yachts to support a competitive supply base and local infrastructure. However, it is this type of process that needs to be encouraged and supported if shipbuilding is to have a future in Scotland. How this might be done is not immediately evident and needs further work. However, small-scale initiatives such as part-funding study tours for the workforce, senior management and suppliers, to see how the business operates elsewhere in the world, would be a useful step forward.

Babcock Rosyth **Figure 5.6**

When put under private sector management, the Royal Naval Dockyard employed 5,758. Fully privatised in 1997, it now employs around 3,400.

Background History

It is currently the HQ of Babcock's Marine Engineering Division with facilities scattered around the UK. Historically:

- It undertook repairs and refits for the navy (especially submarines). The work was not subject to competitive tender.
- In the early 90's, the aim was to become the lead player in submarine refit/repair. Eventually this role went to Davenport.
- To assist its re-orientation to MoD surface fleet repair/refit, it was allocated a non-competitive work programme. This begins to decline in 2002 and will be phased out in 2007.
- Defence work is gradually being opened up to competitive tender.

The yard will continue to tender for MoD work. With defence cuts, the market will not fully maintain the yard even if it is highly successful.

Physical Assets

These both enable and constrain diversification into both commercial markets and new products. Its facilities include:

- Three large dry docks that can accommodate vessels up to 300 x 31 metres
- Extensive non-tidal berthing.
- Five covered bays (75 x 15 m) for new build and conversion.

Part of the site will remain a 'secure' area for MoD work.

A diversification strategy (initially into fabrication and rail equipment) has been in place since the early 1990's. This strategy has now been intensified with a focus on commercial repair and luxury yachts. To date, some small-scale build and repair (tugs, ROVs) has been undertaken. Capacity is being developed with too recent significant acquisitions:

- A design company (Armstrong Technology).
- A fast ferry company (FBM) with aluminium expertise.

Repair and Conversion. It has the dry docks for large projects. But there is overcapacity in the industry and prices are being continually squeezed.

Luxury Yachts. These can be assembled in the covered bays. It is a small, high value market. (They cost up to £1 m per metre). Success will require inter alia:

- Significant investment in new facilities e.g. very rich purchasers expect an appropriate reception at the yard.
- New skills and attitudes. (They are built by people in white gloves).
- A new approach to business e.g. it's not the same as marketing warship refits.
- New suppliers and new skills/attitudes amongst suppliers.
- An effective market entry strategy. It has rejected some projects because they were too difficult. (You cannot get the first one wrong).
- An ideal route could be via co-operation with a Dutch company e.g. producing the hull for fitting out in Holland.

Neither price nor delivery speed is presently a competitiveness factor. Quality and style depend on artistic, decorative and design skills. Success will not halt the ongoing decline in employment at Rosyth. The company is aiming to enter a market with several well-established competitors operating in well-developed clusters.

5.10 Future prospects

Shipbuilding is now a relatively small industry in Scotland and outwith defence work has a small corporate base. Developing new areas of activity alongside the current defence sector work is a major challenge for individuals, organisations and the industry.

Additionally, the productivity issues facing the industry require much more than marginal improvement or small-scale policy initiatives. Incremental improvements in efficiency, an increase in training, improved supply-chain management, devaluation of sterling or even preferential allocation of large government orders will not, on their own, revitalise the industry. Achieving an increase in output and employment is a major challenge.

It is tempting to conclude that the industry needs vision and ambition to drive a step change forward. An example would be the Australian industry's success in establishing a world position in fast ferries through the creation of, essentially, a new industry. This was achieved through new firms set up by visionary individuals leaving the old traditional and non-competitive industry. This new industry is based on fundamentally different technology, business models, culture and attitudes. We found little evidence of such shared ambition within the Scottish industry. Currently, thought is being given to markets in which others are already established but some opportunities are still available.

Should a step change in ambition be created, a long-term, systematic development programme e.g. appropriate research, skills, knowledge would be required to support it. In the shorter-term, the most visible opportunities are:

a) Babcock's efforts to diversify into ship repair and conversion, and super yachts, which represents a major challenge for the company, the wider industry and the economic development community;
b) Scottish consortia bids for repair and conversion projects that are currently beyond the capacity of individual yards. A number of interviewees mentioned the consortia model being examined by the Industrial Power Association, which could both draw in new players and utilise under-used assets. For example, while UIE does not have ship repair skills, it has access to a major dry dock, project management skills and could be interested in being part of a Scottish consortia;
c) other potential collaborative projects. At this stage, specific opportunities are not identified, as these would only emerge once the various players begin talking to each other. Would, for example, DERA be able to add competitive edge to vessels designed by Scottish naval architects?

A means of exploring ideas in greater depth and taking potential opportunities forward is outlined in the final chapter.

6 Naval Architecture

As noted previously, Scotland has a significant proportion of the UK's naval architects. This raises the question of whether Scotland has (or could establish) a major presence in what can be seen as a 'knowledge intensive' part of the shipbuilding industry. While the production of ships continues to decline in Scotland, is it possible to develop a cluster around the design function? Is this the role of high-income economies in the global division of labour? Given these possibilities, this chapter presents the study's findings on Scotland's naval architecture industry.

6.1 The Scottish industry

From the D&B data, there are around 25 ship design companies in Scotland. However, the concept of a ship design company is blurred, and designers do not all appear in the same SIC code. The industry consists of:

a) BAE Systems which undertakes design for other companies as well as the MoD;
b) approximately 5 companies with between 15 and 30 employees;
c) around 20 companies with under 10 employees including self-employed consultants.

The companies excluding BAE Systems employ 180 people. In addition to small companies elsewhere in the UK, ship design is undertaken in larger consultancy and shipbuilding companies. Hence, naval architecture is less often in the form of 'stand alone' companies and is therefore less visible in the statistics. Consequently, Scotland's large share of the UK's 'stand alone' naval architects (reported in Chapter 2), over-estimates Scotland's relative position in ship design. Nevertheless, within the context of business or design services, naval architecture is one of Scotland's few relative UK strengths.

6.2 Origin of the industry

The structure of the industry i.e. a number of small 'stand alone' businesses partly reflects the origin of the Scottish businesses. They are either:

a) surviving elements of now closed shipyards, for example. Upper Clyde Shipbuilders, or Robb Caledonian in Dundee, where management bought the yards' design rights and converted the design department into a new business; or
b) subsequent 'spin offs' from these original design companies which are generally small one or two man businesses. Sometimes this process reflected the continuing employment decline of the initial design company.

The original design companies i.e. the 'buy outs' from the shipyards are now much smaller than when they were part of the shipyard. In part, this reflects the impact of CAD technology such that there is no longer a need for a large drawing office. However, there is no evidence that, freed from their old corporate ties, they have been able to expand revenues substantially by moving into new markets. Within Scotland, ship design is not a growth industry, but some players are active throughout the world.

6.3 Mode of operation

Ship designers sell either to ship owners or to the contracting shipbuilder. The Scottish companies interviewed operate in one or a combination of the following ways:

a) consultant - they receive a fee for producing a vessel design;
b) contractor - they win the contract to build the ship or a significant part of it. They then manage the process of buying in equipment and getting the vessel assembled i.e. shipyards become their customer;
c) joint bids - the size of the Scottish design companies restricts their lead contractor role to small projects, therefore, for bigger projects, they become part of a joint tendering process with a shipyard.

The main constraints to taking on large projects are financial risk and credibility with customers. Essentially, the companies do not have the financial resources to withstand losses if anything goes wrong with a project e.g. delivery delay. This also explains why customers are reluctant to place large projects with small design companies.

The companies have generally made an explicit decision not to manufacture even when they have IPR over product designs. Similarly, those operating as contractors do not employ labour which is bought in when required and enables them to supervise projects anywhere in the world.

The companies' markets include:

a) local owners and shipyards as well as other UK owners and yards. Most, but not all, work with companies such as Babcocks or Ferguson's. Vessel operators such as Caledonian MacBrayne are also important;
b) export markets. Most of the larger companies export, largely in the developing world:
   – projects maintaining and upgrading old UK vessels (often produced by the yard from which the design company spun out)
   – old personal contacts and the need for equipment compatibility helps make sales
c) more specialist and complex vessels. Specialist designers' ownership of design rights enables them to be cost competitive for such vessels;
d) niche product markets including, eg dredgers, freezer fishing vessels and other similar specialist vessels such as survey ships;
e) one-off designs that are largely restricted to situations where a customised solution is essential.

The companies interviewed did not seem aware of any major new market opportunities; neither did we find any evidence of the companies operating in the newer market areas such as fast ferries, fast freight or large-scale conversion. In addition, the development of high quality design capacity in most shipbuilding countries e.g. Holland, continue to reduce Scottish competitiveness in these countries.

6.4 Ship designers and the local economy

Figure 6.1 overleaf presents a composite case study of a ship design company 'made up' from the company interviews. It is designed to help illustrate the actual and potential interactions between a ship designer and the local economy.

Operating as a consultant, there are limited links and interdependencies with the local economy. For example:

a) beyond its own income, a consultancy's indirect effects on other Scottish companies are limited;
b) beyond the need for a skilled and experienced workforce, it puts few demands on the local environment which, in turn, has only a limited effect on the company's performance. However, the area's image, reputation, history and accessibility do have a positive effect.

In this mode of operation, the company's economic development impacts are limited. Its interdependence on the local economy may also appear limited. However, these companies recognise they would benefit from the existence locally of competitive shipyards and shipping industry.

A Ship Design Company **Figure 6.1**

For large projects, it operates on a consultancy basis. This is low risk but generates relatively limited income and profit. Acting as a contractor, it tenders to build the vessel. If successful, it project manages the construction and fitting out. This requires:

- Subcontract and Supplier Manufacturers. Based on its own equipment designs, this is put out to competitive tender.
    - Much goes to engineering and fabrication companies with little specific marine know-how.
    - Much of the smaller and higher value work is done in England especially North East and South Coast. Generally, Scottish companies are not price competitive.
    - Larger, basic fabrication is more often done in Scotland, however, much e.g., engines, cables can no longer be sourced in Scotland.
    - There is little 'relationship based' subcontracting; projects are simply tendered via the market.
    - Items must be inspected in the plant prior to shipment. Dealing with widespread suppliers generates a very high airfare bill.
    - The cost competitiveness and performance of suppliers is a crucial contributor to their competitiveness and profits.

- A Shipyard. For smaller vessels, it uses UK yards e.g. Appledore in Devon. For larger vessels i.e. over 100 metres, it uses overseas yards.
    - Often the main competitors are the best shipyards. Generally they have their own designers and design capacity.
    - This often excludes the company using the best yards for the ship's construction.

  Acting as a lead contractor enables them to make money from the design of equipment and subsequent maintenance etc. However, their competitiveness depends on the performance of, and their relationship with, many other companies.

To cope with variations in workload, it has a small core design staff and:

- Works with other local designers to broaden its skill base or simply increase capacity, and
- Uses the one-two man bands on a project specific basis.

The range of such 'self-employed' designers locally makes this approach feasible and successful.

However, its and the local designers are ageing. While there are good graduates coming out of Scottish universities, developing their talents is far from easy:

- It is difficult for them to gain the necessary experience.
- The absence of local shipyards (and equipment manufacturing) limits the experience they can readily obtain.

The company devotes considerable time and effort to dealing with this problem. It finds graduate recruitment schemes very useful.

As part of a joint tender, it is easier for the designer to operate if there are other high quality local players. As a contractor, the potential impact on the local economy increases and:

a) it influences where the equipment is manufactured and the vessel built. This produces most of the employment and, in economic terms, value added;
b) local suppliers and yards can only be used if they are efficient and competitive. Using suppliers that are more distant imposes a disadvantage. Consequently, local suppliers can increase the company's competitive advantage;
c) access to manufacturing facilities is essential as customers want to purchase a vessel, not a drawing. Integrated companies i.e. with both design and manufacturing of significant size and resources retain competitive advantage;
d) advantages include a permanent presence in overseas markets and the ability to produce semi-standard vessels. This is not possible for a 'stand alone' design company. It can only compete effectively when one-off designs are required by the customer. Similarly, the larger integrated producers make or purchase equipment from lower cost production systems;
e) as a contractor, its competitiveness depends upon the local economy, and, in turn, a contractor can have a significant indirect effect on other local companies. Not being part of a strong shipbuilding cluster is a clear competitive disadvantage.

One way forward suggested by some of the interviewees is for a Scottish company to front joint bids by a consortium of Scottish companies. The model is the Industrial Power Association's consortia approach but with the aim of making more rapid progress to submitting actual tenders rather than getting 'bogged down' in discussing the model.

6.5 Future prospects

Naval architecture employs few people and as a 'stand alone' industry, there is no evidence it can achieve significant growth in Scotland. In terms of employment and value added (i.e. GDP), the main impact from the Scottish companies is via the production of the ship and the manufacture of its equipment. Design and manufacturing are strongly inter-related and the design companies appear to have limited long-term prospects without such links. In this respect, many of the competitiveness issues facing shipbuilding may also apply to the design component of the industry.

7 Suppliers to North Sea oil

Chapter 2 highlighted that much of Scotland's marine related industry is closely related to supplying the North Sea oil industry. This chapter examines these companies in more detail. At the outset, it should be stressed that we are not interested in the companies producing oil and gas, but rather marine related industries e.g. shipbuilding that serve oil and gas related companies as their market.

7.1 An overview

Scottish Enterprise has a long established interest in the North Sea oil and gas cluster and, more specifically, in ensuring ongoing economic activity in Grampian post-North Sea oil. However, with the exception of some small-scale survey work, we have found no systematic data or analysis of the suppliers to the North Sea[7]. This lack of information reflects one of our main conclusions – namely, that inadequate attention is being devoted to, product or manufacturing based suppliers, as a potential source of new industrial clusters rather than as a small part of the supply chain within the oil and gas cluster.

Nevertheless, it has long been recognised that Scotland has some significant strengths. For example, the Monitor study in 1993 focused attention on two distinct areas:

a) *drilling and downhole contracting* The analysis of D&B data identified a significant number of companies that describe themselves as manufacturers of equipment for oil and gas or mining equipment manufacturers. Many of them currently export;
b) *subsea technology*. The D&B data identified a significant number of companies using this type of terminology in their 'line of business' description. Again, many of them are recorded as being involved in export markets.

Companies in both these areas make products. In contrast, the vast majority of companies identified in the D&B search describe themselves as service providers, contractors, distributors or wholesalers to the oil and gas industry. Few of these are, or could be, involved in exporting as they are dependent upon activity in the North Sea and are unlikely to be the source of post-oil economic development.

In addition, the data search also found a significant number of oil and gas related consultancy companies of various forms. Without more detailed work it is not possible to say how many of these are strictly oil and gas, and how many serve or could serve, wider marine and environmental markets. Nevertheless, it is clear that at least some of them can and do serve international markets and some have wider marine, rather than just oil and gas, expertise.

[7] See, for example, Douglas-Westwood Facing the Future, 1995. (A report prepared for SE on diversification amongst oil and gas suppliers).

7.2 Oil and gas mining equipment

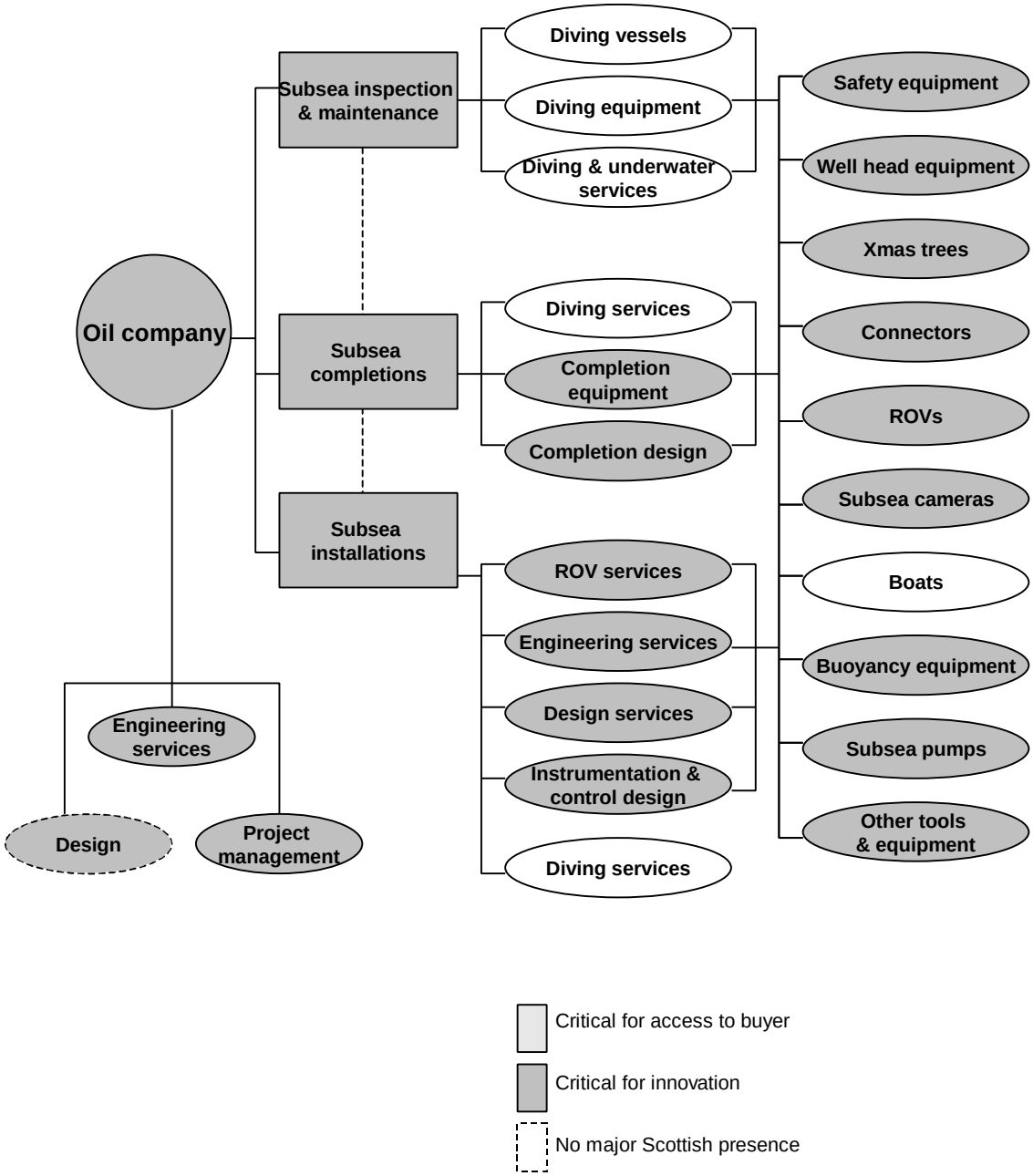
Without a more detailed survey, we do not know what the manufacturers of mining equipment actually make. Much of SE's focus has been on issues relating to the procurement process of the oil companies and the creation of prime contractors for downhole drilling and services. Nor do we know how much 'marine knowledge and technology' is used by these companies i.e. how much their equipment is specific to the recovery of oil and gas as opposed to equipment specifically for the marine environment. We believe these companies should be examined in more detail. In this section, we focus on the subsea area that is, self evidently, marine related.

7.3 Monitor's subsea analysis

As a starting point, Figure 7.1 shows Monitor's cluster map for sub-sea services and installation. It is presented to illustrate the range of industries involved in serving the subsea oil and gas market and to make a number of observations on SE's approach to the subsea sector:

a) the analysis was undertaken specifically from the point of view of the production of oil. The oil companies are seen as *the* market;
b) many of the industries provide services to the oil companies. The main concern was whether or not a Scottish prime contractor could be created and it was concluded this was unlikely to be possible in subsea installation and services;
c) the Scottish subsea strengths in terms of potential prime contractors for the North Sea were assessed as follows:
   - vessel companies e.g. Rockwater, Stena which own vessels from which they can lay and install umbilicals, flow lines etc
   - diving and ROV service companies
   - pipelay companies e.g. BT Marine, which also lay telecom cabling
d) the focus was how innovation could assist the oil and gas industry and support the creation of a Scottish prime contractor, hence:
   - while ROV operators and the production of ROVs contribute to innovation and the performance of oil and gas, there was less interest in how oil and gas drives and enables innovation in ROVs
   - similarly, production of boats is not seen as critical. However, whether or not the oil and gas market could drive innovation in shipbuilding is not considered.

Scottish position in subsea services and installations Figure 7.1



Source: Monitor 1993

The core of the cluster is seen as the oil and gas companies and their immediate suppliers. In fact, many are services and, post-North Sea oil may not have a good reason to remain in Aberdeen.

The variety of manufacturing industries shown in Figure 7.1 for example, safety equipment, well head equipment, ROVs, subsea cameras, boats, subsea pumps are referred to as subcontractors. The Monitor study notes that these subcontractors were not the primary focus of the work and they are not analysed in any depth. It is noted that most of the companies are small, often members of the Subsea Technology Group, and usually 'high tech'.

It is also clear that some are closely tied to oil and gas e.g. well head equipment while others e.g. ROVs, cameras, control equipment could serve a variety of markets.

The important question is whether these manufacturers could, using North Sea oil as a 'demanding customer', evolve into an internationally competitive industrial cluster serving a variety of markets. While there could be other industries that might be the basis of 'post oil' clusters, the production of ROVs emerged as a potential candidate worth further research.

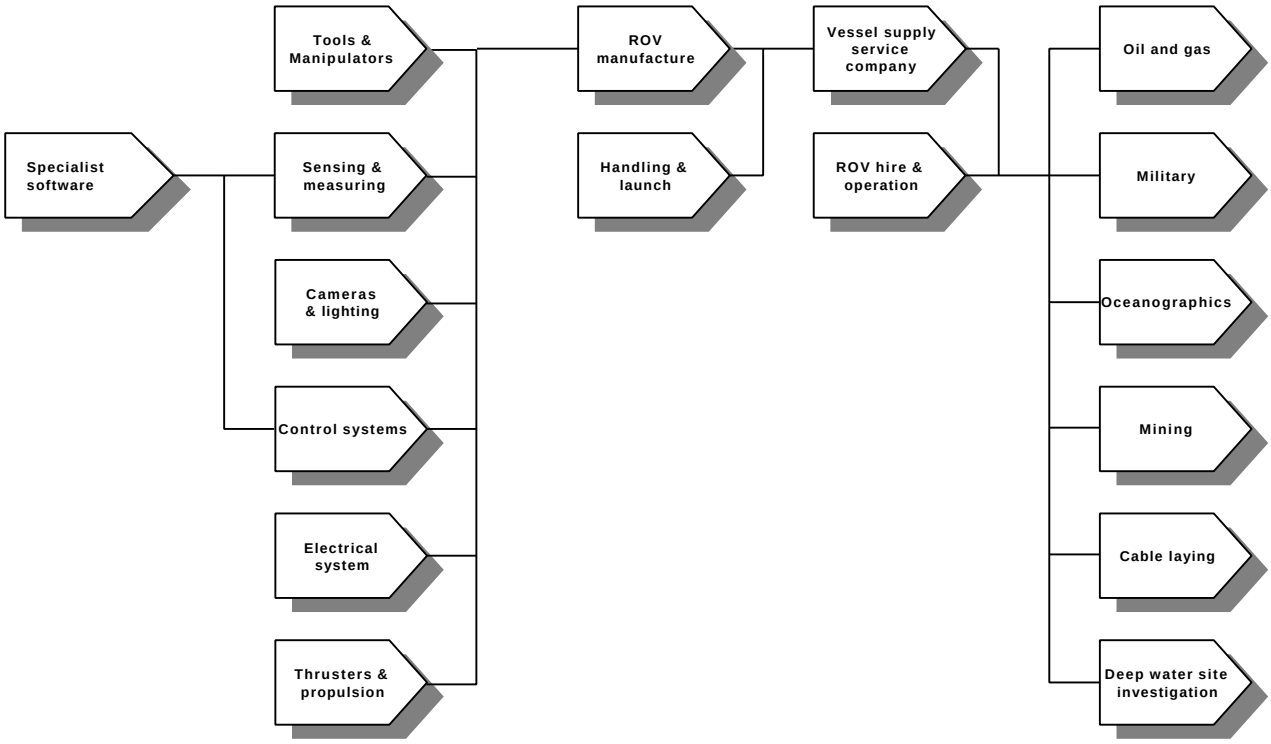
7.4 ROV related industries

We found no published or Scottish Enterprise data on the ROV industry[8], therefore, our comments are based on a limited number of interviews with ROV related companies. These companies did not see themselves as simply part of an energy or oil and gas cluster as they serve a much wider range of markets. They suggested that Scotland has an established presence in the industry with some claiming that nowhere else in the world, not even San Diego, which was the main US centre, has an equivalent concentration of ROV related activity. While the industry developed in Aberdeen to serve the North Sea, it has a wider range of applications in other markets.

As in traditional shipbuilding, much of the value is in what goes into the vessel rather than in the production of the ROV per se. Our interviewees noted that some of this equipment is produced in Scotland and that these companies should be viewed as an industry or cluster in their own right rather than simply as subcontractors in the oil and gas cluster. To illustrate how this differs from the existing approach as reflected in Monitor's cluster map in Figure 7.1 a potential ROV cluster map is shown in Figure 7.2. Essentially the ROV related industries become the core of the cluster rather than on the periphery, and the analysis of competitive advantage i.e. the diamond and cycle of innovation is of ROV production rather than the production of oil and gas.

[8] However, Douglas-Westwood Associates are producing a study of the global ROV market for publication in the near future.

Potential Remotely Operated Vehicles cluster map **Figure 7.2**



Based on the interviews, an analysis of the Miller Freeman Offshore Oil and Gas Directory and D&B data, Scotland has:

a) perhaps six or seven, mainly small, companies producing ROVs. This includes one or two large ROV operators that design and build their own ROVs. The manufacturers include Sub Atlantic Engineering, Hydrovision, Subsea Offshore and Perry Tritech Ltd;
b) several substantial ROV leasers and operators e.g. Ashteed Technology and Oceanscan along with service providers;
c) equipment manufacturers such as Caley Ocean Systems and Norson making handling and launch equipment;
d) companies such as Tritech International (sensors and sonar), Nautromix (positioning equipment), Hydrocable (ROV cables) and All Ocean Engineering (instrumentation). It was suggested to us that there are between 30 and 40 component manufacturers and service providers to ROV manufacturers that serve a variety of other markets.

The industry is relatively small-scale with the companies employing fewer than 1000 people. Globally, there are currently around 450 ‘work class’ ROVs in operation. This represents a 15% increase over the past year with the industry facing ongoing innovation and technical change e.g. the all electric rather than hydraulically powered ROV, deepwater positioning, the Autonomous Underwater Vehicle (AUV).

Not only did interviewees suggest that Scotland has a strong presence in the industry, but it was also noted that operating in isolation would become increasingly difficult for these companies. The benefits of proximity are seen as the ability to innovate and find effective, novel solutions to customers' problems via the flow of information and ideas. This has helped keep them at the leading edge of subsea technology. It also illustrates the potential benefits of a cluster perspective.

7.5 Corporate strategy and rivalry

The ROV operators are generally large, non-Scottish owned companies. The manufacturers include a variety of small indigenous and UK companies. The following points emerged from the interviews:

a) the small size of the indigenous companies limits in-house R&D and makes them relatively vulnerable. Financing R&D remains a problem;
b) there is considerable overseas ownership of the industry. Aberdeen will need to be 'the place to be' for ROVs if these companies are to remain committed to the area in the long-term;
c) there is considerable networking and friendly rivalry;
d) innovation is a key element in corporate strategy. However, while most of the Scottish firms are relatively young, we did not find evidence of significant new firm formation, which might be necessary to build and maintain an innovation based industrial cluster into the post-North Sea era.

The companies are seeking to respond to and exploit a variety of market trends. For example:

a) basic ROVs are becoming a commodity with increased pressure on price, and a need to reduce production costs, e.g. low cost standard ROVs are now being produced in Singapore;
b) there is pressure to assemble them near their area of operation, eg South America;
c) at the same time, other companies' strategies aim, to quote Oceantools Ltd '*to develop a range of cost effective, reliable products designed to replace the obsolete, unreliable equipment which is still prevalent in the ROV industry*';
d) pressure for improved reliability, in part, due to the high cost of surface vessels time from which they operate;
e) the industry has plenty of scope for further innovation and the creation of new sources of competitive advantage.

7.6 Demand

Historically the North Sea has been a main source of demand for ROVs. It was the difficult environment in terms of water depth and rough operating conditions that helped drive innovation. While the North Sea will continue to be an important market, the most demanding oil and gas markets are now newer overseas fields e.g. Gulf of Mexico and Brazil where it is necessary to operate in depths of up to 3000 metres. Nevertheless, the UK ROV operators and leasers remain a potential source of local demand for ongoing survey and maintenance work.

As illustrated in Figure 7.2, ROVs serve a variety of mainly marine markets e.g. cable laying, oceanographics, and defence, but also have applications working in the radiated water-filled fuel ponds of nuclear power stations. There has been an increase in demand for water jetting ROVs to undertake post-lay burial of deepwater cables and some operators have modified their oil and gas ROVs for this purpose. The military is still a significant market, and it has been suggested, there is some convergence between the needs of the military and the oil and gas companies e.g. use of disposable ROVs and ROVs with more sophisticated handing devices. Hence, there are demanding UK markets outwith oil and gas.

7.7 Related and supporting industries

The ROV related industries are part of a wider grouping of companies and industries linked by subsea technology. This should assist the maintenance of critical mass along with the generation and dissemination of knowledge and know-how. As already illustrated, there is, at least a scattering of 'high tech' suppliers. However, it is also true that much of the higher value components and equipment is imported from, for example, Japan (cameras) and the US. In part, the quality and technology of US equipment has been driven by their investment for defence applications.

Our interviewees made no mention of traditional shipbuilding as a related or supporting industry. However, it is notable that Nautromix's dynamic positioning systems have recently been installed in a variety of new survey vessels including a ROV and supply vessel built in Spain for operations in the Gulf of Mexico. Presumably, it would benefit the future of companies such as Nautromix if these state of the art vessels were being built in Scottish shipyards.

7.8 Factor conditions

There is a well developed labour market and knowledge base, but talent is already beginning to drift away. As the technological and development challenges are moving to the Gulf of Mexico and Brazil, so the talent is moving back to Houston which is at the centre of the technology being developed for these fields. Talent is also moving to Norway and Perth Australia.

There is a widespread complaint that the R&D infrastructure is inadequate to support the development of the industry. This is largely being left to the companies which are, however, too small to bear the cost. More specifically, it was suggested:

a) the US industry derives significant benefits from its dual use approach to military technology. There is no equivalent military expenditure or commercial spin off for Scottish companies;
b) the UK focus remains almost exclusively on oil and gas research. This, admittedly, has some spin offs for ROV related industries but does not address their needs explicitly;
c) the universities and organisations such as DERA do little relevant ROV research.

Given that competitiveness derives largely from innovation, these problems, if true, represent a serious weakness and threat to the industry's long-term development. It should be noted that some of the larger companies have used academic research including both the traditional naval architecture departments and the newer petroleum related engineering departments. Professor Mike Cowley's review of Scottish academic marine related research highlights the following examples:

a) underwater instrumentation, simulation and buoyancy control for underwater vehicles at Glasgow University;
b) underwater robotics and hybrid ROV and AUV research at Heriot-Watt;
c) ROV design (drag minimisation), sonar based subsea navigation and the support ship and sea interface at Strathclyde University (Naval Architecture).

A seminar bringing together the key players would help identify what research and development is being undertaken, and what research could be usefully commissioned to develop the Scottish industry. This work could tap into EU funding packages.

7.9 Governance

The companies are not part of the traditional trade associations such as the Marine Equipment Manufacturers Association. While some are members of the Subsea Technology Group, this is a marketing organisation, and it is not concerned with the overall development of ROV related industries. Apart from informal networks, there is no system of governance for the industry.

7.10 The development process

An important component in successful economic development is the process through which new industrial clusters grow out of existing clusters. This is a means of diversification and innovation building on and using existing assets. In the context of suppliers to North Sea oil, the aim could be the development of new industrial clusters e.g. an ROV or oil and gas equipment cluster serving a variety of international markets. This would be a legitimate policy objective within any cluster strategy. Given the resource base and finite nature of the Scottish oil and gas cluster, this becomes an even more important policy option.

It is clear that some North Sea oil suppliers could diversify into, and indeed some serve, non-marine markets. However, we would concur with the conclusion of Douglas-Westwood's 1995 'Facing the Future' study that marine related markets offer the main diversification opportunities. Broadly, two approaches can be used to assist diversification into non-oil and gas markets:

a) company specific programmes supporting, for example, the development of diversification strategies, export assistance etc;
b) an industry or sub-cluster focus aiming to create the conditions in which new industries can emerge and establish competitive advantage.

Currently there is some limited activity within the first option. However, we believe the second option represents a more comprehensive approach to long-term development, the creation of new industries and competitive advantage at a Scottish level.

A review of existing Scottish Enterprise Network policy in this field was not within our remit. However, our understanding is that:

a) the focus of the Energy Team remains the production of oil and gas e.g. initiatives which will extend the life of North Sea;
b) for the longer-term, the aim is to ensure that Aberdeen remains a centre of the oil industry;
c) as part of this aim, considerable efforts are being made to assist Scottish companies enter overseas oil and gas markets;
d) some limited efforts via business development assistance are being made to help individual companies diversify into non-oil markets;
e) no systematic efforts are being made to enable new industries to emerge out of the oil and gas cluster.

In the longer-term, the development of such clusters is a potential means of ensuring sustainable economic activity post-North Sea oil. This is not an alternative objective to maintaining Aberdeen as a centre of the oil industry; it is complementary. A successful ROV cluster would help maintain Aberdeen as an oil centre, which would help maintain a successful ROV cluster. However, these are different strategies and require different initiatives.

Currently, several of the ROV companies are members of the Scottish Subsea Technology Group (SSTG). However:

a) a future ROV related cluster involves more than subsea technology and SSTG's members. It could include companies such as Caley Ocean Systems Ltd as designers of the launch and recovery systems, and elements of the Scottish shipbuilding industry;
b) it requires a focus on all elements of the diamond e.g. developing and aligning the science base to respond to 'local' demand rather than simply joint marketing initiatives.

Several interviewees made the point strongly that mechanisms outwith the energy and oil and gas team are needed to enable this focus on the development of new industrial clusters. Understandably, the energy team know most about, and focus on the energy cluster. However, a different focus is required to develop new industries as an 'ROV centred' view of the world is quite different from one that is 'oil and gas centred'

7.11 Policy implications

Consideration should be given to the following:

a) a more detailed review of the suppliers to North Sea oil to identify potential or embryonic future industrial clusters. Specific attention should be given to the oil and gas equipment manufacturers and the consultancies;
b) a more detailed analysis of the ROV related companies to confirm their potential to develop into a significant future industrial cluster;
c) establishment of a SE Network resource to take forward strategies to assist the process of diversification and the development of non-oil and gas clusters from North Sea Oil suppliers.

While we believe that mechanisms outwith the energy team are required to provide the necessary 'non-oil and gas focus', a close working relationship with the energy team would be essential. The North Sea is, and will remain, a major market for any emerging clusters. Furthermore, it should be understood that these suggestions complement, not replace, attempts to ensure that Aberdeen remains a centre of the oil industry post-North Sea.

8 Issues and Strategic Options

In this final chapter, we set out a summary of the key issues and options arising from this project. These include some recommendations for further development work and others where more immediate action would be appropriate.

It is structured:

1. Overview and the concept of a Scottish cluster
2. A strategic perspective – what objectives?
3. Oil and gas suppliers – new impacts
4. ROVs and decommissioning – emerging sub-clusters
5. Shipbuilding, repair and conversion

8.1 Overview and the concept of a Scottish cluster

Scotland has a significant presence in a number of industries that are related to the sea. These include:

a) suppliers to oil and gas;
b) fishing;
c) fish farming;
d) shipbuilding and ship repair;
e) a limited presence in marine equipment supplies;
f) water related construction, civil and environmental engineering (but largely for oil and gas).

Scotland also has a presence in shipping and ship management related services, but these have only limited connections to Scotland's other marine industries.

In addressing the question of whether Scottish Enterprise should use a cluster approach to these industries. We conclude that it should not:

a) there was a shipbuilding and marine engineering cluster centred around the Clyde when it was at its peak. What remains are fragments of that cluster that have survived for reasons including:
   - individually well managed businesses
   - specialisation in product or service areas
   - development of markets largely outwith Scotland
   - greater focus on non-marine parts of their product range
   - focus on UK defence customers
   - focus on UK offshore oil and gas
b) there are significant parts of the cluster in which Scotland no longer has either companies or capacity e.g. very large ship construction, marine engine manufacture;

c) related activities such as fishing and aquaculture are subject to competitive forces e.g. EU Fishery Protection and Vessel Decommissioning, that are significantly more potent than any contribution excellence in Scottish marine engineering could counter;
d) the underpinning strengths in technologies, research and higher education are no longer driven by local demand. They work for, and supply skilled people to, marine industries largely outwith Scotland.

It is our view that 'survivor' organisations have done so by being:

a) innovative – developing new products, skills and services;
b) proactive – moving before the general decline in the UK industry;
c) outward looking – addressing markets on a global basis, getting on aircraft and selling what customers want.

None of these characteristics have been driven specifically by other parts of the Scottish cluster, hence inter-dependence and trading between these businesses has been in a long process of decline. In summary, smart businesses have survived by avoiding exclusive dependence on the Scottish industry. Therefore, it is not surprising that local linkages that might drive cluster competitiveness are now very weak.

8.2 A strategic perspective – sub-clusters?

While there is not a single coherent cluster, at a macro level Scotland has:

a) several industry groupings e.g. shipbuilding, ship repair, ROVs aquaculture etc. We shall refer to these as 'sub-clusters';
b) marine related science, technology and know-how that, to a greater or lesser extent, cross-cut and underpin these industries.

There could be some useful knowledge transfer between the sub-clusters that contributes value and competitiveness. However, marine science and technology is only one input and competitive success may require inputs from completely unrelated clusters. For example, aquaculture systems would benefit from marine engineering inputs; however, competitiveness may be better improved by fish disease control science.

At a strategic level an 'ideal' future objective might be a virtuous cycle of:

a) Scotland is able to develop or accelerate several marine related sub-clusters;
b) sub-cluster competitiveness is enhanced by development of critical parts of the underpinning science and technologies;
c) competitive sub-clusters create critical mass that starts to drive the underpinning technologies;
d) these technologies spin out new commercial opportunities as well as improving existing company competitiveness.

However, the prospects for Scotland's marine sub-clusters are challenging and action is required if they are to have a long term and internationally competitive future. We therefore recommend focusing on a number of these sub-clusters and on building networking initiatives within the marine science and technology base that would enable them to better tackle sub-cluster competitiveness.

8.3 Oil and gas suppliers – new impacts

Suppliers to the oil and gas industry are significantly the most important source of marine related companies. The key issues for this industry are set out below:

a) How many of these companies can diversify into non-oil and gas marine related markets?
   - many cannot and much of the current employment will not survive the 'end of North Sea' because significant elements of it are in day to day monitoring, maintenance and service. A more detailed analysis (if not already known to SE via the Energy Team) of the oil and gas suppliers is required;

b) Can new industries or sub-clusters emerge from these suppliers, possibly by combining them with assets in other parts of the Scottish economy? Some of these options relate to the work of the Scottish Subsea Technology Group and possibilities worth exploring include:
   - an ROV related sub-cluster i.e. including underwater navigation, control systems, sonar, sensing equipment, disposables, and handling and tooling etc;
   - decommissioning as a 'demanding customer' that will drive innovation and develop new industries. This could possibly be linked to an environmental industries focus;
   - environmental industries cluster drawing on both oil & gas and other inputs of the Scottish economy;

c) What approaches are currently being taken to diversification:
   - internationally into other oil and & gas markets;
   - into new markets. If so, should this be approached as individual company development work or is there an approach to possible sub-cluster developments?

   If the second approach is relevant, does it need to be 'distanced' from oil and gas work and viewed as a different strategic objective? For example, what will Scotland have needed to have done within the next 12 months to still be a global leader in the design and construction of ROVs 10 years from now?

8.4 ROVs and decommissioning – emerging sub-clusters

The following points are important in taking the approach of 'kick starting' sub-cluster development around ROVs and decommissioning:

a) research is required to establish more detailed information on, for example, the Scottish industry strengths, markets, technology challenges, potential Scottish players etc. What involvement might Scotland's dredger designers have or what benefits could DERA's advanced materials and deep water testing expertise bring?
b) public funding support for industry research consortia including company study tours etc For example, innovation could be further stimulated by a challenge fund for alternative approaches to decommissioning that recognises this as a growing global marketplace. Could Scottish university engineering and environmental strengths be combined with DERA's underwater explosives technologies in ways that create new advantage?

It is essential to consider these areas as potential core elements of a 'future' sub-cluster rather than as suppliers in the present oil and gas cluster. A different perspective requires different strategies and organisational structures. For example, a 'ROV-centric' view of the world market potential to *add value* is likely to be very different from an 'oil and gas centric' view of how to make their ROV suppliers *reduce cost*.

We note that the window of opportunity for this is limited as the demand for innovation in the North Sea declines and the shift back to companies in Houston serving the Gulf of Mexico accelerates.

8.5 Shipbuilding, ship repair and ship conversion

While employment is still significant, Scottish shipbuilding is not internationally competitive and represents the 'remnants' of an old cluster that still has some beneficial cluster characteristics. Outwith the protected defence market it faces a difficult future without significant change and development. Technically complex ships will continue to be built in Europe; the challenge is to have a competitive capability in Scotland.

Scotland has relatively strong capabilities in ship design and some related consultancy. However, it is small-scale with its long-term development being highly influenced by its position, or lack of one, within a shipbuilding cluster. A focus on this industry in isolation may help develop those individual businesses but it is unlikely to generate long-term economic development.

The process of revival e.g. through innovation or diversification into new growth markets is a major challenge and there are only a few companies big enough to resource such ambitions.

Small-scale and shorter term initiatives such as training development or increased marketing profile may be less effective and could be a questionable use of resources if they do not change some of the underpinning barriers to competitiveness, for example, a willingness to work together. The key question lies in defining the underpinning market failures – are they in the market or in companies – and which are on the critical path for the development of sustainable competitiveness?

8.5.1 Defining 'the possible' – what is the vision for the Scottish industry?

Change is needed and a clear, shared long-term vision of 'the possible' is an essential part of that change process. Different thinking will be the trigger to different action. In the course of this work, we have found limited evidence of 'the possible' thinking within Scottish shipbuilding anda key objective must be to facilitate its creation. This process should:

a) Create space and time for some serious, long term thinking, that is, beyond the next order – industry pressures and culture do not tend to encourage such discussions. The public sector should recognise this as a critical market failure and address it by facilitating this process.
b) Use scenario planning and visioning processes to facilitate the industry generate options for its 'possible' over a ten year horizon – the question *"what could a successful Scottish industry look like in 10 years time?"* followed by *'what do we need to start doing today to make that happen?.* These techniques get people 'out of their box' and thinking about an industry that could have a good future as well as a long past. Creating views that extend beyond "survive" would start to outline a destination from which the industry could begin to draw a map forward.
c) Establish industry ownership and leadership in ways that foster the ambition and innovation that exists within some Scottish companies. The public sector role in this is to facilitate and contribute; it cannot and should not lead this process.
d) Facilitate challenging conversation that demands new ideas from those involved. The process of industry survival has had many managers looking outwards; as a result, their awareness of the current experience, expertise and capacities in Scotland is limited. Superficially, this is a communications problem; more fundamentally, it is an industry-wide knowledge management issue. Competing at the margins may be difficult because the prime contractors were unaware of, or unable to engage, potentially competitive Scottish assets in creating a winning bid.

It is our view, and we have tested this with some interviewees, that this is a realistic and essential next step for this work. It would be easy to recommend that the public sector develop an agenda for this e.g. "*we will create a joint marketing company for you....*". It is our view that this would be counterproductive; 'the possible' future agenda must be defined by the industry as evidence of its own desire to survive and compete. The public sector role is to facilitate this process to:

a) make it happen;
b) ensure that long term view is taken and there is no drift back to today's agenda;
c) offer radical 'starter' ideas from which the industry can add, subtract and modify thinking e.g. The Clyde Consortium;
d) sharing facilities and using spare capacity;
e) capture and respond to immediate needs identified in e.g. market or technical research;
f) give support to an industry-chaired and owned discussion process.

8.5.2 Talking, listening and learning

The interview programme indicated strongly that there are not effective networks through which a way forward could be generated and implemented. We recommend that some facilitated discussions of key senior people be convened to explore specific possibilities, for example:

a) getting into fast freight or fast ferries;
b) the possibility of joint bids, or a Scottish consortia company modelled on the discussion within the Industrial Power Association, for ship repair and conversion.

The interviews also indicated a limited amount of personal experience of senior Scottish managers working in or visiting overseas shipyards. As a result, their exposure to current good practice and emerging ideas has been limited. Combined with the highly favourable comments on the Dutch benchmarking visit, this highlights the potentially valuable activity of learning tour or benchmarking studies.

Suggestions offered by interviewees include:

a) broadening exposure to the Dutch experience;
b) German ship building and repair;
c) how the Italian ship building cluster, based around large liner construction yard, operates.

8.5.3 Babcock, Rosyth – a strategic opportunity?

As noted previously, Babcock at Rosyth may offer a unique opportunity for new and additional development of the industry in Scotland. Whilst this may conventionally be seen as a single company business development activity, we recommend that it should be considered as a potential strategic development opportunity for the Scottish industry with the objective of benefits in:

a) accelerating the transformation of a large organisation that believes it has long term potential for competitiveness in future markets;
b) offering important potential impacts to the local (Scottish) supply chain in materials, services and people;
c) offering leadership as an exemplar of an 'old economy' organisation succeeding in the 'new economy'.

8.5.4 Concluding comment

In a knowledge based economy customers will continue to want marine products and services. The key task for the Scottish industry is to enhance and apply its 'know-how' in the areas where it makes that knowledge a competitive advantage. *Competitive performance starts with competitive thinking* – that must be the next step.

Appendix 1

Industry and LEC interviews contact list

Marine industries association and research institutes contact list

Association/Research Institution	Contact	Area of Expertise
Association of Marine Equipment Manufacturers	Trevor Owen	Trade Association
British Trade International	Andrew Munford	Industry Overview
DTI	Chris Feint	Shipbuilding & repair unit
Glasgow City Council	Fergus Cooper	Shipbuilding
Glasgow Nautical College	Ian Lennox	Marine Engineering Training
Glasgow University	Professor Nigel Batrup	Contract research shipbuilding, repair, manager
Glasgow University Marine Technology Centre	Professor Mike Cowling	Marine technologies
Industrial Power Association	Arthur Francis	Trade Association
Institute of Marine Engineers (IME)	General discussion	Education & Training Accreditation
Royal Institute of Naval Architects (RINA)	General discussion	Trade Association
Ship Builders and Ship Repairers Association	General discussion	Trade Association
Southampton University	Jonathan Williams	Marine Technology & Cluster Development
Strathclyde University	Professor Chengi Kuo	Naval Architecture & Ocean Engineering
Scottish Subsea Technology Group	Jimmy Hare	Trade Association

Marine industries organisations contact list

Organisation	Contact	Area of Expertise
Ailsa Troon	Alistair Bisset	Shipbuilders & repairs
Babcock	Willie Stewart	Ship repair - MOD primarily
BAE Systems	Sam Cameron (Govan) Ian Murray (Scotstoun)	Shipbuilding
Bowtech	Stephen Bowring	ROV components
Caley Ocean Systems	David Cooper	ROV launch systems
Craig Group	John Allan	Ship repair
Denholm Ship Management	Hamish Cubit	Ship management
DERA	Martin Moody	R&D, marine technologies
DHE Ltd	Alan Dundas	Ship design
DSND	Stuart Risk Hugh Williams	ROV, operators, users and design
Douglas-Westwood Ltd	John Westwood	Consultants
Howden Group	Ross Wilson	Pumps & compressors
Hydrovision	Chris Tarmey	ROV components
IMT Marine Consultants	Neil Paterson	Marine consultants
Lithgows Ltd	Hugh Currie	Aqua Centre
Marine Design Consultants	David Hunter	Ship design
Seadrec	Mr McVicar	Dredger design
Semple Cochrane	David McGinley	Ship repair
Subsea Engineering	Dick Martin	ROV operators, design and build
Scottish Enterprise	Stewart Brown	ex-member DTI Foresight
Scottish Enterprise	Hamish Dingwall	SE oil and gas team

Scottish Enterprise Network contact list

Scottish Enterprise Network	Contact
Ayrshire	Jim Kenny
Borders	Sandy Watson
Dunbartonshire	Alan Mungall
Fife	Morag Miller
Forth Valley	Christine Esson Jonathan Drew
Glasgow	Stuart Patrick
Grampian	Tony Aldous Karen Tolmie
Highlands and Islands	Ian Sutherland Archie McGreevey
Lanarkshire	Steve Clifford
Lothians and Edinburgh	David Gass
Renfrewshire	Kevin Johnston Linda Robb Alistair McGhee
Tayside	Andy Burrows Gordon Langlands

Appendix 2

Potential products and services

Marine Engineering Related Search Criteria

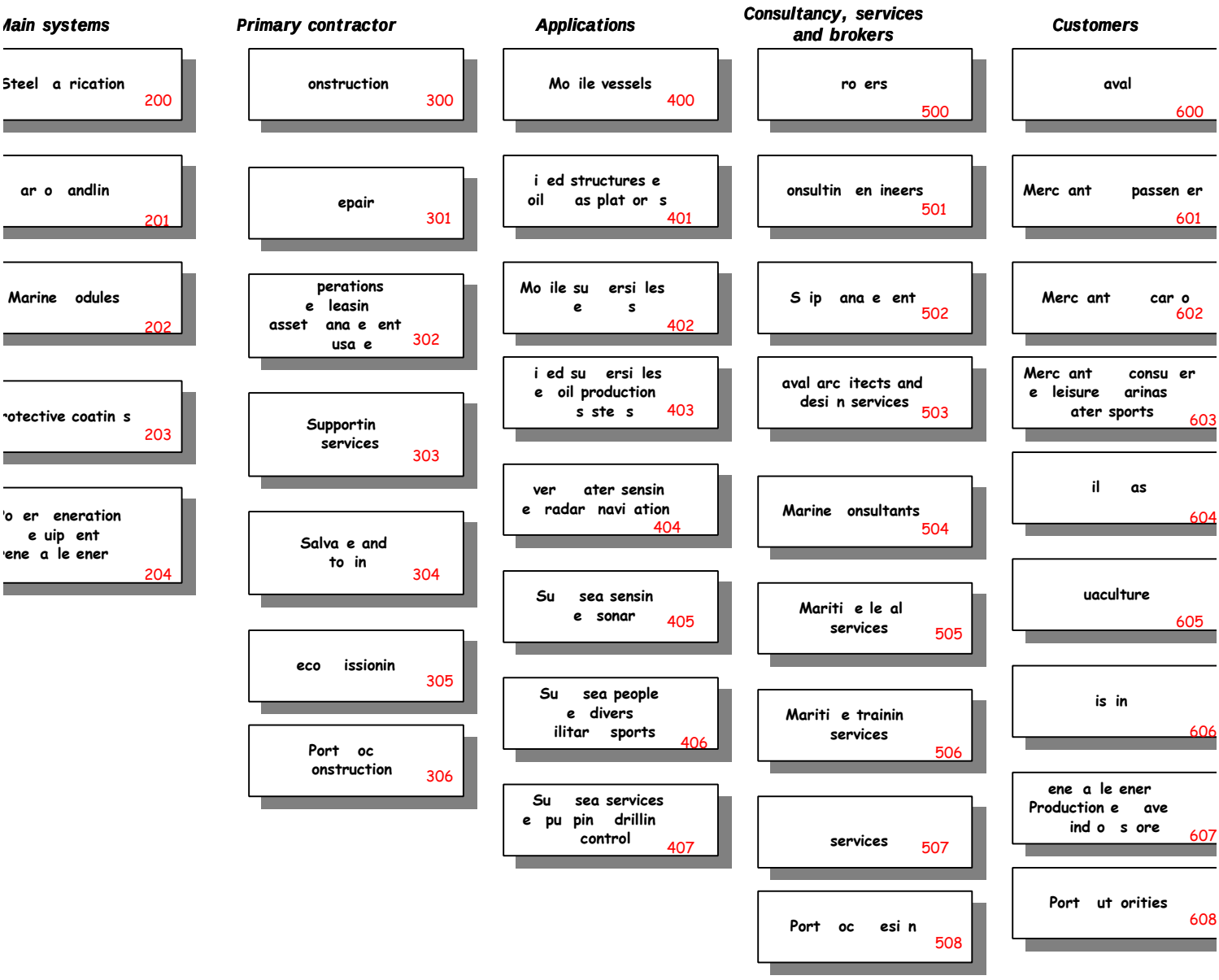
The following list is a potential search criteria that could be used within the marine engineering sector:

- Cargo – superintendents
- Cargo – surveyors
- Custom clearance
- Diving
- Dredging
- Freight operators
- Freight forwarders
- Lighterage services
- Maritime lawyers
- Naval architects
- Port agents
- Ship building
- Ship design
- Ship management
- Ship operators
- Ship repairs
- Ship stores
- Ships' chandlers
- Ship brokers
- Ship owners
- Ship agents
- Towage and salvage
- Underwater pipelines
- Underwater cables
- Submersible manufacturers
- Sub-sea engineers
- Underwater robotics
- Offshore site investigators
- Propeller manufacturers
- Marine engineers
- Shipping companies and agents
- Ship painting and cleaning
- Ship towing
- Boat builders
- Boat repairers
- Propeller manufacturers
- Navigation equipment
- Amphibious motors
- Pumps and compressors
- Manufacture of ship engines
- Compressor manufacturers
- Marine control panel manufacturers
- Marine engines
- Marine electrics
- Marine electronics
- Pump manufacturers
- Marine engineering consultants
- Sub-sea/underwater engineering consultants
- Design engineering
- Propulsion systems
- ROV manufactures
- Sub-sea construction
- Sub-sea control systems
- Sub-sea design engineers
- Sub-sea dredging
- Sub-sea engineering consultants
- Sub-sea engineering
- Sub-sea engineering contractors
- Sub-sea equipment maintenance contractors
- Sub-sea inspection services
- Sub-sea protection
- Sub-sea production systems
- Sub-sea work over control systems
- Sub-sea pipeline protection systems
- Pipeline stabilising systems
- Pipeline maintenance and repair services
- Marine fabrication
- Sub-sea structures fabrication
- Remotely operated vehicles – ROV manufacturers and operators

Appendix 3

Possible marine industries and services map

tential Marine Industries and Services Map



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Appendix 4

Members of Marine Equipment Association

Members of the Marine Equipment Association

Scotland

Balmoral Group:	Supply and manufacture of a wide range of products for both oil/gas and ships e.g. anchors, chains, buoys, moorings, lifeboats, ROV packs etc
Brown Brothers:	Ship stabilisers, steering systems, high pressure fluid swivels etc for defence, commercial, maritime and oil/gas.
Gael Force Marine:	Moorings, anchors etc, fishing boat and fish farm equipment.
Hall Thermotank Ltd	Design and installation of refrigeration and air supply systems.
MacTaggart and Scott:	Electronically controlled, hydraulically powered handling systems.
Outreach Plc.	Hydraulic marine cranes.
Thomas Gunn Navigation Services:	Supply of navigation charts and an overall supplies sourcing service.
Young & Cunningham Ltd:	Valve manufacturers.

South Coast

BAE Defence Systems:	Prime contractor for design and construction of naval defence systems.
Corrintec Ltd:	Design, manufacture, installation of cathedic protection systems.
DERA Centre for Marine Technology:	Consulting and research services for vessels/platforms, ship electrical systems, marine electronic operations and safety.
FBM Marine:	High speed ferries.
GEC Marconi Ltd:	Design, manufacture and support of naval vessels.
Giro Engineering Ltd:	Design/manufacture of sheathed fuel injection systems and associated alarm systems.
Hamworthy KSE Group:	Dry cargo handling equipment (e.g. ramps, Re-Ro doors), liquid cargo handling (e.g. pumps, compressors etc).
John Crane Marine International:	Manufacture of marine hull and pump seals, cabling, handling equipment etc
Kempsafe Ltd:	Manufacture of navigation equipment.
Marine Data Ltd:	Manufacture of navigation equipment.
Oil Spill Response Ltd	Oil emergency clean up services.
Strainstall Engineering Ltd:	Structural stress analysis and monitoring.
Thompson Valves Ltd:	Valve manufacturer.
Thompson Marconi Sonar Ltd:	Sonar equipment.
Vosper Thornycroft Contracts Ltd:	Electrical control and monitoring systems.
Widney Aish Ltd:	Mechanised and electronic equipment for defence system protection.
Alstrem Engines Ltd:	Manufacture of high speed diesel engines etc
Caird & Raynor Clark:	Manufacture of desalination equipment.
G. L. Communications Int. Ltd:	Manufacture of marine loudspeakers.
Kamewa Ltd	Ship positioning systems, propellers, winches, waterjets, tunnel thrusters.
Kelvin Hughes Ltd:	Manufacture of marine navigation equipment.