A NEW ANALYSIS OF MARINE-RELATED ACTIVITIES IN THE UK ECONOMY WITH SUPPORTING SCIENCE AND TECHNOLOGY

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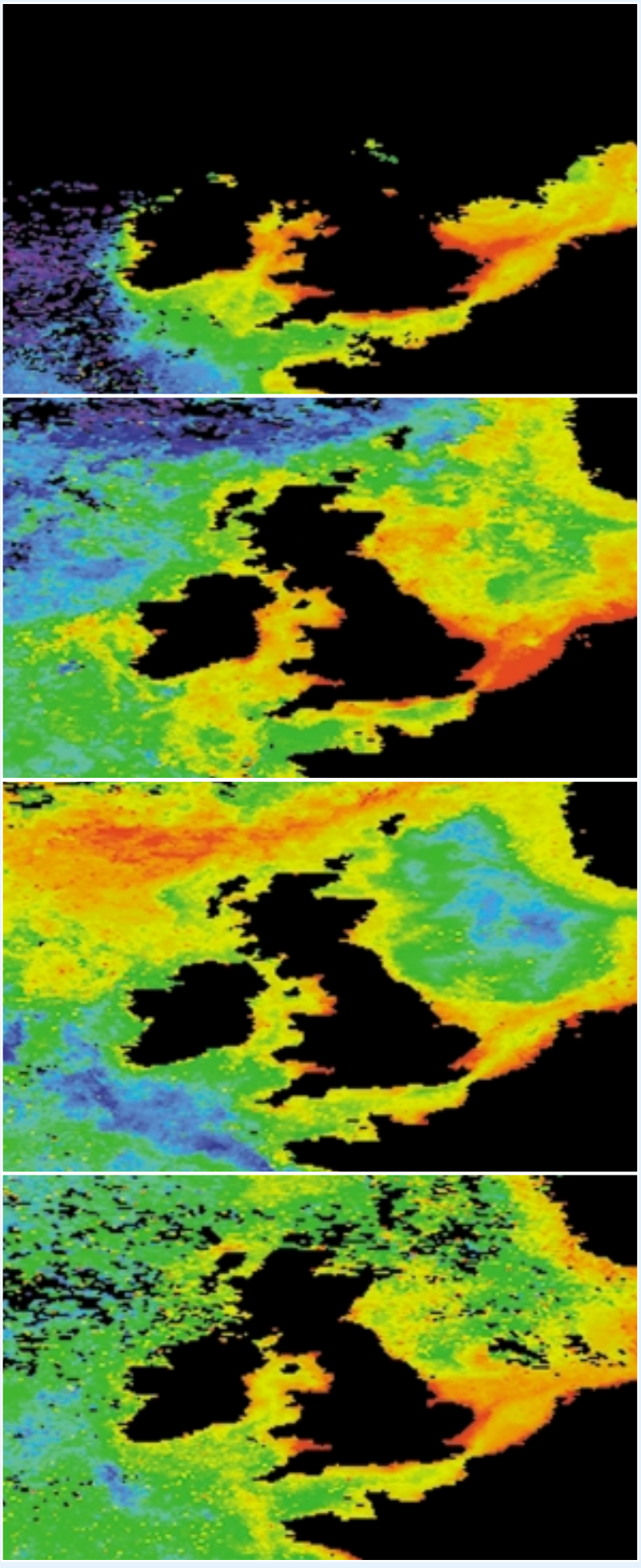


PML/NASA

Summary

In this survey we have updated the results of our earlier analysis on the contribution of marine-related activities to the UK economy. For 1999-2000, the contribution is estimated at £39bn, or 4.9% of GDP. In 1994-95 the estimated contribution was £27.8bn, 4.8% of GDP. Excluding tourism the 1999-2000 figure is 3.4%. The overall conclusion is a confirmation of the importance of marine activities to the UK economy.

We have used the same techniques and categories of marine-related activity as in the previous survey. For some sectors which are officially reflected in National Statistics, it is possible to identify trends. Generally, between the two surveys, the changes in the total contribution to GDP are probably due to different measures of assessment in some of the less well-defined sectors.

Because this assessment is intended to be an interim update, perhaps in anticipation of a full revision after ten years, we have not fully revisited some of the smaller sectors. Nor have we repeated the survey of industry research priorities and expectations which was included in the 1994-95 survey. We have, however, repeated the survey of university departments, many of which have undergone substantial changes in the interim period.

INTRODUCTION

The United Kingdom is a maritime nation. For many years skills in navigation and seamanship have made an important contribution to the prosperity of the economy of the islands. Today, marine transport is the dominant method for importing and exporting goods; sea fish are a major food source; offshore oil and gas are the principal source of energy; and marine activities are also important for the implementation of our defence policies. Increased leisure means that the use of our coast and coastal seas for recreational activities will continue to expand and inevitably lead to conflicts of interests with other uses of coastal waters such as waste disposal.

On larger space and longer time scales, the United Kingdom's climate, unusually temperate for these latitudes, depends on patterns of ocean circulation. Understanding these patterns will help forecast any possible climate change and anticipate the consequences. The shipping and marine insurance sectors also generate substantial invisible earnings. They have developed from our long sea-going traditions, and can gain international competitive advantage by exploiting the research and development knowledge base, which United Kingdom scientists and technologists are actively increasing.

The Inter-Agency Committee on Marine Science and Technology is a Government Committee which reports to the Government Chief Scientific Adviser in the Office of Science and Technology. Its responsibilities include maintaining an overview of UK marine science and technology in both the public and private sectors. It seeks to ensure that there are arrangements to exploit these activities to enhance wealth creation within the United Kingdom economy, and to improve the quality of life of its citizens.

In support of these IACMST responsibilities, this publication estimates the levels of marine-related activities within the UK economy and compares them with the related levels of research and development activity. Its primary purpose is to provide a context in which to place research, and research funding priorities. The results will also be of wider interest to all those who have a personal or professional interest in the waters which surround our islands.

2
MARINE-RELATED ACTIVITIES IN THE UK ECONOMY

2.1 Introduction

In official statistics the statistics of marine economic activities are generally difficult to separate from other activities. For some sectors such as Shipping, Fisheries, Harbour Construction, and Oil and Gas, information is available from the official statistics within the structure of the Standard Industrial Classification of Economic Activities 1992. For other sectors such as Invisibles, Environmental Protection, Manufacturing, and Leisure and Recreation, the sources of information are much less clearly defined. As in 1994-95 we have taken opportunity of recent one-off analyses in these various less well-defined sectors. The basis and results of these sector analyses are not necessarily the same as previously, so that strict comparisons in terms of trends are not always possible. We have retained the same categories of sectors as in 1994-95, although there could be some merit in a separate review of these in any future exercise.

Scope of Survey

As previously, in choosing which activities are to be included as marine-related, we have maintained the narrow definition used in the earlier economic survey. We include those activities which involve working on or in the sea. Also 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. For example, in the case of the fisheries and the oil and gas sectors, only the landed value and the costs of initial processing are included. In detailed discussions of the individual sectors, some indication is given of the wider economic implications. Our restricted definition is based on the understanding that the figures produced are minimum estimates of the economic importance of marine resources and activities.

Data Sources

Wherever possible we have used official Government statistics and structured our analysis in the terms of the Standard Industrial Classification of Economic Activities (1992).

In many cases it has been necessary to estimate the level of economic activity in a sector by direct approaches, for example, by accessing company annual reports, surveys by Associations, sector market analyses and consultations with knowledgeable individuals. Data sources from the Internet are now much more readily available than at the time of our previous survey and we have been able to use these extensively. However, compared to the previous survey it was noticeable that many of the official statistics had been delayed because of Government restructuring following the 2001 General Election. We have also benefited from the recent publication for the Government Foresight Marine Panel, "UK Marine Industries World Export Market Potential" by Douglas-Westwood Associates (Reference 1).

Our first target has been to estimate the value of the total turnover in a sector. The target year for the survey was April 1999 to March 2000. In some cases the calendar year 1999 has been used instead and in a few cases data from an earlier year was the latest available. Also, in some cases, where data after 1999-2000 is readily available we have included this as additional information.

Gross Domestic Product

A sector's contribution to GDP is its net output, that is, the value of its gross output (turnover) less any goods or services it has acquired from other industries or has imported. For example, the value of the gross output of the ship building industry includes the value of the steel bought from the steel industry and also the value of services provided by insurance, advertising and so on. A large proportion of the turnover is spent purchasing component parts that are themselves manufactured in another sector. If the two sector turnovers are added, there will be double counting, which will inflate the apparent value of the final product to GDP. There are three standard approaches to estimating GDP, measurements of expenditure, of incomes, or of the total value of output of goods and services in the economy. For our purposes, the adopted method of estimating the contribution of the marine sector to GDP has been based on the measurement of output values from each activity, where the total output is then reduced by a value-added factor which varies between zero and one (Reference 2).

Within this range, value added factors vary from the highest values in the service sector where wages and profits are the principal components of the turnover, to very low values in some areas of manufacturing and retailing where a product is purchased, marginally improved and sold on at a profit. A summary of the principal economic sectors within SIC (92), together with their percentage contributions to GDP is shown in **Table 2.1**. This table is based on the input-output tables for 1999 (Reference 3).

Table 2.1
Principal sectors of the economy and marine elements

	SIC(92)	SECTOR	MAIN MARINE	% of gdp	value added factor
1	0-0.5	Agriculture	Fisheries	1.1	0.45
2	10-14.5	Mining and quarrying Aggregates	Oil and gas	2.1	0.66
3	15-37	Manufacturing	Ships Leisure craft Instruments	18.5	0.38
4	40-41	Electricity, gas and water		1.9	0.34
5	45	Construction	Sea defences Crossings Rigs and pipes	5.0	0.38
6	50-55	Wholesale and retail		15.2	0.53
7	60-64	Transport and communication	Freight passengers cables	8.0	0.46
8	65-74	Financial, business services	Insurance Research	26.7	0.56
9	75	Public administration	Navy policy safety	4.8	0.54
10	80-85	Education, health...	Universities Research Labs	11.8	0.51
11	90-99	Other services	Sewage disposal Marinas	4.8	0.53

gdp contribution and estimated **value added factors** for 1999
sources from the Office of National Statistics

2.2 Sector Analysis

Oil and Gas (SIC (92): 11.00)

This remains the most important of all the UK marine-related economic activities. The contribution to the UK economy varies substantially, as oil prices fluctuate, even though production and employment levels remain relatively stable. Oil prices hit a fifty-year low in real terms in December 1998. At the beginning of 1999, low prices were causing great concern to the industry. During 1999 oil prices improved, and production levels for both oil and gas were at record levels. Details are given in the 'Brown Book' (Reference 4); in 1999 (Appendix 7), proceedings from the sale of oil and natural gas liquid produced from the UK Continental Shelf are estimated at £10.95bn. Adding gas sales, which generated £ 5.10bn, makes an oil and gas sales total of £16.05bn, compared with £13.3bn in 1994.

Because the statistics are now presented in terms of Gross Value Added, and because Exploration and Appraisal revenues are handled in a different way, exactly comparable figures are difficult to obtain. The 1999 total sector output at basic prices (**Table 2.3**, Reference 3) is £20.60bn. This includes revenues from pipelines and terminals, and revenues from Exploration and Appraisal licensees (the 1994 comparable figure is £15.9bn).

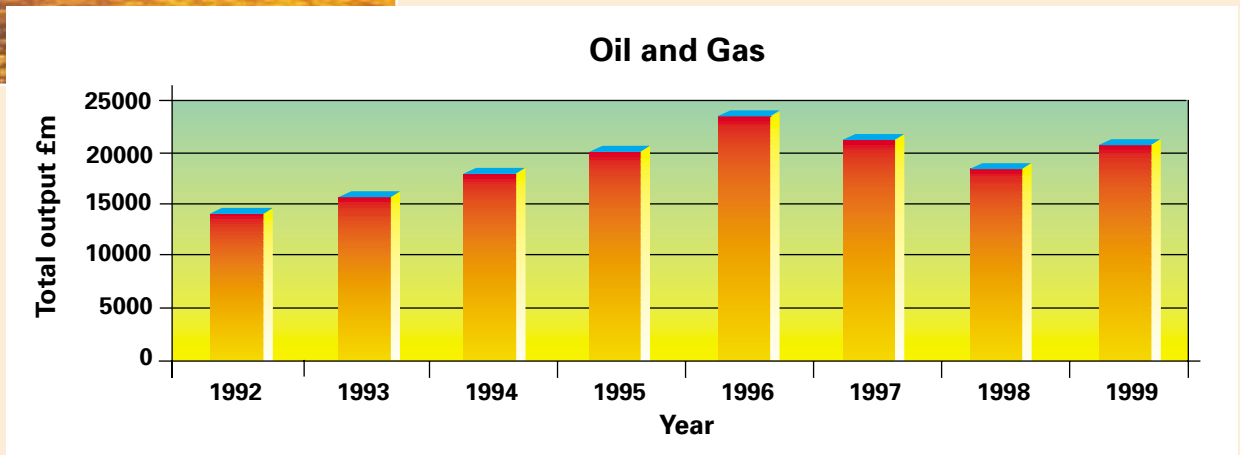
Development expenditure by operators and other licensees was around £2000m (oil) and £1154m (gas). Both these figures are substantially below 1998 and earlier years because of the prevailing uncertainties about future oil prices. Operating expenditures were £2957m (oil) and £1287m (gas); exploration expenditure was estimated at £457m, again anomalously low compared with previous years.

Exports in 1999 were £8.8bn. Reference 4 indicates that some 27,200 jobs existed in 1999, directly in the oil and gas extraction sector offshore and onshore, and in certain classes of contractors peculiar to the industry. This is very little changed from 1994-95, but there is a tendency within this total for the numbers employed offshore to continue to fall.

The Gross Value Added (**Table 2.3**, Reference 3) in 1999 was £14.81bn, or 1.9% of GDP. The percentage increased considerably in 2000 to 2.7%, as oil prices increased while production cost remained stable. It reached 3.3% in the final quarter of 2000. **Figure 2.1** summarises some recent inter-annual variability.

Turnover	**£20.60bn**
Value added	**£14.81bn**

Fig 2.1 Trends in the production of oil and gas 1992 to 1999



Leisure and Recreation

Holiday Tourism (SIC (92): various, including 55)

This is a very difficult sector to estimate, partly because the distinction between a coastal/seaside holiday and other holidays is difficult to define. Our approach this time has been to get information directly from the British Tourist Authority. The British Tourist Authority estimated the total turnover for tourism in the UK in 1999 to be worth more than £64bn per year and its Chief Executive has stated that £17bn per annum is related to seaside tourism (presentation to WWW-UK Oceans Recovery Summit, Edinburgh, 23 October 2001). These figures have been confirmed in more detail in correspondence with the BTA.

The value added factor which we used in the 1994 analysis (0.70) is revised downwards based on Office of National Statistics Input-Output Tables 2001 Edition for the hotel catering etc category (92) to 0.63.

Despite the reduced factor, the value added from this sector is considerably more than the £5.54bn we estimated in 1994. We have no way of directly assessing whether there has been a real increase in activity, as the methods of estimation are not the same. Nevertheless, there are indirect indications that the increase is not real. The English Tourism Council has recently prepared a strategy for regenerating England's resorts, entitled Sea Change (Reference 5). Between 1973 and 1998 the share of UK generated tourism nights spent at the seaside fell from 27% to 13%, as people are taking longer main holidays abroad. However, there is a continuing change in favour of short breaks, which helps to maintain the income levels.

Turnover	£17bn
Value-added	£10.7bn

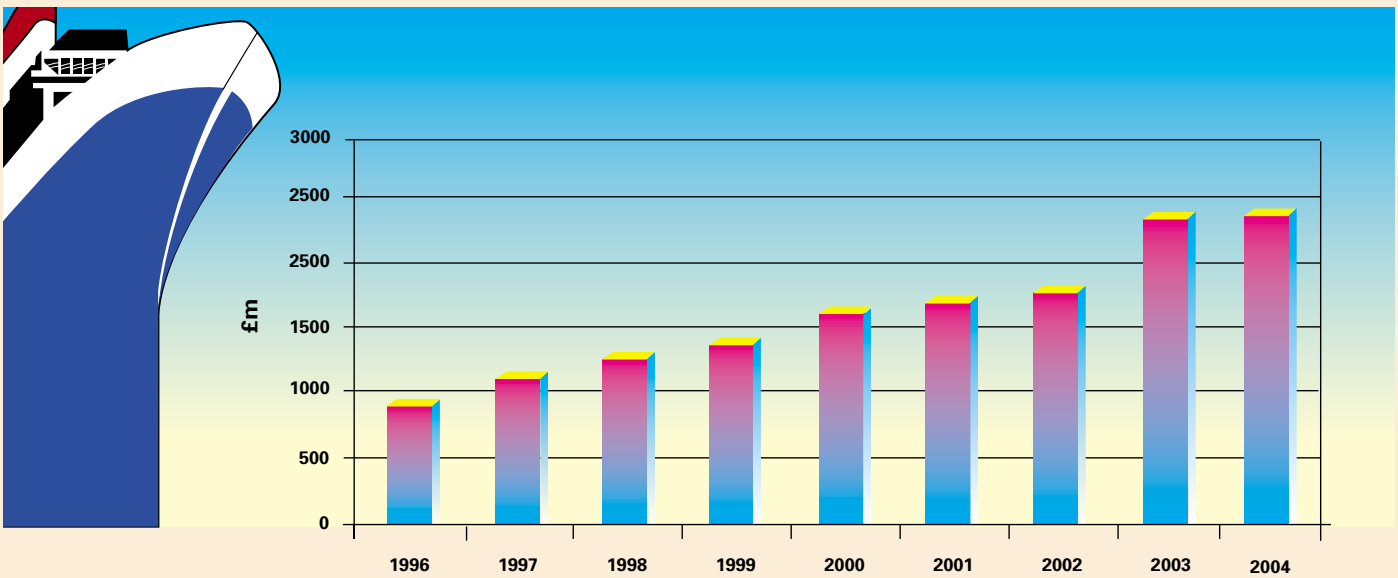
Cruising (SIC (92) 61.10)

Leisure cruising has been a very strong area of market growth (12% per annum in Europe) through the 1990's. Reference 1 estimates a UK market share of 12% of the global market of £11.9bn, totalling £1.4bn. See **Figure 2.2**. There are fears of over-capacity as many new cruise liners are due to enter service in the next few years. We have used a value added factor of 0.46, as in 1994.

Turnover	£1.4bn
Value-added	£644m

Associated British Ports

Fig 2.2 UK Cruise Revenues: actual and projected



Leisure Craft Services (SIC (92): 63.00; 92.62 and general)

The services provided to this growing sector are included separately from leisure craft construction (q.v.). Reference 1 quotes data from the British Marine Industries Federation for services and sales in 1998 including chandlery and clothing, as well as repair berthing, hire charges, brokerage and fuel, of £889m. The British Marine Federation figures for the leisure industries in 2000 shows 50% of the revenue is from services. The total revenue has increased by more than 9% per year in the period 1999-2001. As for 1994, a factor of 0.48 is assumed.

Turnover	£889m
Value-added	£427m

Total for leisure and recreation:

Turnover	**£19.29bn**
Value added	**£11.77bn**

Royal Navy

Royal Navy

Naval operations are a service to the nation and are classed as a legitimate contribution to GDP. Although naval statistics are readily available from official sources – the Defence Analytical Services Agency – the logistics figures are no longer published separately for each Service. The total MoD estimate for 1999-2000 was £22.3bn (Reference 6). We have allocated a proportion of the £462m total Defence Logistics budget as for 1996. Similarly, we have allocated some other central costs on a one-third basis.

As in our previous publication we are using estimated published figures. Staff costs are taken as a proportion of turnover according to the overall MoD ratio of 0.38.

	£m
Commander in Chief Fleet	1058
C-in-C Naval Home Command	541
Chief of Fleet Support	1883
Equipment (sea systems)	2300
Distributed central costs	878
Total	**6660**

Turnover	**£6660m**
Value-added	**£2531m**

Business Services

(SIC (92): 66.03; 67.20; 71.22; 74.30)

British Invisibles (now IFSL), a private sector organisation for promoting British financial services throughout the world, published an analysis of Maritime Services, updated to 2000 (Reference 7).
Overseas earnings in 1998 were:

	£m
Baltic Exchange	297
Lloyd's Register	51
Banking services	100
Insurance brokers	160
Law firms	170
P&I Clubs	90
Barristers	20
Publishing	30
Others	30
Total	**948**

Employment in 2000 was estimated at 13,800, about the same as ten years ago, with increased employment in law firms, but a halving of employment in banking for ship finance. In ship finance the loanbook provided by a dozen commercial banks in London, £9bn, accounts for 18% of the total world loanbook.

For Lloyds the 1996 marine account (the latest available) showed a profit before expenses of £193m, a return of 22% on premiums of £872m (Lloyds press release June 2000). The total London-based marine insurance market received £1190m in premiums in 1999, (personal communication,IFSL) which on the same ratio means an annual profit of £260m for all the London-based marine insurance, which included the overseas earnings and the UK insurance business. However, insurance profits from year to year are notoriously variable, and should be generalised with great caution.

Scaling the overseas earnings upwards to include UK-generated business, and converting to turnover has been done using value added figures based on relevant sectors in the 1998 Input-Output tables.

Turnover £4535m
Value added £1080m

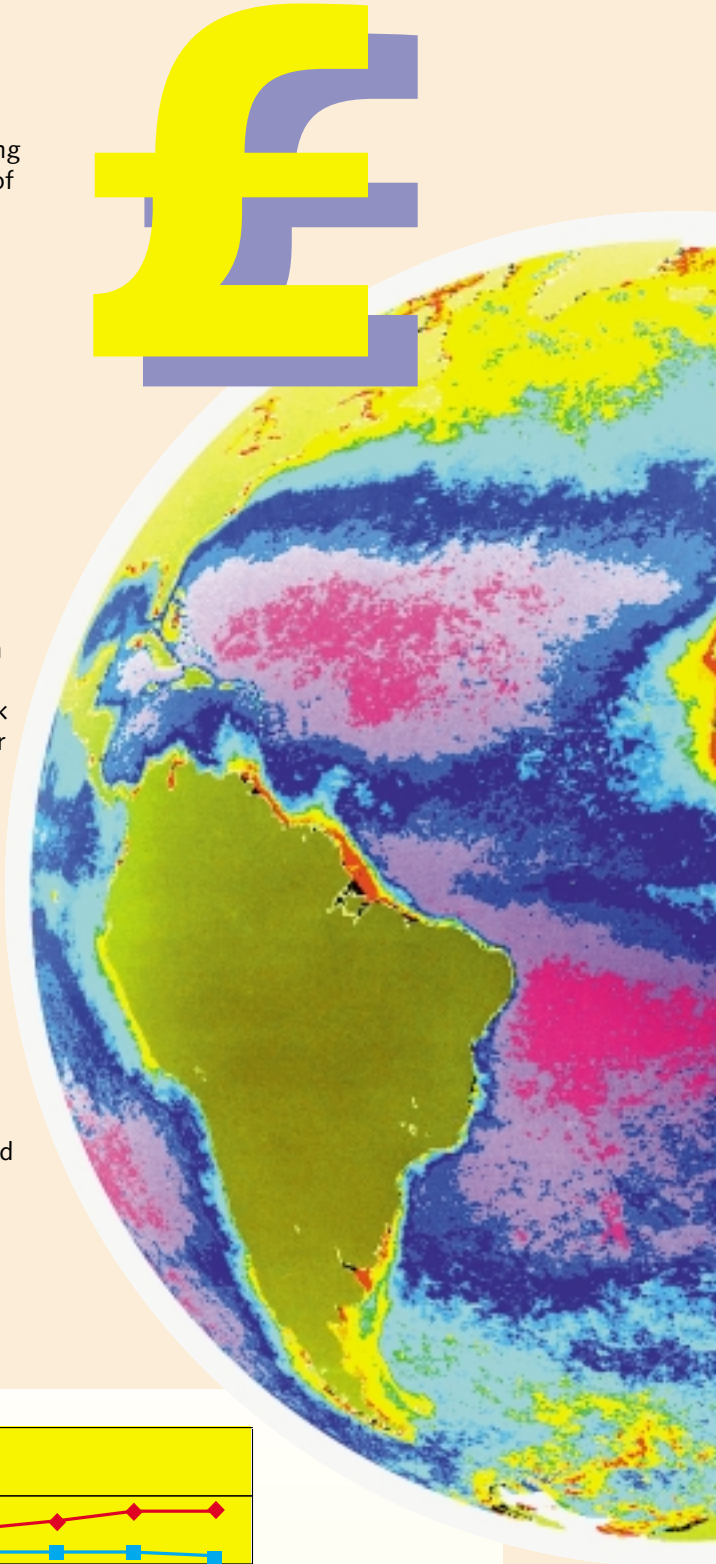
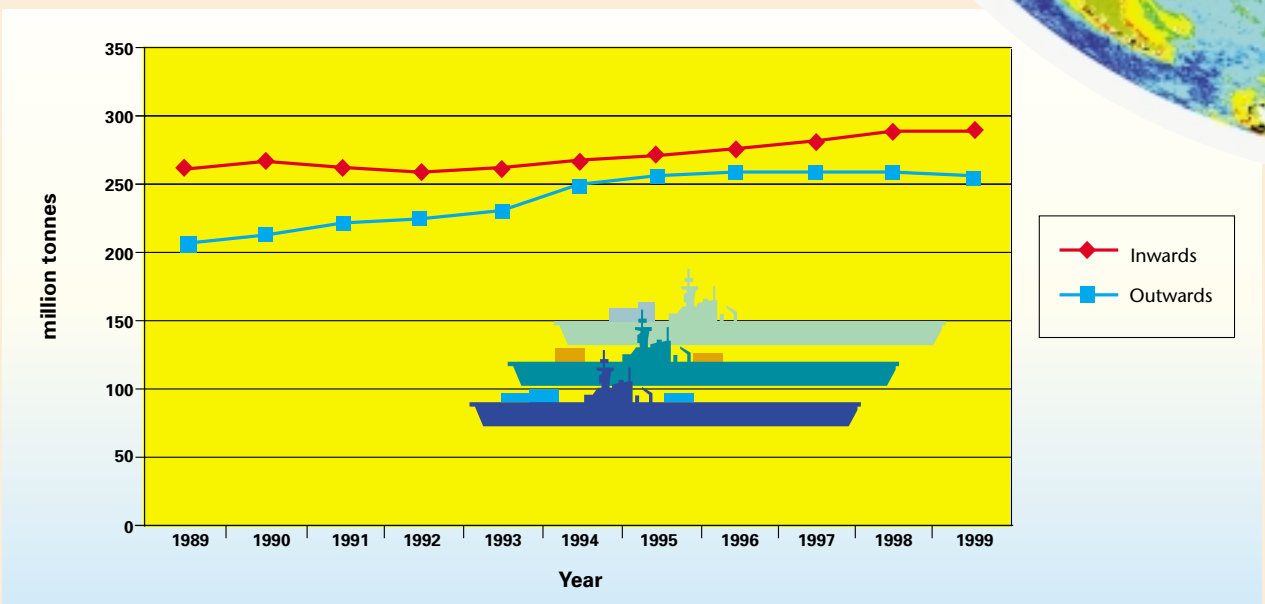


Fig 2.3 Total UK Port Traffic



Shipping Industry Operations (SIC (92): 61.10)

Statistics on tonnage carried are readily available from official sources (Reference 8). See **Figure 2.3.** However, it is much more difficult to estimate the UK GDP contribution. For 1999 the tonnages (millions) for Great Britain ports were:

	Inwards	Outwards
Foreign	199	184
Coastwise	56	66
One-port	36	3
Totals	**291**	**253**

The total for Great Britain was 544 million tonnes, and for the United Kingdom including Northern Ireland, 565 million tonnes. Fuel is the dominant bulk traffic cargo.

The Chamber of Shipping has issued the following details of the importance of shipping to the UK economy.

Contribution to UK Balance of Payments (£m)

	1997	1998	1999	2000
RO-RO	842	798	946	1108
Container	462	606	668	701
Dry Bulk/Other Dry Cargo	142	183	149	242
Cruise	430	455	552	506
Tanker	282	223	229	302

Balance of Payments is total receipts minus total payments

UK Ships' Global Earnings (£m)

	Current	Constant 1995 prices
1985	3010	4748
1986	2923	4469
1987	3083	4481
1988	3428	4702
1989	3722	4754
1990	3664	4346
1991	3624	4027
1992	3747	4007
1993	4151	4319
1994	4670	4790
1995	4916	4916
1996	5072	4910
1997	4815	4530
1998	4334	3958
1999	4797	4275
2000	5122	4485

Because of the international nature of the industry, strict figures for the UK are very difficult to estimate. For example, a recent survey by the London Guildhall University showed that around a third of UK officers are employed by overseas-based companies.

A rough estimate of the contribution is possible using the estimated UK market share of the world's £156bn market at £5.2bn (Reference 1). The Chamber of Shipping gives a similar figure of £4.8bn for overall earnings by UK ships. Assuming a value added factor of 0.46 to £5.2bn for the sector, gives a value added of £2400m.

Turnover **£5.2bn**
Value added **£2.4bn**

Ship and Boat Building and Repairs

(SIC (92): 35.11; 35.12)

This sector is clearly defined and quantified by the Office of National Statistics.

It includes offshore rig construction and naval construction. There may be some double counting with naval procurement figures in that section. For ships the total turnover was £2.54bn, of which 18% were export sales. For the pleasure and sporting boat sector the turnover was £652m, of which 59% was for export.

The British Marine Federation figures for 2001 show strong growth with leisure boats and equipment, including electronics and propulsion revenue of £784m (included with services for leisure boats in **Figure 2.4**).

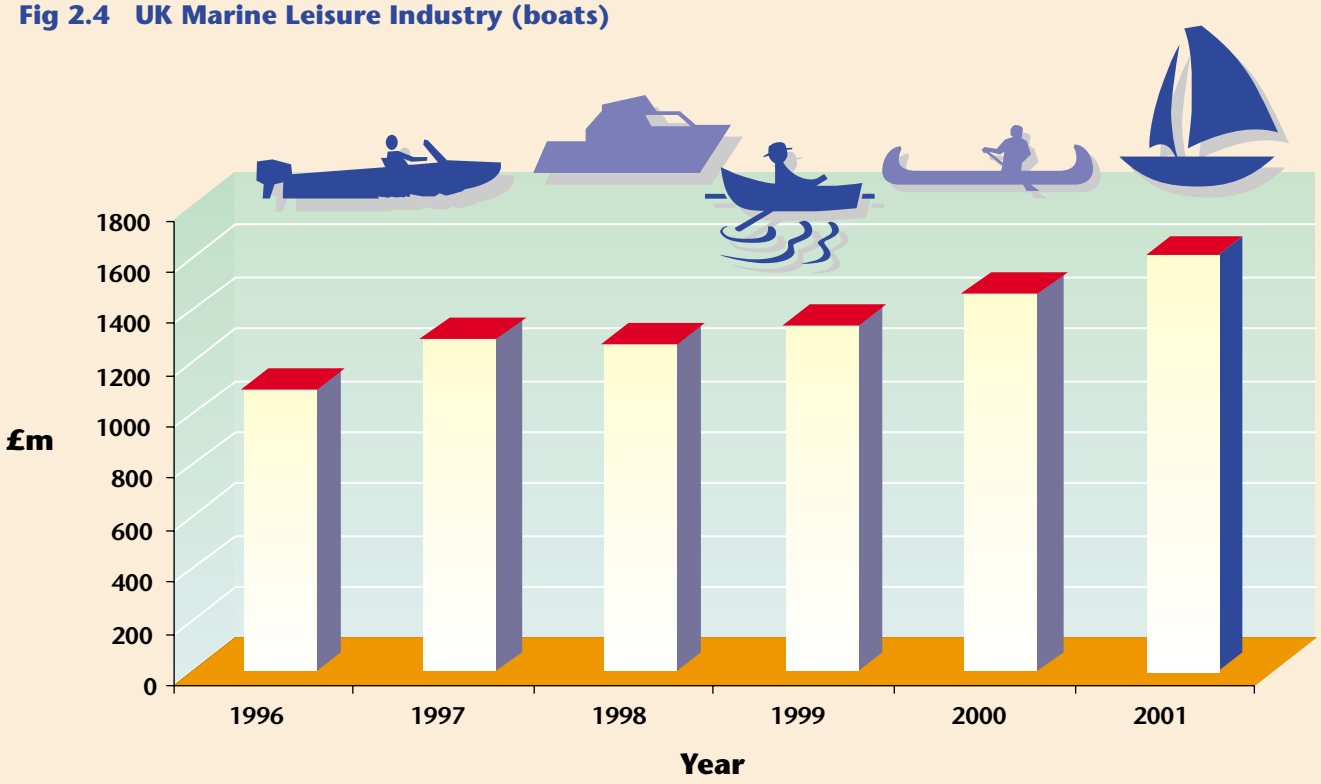
The future development of the leisure craft market is closely linked to personal affluence and general economic prosperity and, as the leisure time of an ageing population increases, the sector is expected to continue to expand. The UK share is around 10% of the world market (Reference 1).

For 1999 the values for the total sector were:

Turnover £3172m
Value added £1574m

School of Ocean Sciences, University of Wales, Bangor

Fig 2.4 UK Marine Leisure Industry (boats)



Associated British Ports

Marine equipment

(SIC (92): general manufacturing)

This remains a difficult sector to analyse, as explained in our previous study. However, the sector is increasingly acknowledged as an entity by DTI, which has published export information literature with the FCO (Reference 9), and commissioned a study by First Marine International, "Competitive analysis of the UK marine equipment sector" (Reference 10), in March 2001. This publication estimates a sector turnover of £1.7bn for 2000, with a value added of £918m. The analyses were restricted to ship equipment.

The major contributors are propulsion systems (£368m estimated turnover), accommodation (£234m), and navigation and communications, (£164m). Of the UK market value of £1224m, 52% was met by UK manufacturers. The UK has about 2.2% of the global market. Since 1996 the share has fallen from 3.7%, partly because sterling has increased in value by about 33% relative to European currencies. The report shows an increase of 12% in marine related turnover for companies surveyed both in 1996 and 2000, and a fall of 32% in total employment. The Society of Maritime Industries has now been formed as the body representing the interests of the whole supply chain, with a membership extended from that of the earlier British Marine Equipment Council.

Turnover **£1669m**
Value added **£918m**

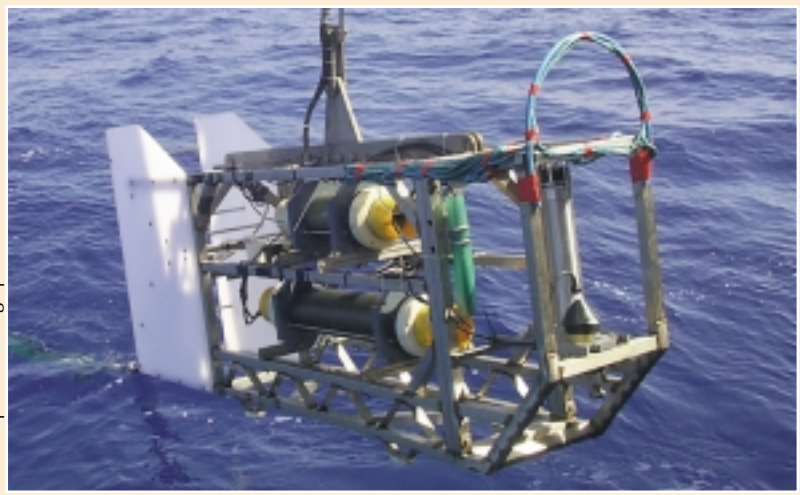
In the oil and gas sector in 1999, there was a fall of investment in the construction and installation of new platforms because of uncertainties in the industry (approximately 60% of the 1998 capital investments). Nevertheless, £2000m capital was invested in new systems for oil and gas production, and £1154 for gas production. £1058m was spent on platform structures, modules and equipment, and £99m on pipelines. Expenditure in 1998 was £2064m and £268m respectively.

As in our previous report, we make a conservative estimate including only the two elements, platforms and pipelines, noting that 1999 was not a typical year for the oil and gas sector investment, we assume a value added factor of 0.38, as for the general manufacturing sector. This gives a value added of £440m for oil and gas equipment.

Turnover £1157m
Value added £440m

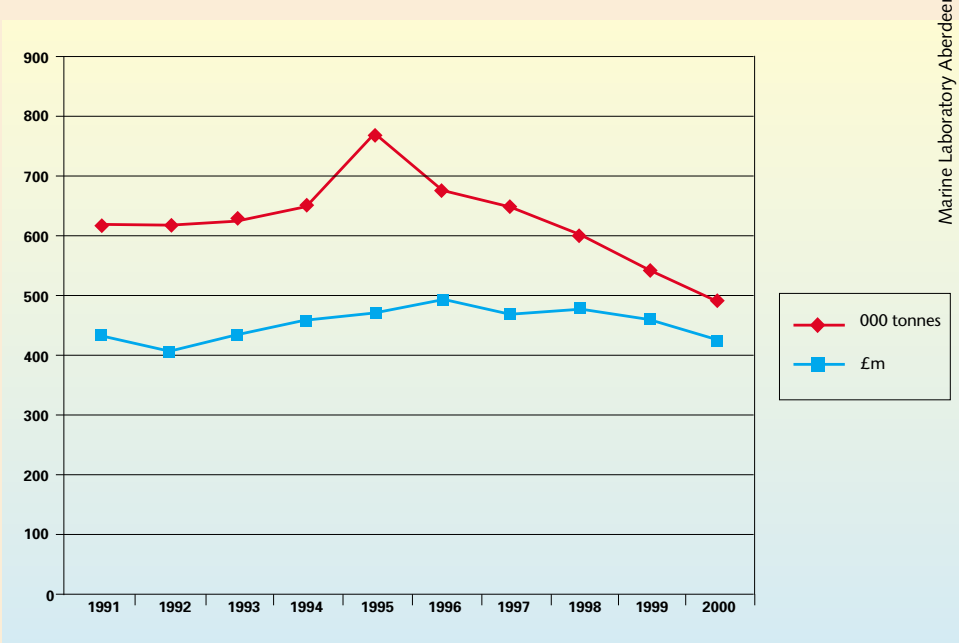
Total for marine equipment sector

Turnover **£2326m**
Value added **£1358m**



Southampton Oceanographic Centre

Fig 2.5 Fish landings in UK by UK vessels




Marine Laboratory Aberdeen

Fisheries (SIC (92): 05.01; 05.02; 15.20)

Sea Fisheries

The MAFF (now DEFRA) statistics for 1999 and 2000 were published in August 2001 (Reference 11). The 1999 and 2000 volumes and value of fish landed were:

1999	Tonnes '000s	£m
UK fleet's UK landings	542	464
UK fleet's foreign landings	330	123
Imports	552	1302
Exports	351	746

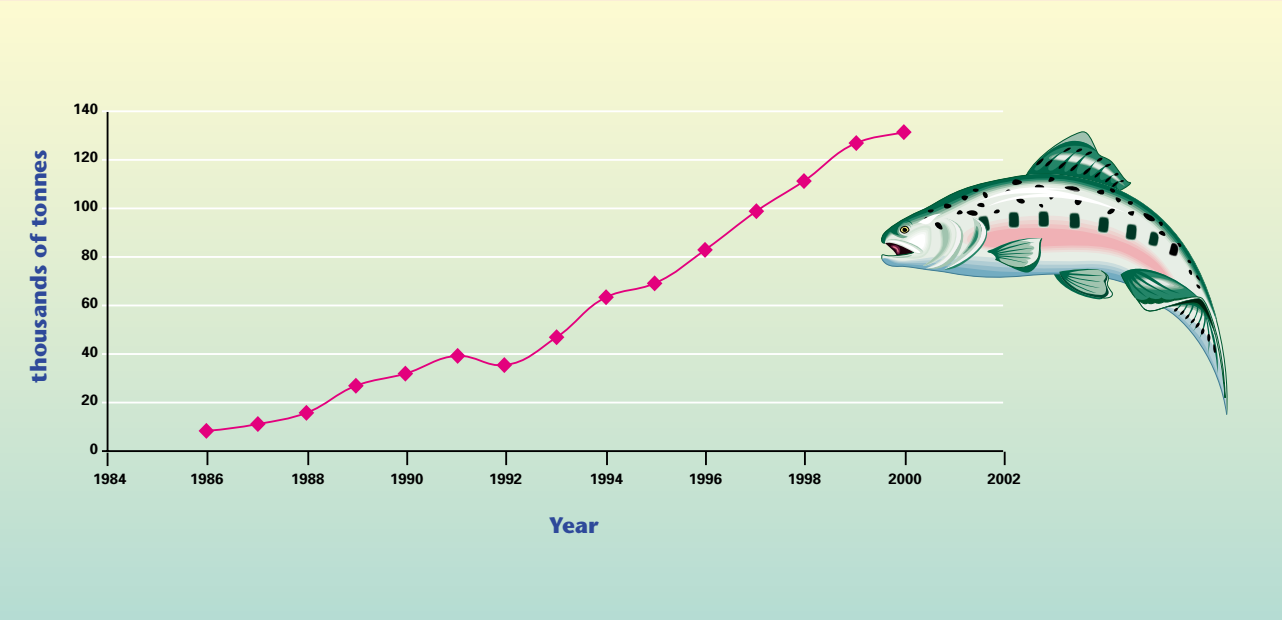
2000	Tonnes '000s	£m
UK fleet's UK landings	494	422
UK fleet's foreign landings	284	128
Imports	547	1325
Exports	365	696

There has been a steady decline in landings in recent years (**Figure 2.5**). In 1999 the UK landings at UK ports of demersal fish was valued at £280m (2000, £248m). The 1994 value was £292m. For pelagic fish the figures were £18m (2000, £20m) and £3m in 1994. For shellfish the 1999 value was £166m (2000 also £153m), compared with £128m in 1994. In 1999 landings in UK ports by foreign vessels were around 53,500 tonnes, with a value of £58m.

At the end of 1999 there were 7,448 registered vessels (2000, 7,242 vessels), a substantial fall from the 10,645 at the end of 1994. Employment had also fallen in 1999 to 15,961 (2000, 15,121) compared with 20,703 in 1994. However the registered tonnage of the fleet had increased to 238,367 at the end of 1999 (2000 tonnage is 247,417) from 205,665 at the end of 1994. We assume a value added factor of 0.55.

Total turnover 1999 £587m
Value added 1999 £323m

Fig 2.6 Atlantic salmon production



Marine Laboratory Aberdeen

Fish Farming

Fish farming continues to be dominated by the salmon industry in Scotland, which is growing strongly in terms of tonnage (**Figure 2.6**). In 1999 126,700 tonnes were produced, and this will rise to around 150,000 in 2001. In 1994 the total tonnage was 64,000. Trout farming is distributed with about a quarter of the whole production in Scotland. In 1999 the tonnage had increased to 5,834 from the 1994 level of 4,300. Mussels and oysters are still the major products of the shellfish industry. Figures are based on personal communication with the Scottish Executive, and Reference 12.

Estimated £m for 1999	Scotland	Rest of UK	Total
Salmon	266		266
Trout	14	40	54
Shell fish			8
Total			328

Turnover	£328m
Value added	£180m

Fish Processing

The PRA2 1999 figures for Processing and Preserving of Fish Products (Industry 15200) shows total UK sales of £1,532m. As previously for this sector, we assume a value added factor of 0.21.

Turnover	£1532m
Value-added	£322m

Sea Fish Authority 1999 statistics show an expenditure of 80.8p per person per week on fish protein, compared with 71.5p in 1994, a slight decline after allowing for inflation. For comparison, in the same period, beef consumption has fallen substantially and only poultry consumption had shown a significant increase.

Total for Fisheries:

Turnover	**£2447m**
Value-added	**£825m**

Ports (SIC (92): 63.22)

Previously we used turnover figures for Associated British Ports and scaled up for total UK figures based on tonnage handled. This time we have added The Mersey Docks and Harbour Company, Clydeport plc and Forth Ports PLC to ABP for a wider information base. Collectively these ports handled approximately 227 million tonnes of cargo in 1999 out of a UK total of 565 million tonnes. Their collective Company turnover was £679m, which scales up to £1690m for all UK ports. A factor of 0.7 is assumed.

Turnover **£1690m**
Value-added **£1183m**

Marine Environment (SIC (92): 45.21; 90.00)

This is a very difficult sector to estimate and some expenditure will be covered in other sectors such as tourism. Most of the expenditure is by Water Companies, to meet European and national legislative standards. OFWAT, the Government regulatory body which sets the basis on which the companies operate and charge, has set capital investment figures for 2000-2005 of £15.6bn, most of which is to preserve or enhance the environment; only a part of this will be marine-related. It includes work to improve treatment of sewage before discharge to sea, and to improve bathing water quality. Also, additional work is planned to avoid intermittent excess discharges. Of the £3bn per annum for capital investment, a quarter may be marine-related, to which we apply the factor of 0.38, for the construction industries. To this we add annual operating costs for sewerage treatment before marine discharge of £300m, with a factor of 0.5, as for the 1994 survey.

Turnover **£1050m**
Value-added **£435m**

Marine Construction (SIC (92): 45.21; 45.24)

This is another difficult sector for which there are some official but not comprehensive statistics, and some indicators of other activities.

The DTI (personal communication) official statistics for construction in the 'Harbours' category show expenditure of £297m in 1999-2000, compared with £218m in 1994. This category includes works directly connected with harbours, docks, piers, jetties, dredging, sea walls and embankments, but is limited to returns from contractors and local authorities. MAFF spent around £350m on flood defences, of which about £200m is for defence against sea flooding. There will be some overlap in these two figures. Dredging is assumed to be covered in general port operation cost, although there are sometimes very large dredging capital expenditures.

In addition, the UK has strong consultancy expertise, with a worldwide market. The New Civil Engineer conducts an annual survey of earnings by UK consultants in various sectors, but it is not possible to isolate marine or coastal consultancy from the listings. For 2000, the top ten UK consultants in the 'water and waste water' category charged fees of £275m; and in 'environment', £165m.

Our conservative estimate is lower than in 1994-95 because we no longer include major estuary crossings construction. A value added factor of 0.38, the average for the industry, is applied.

Total for construction:
Turnover **£497m**
Value-added **£189m**

Associated British Ports

Table 2.2
Marine-related Research and Development undertaken by Government Departments and Agencies

Summary of R&D Expenditure by Public Sector 1999-2000

		1994-1995			1999-2000
MAFF		8.9	MAFF		10.2
SOAEFD		5.2	SE		4.4
DoE		2.8	DETR	Env	2.5
DoT		1		MSA	1.4
NRA		1.1	EA		0.6
NIO		2.2	NIO		0.9
MoD			MoD		
	DERA	168		DERA	190
	Met Office	3		Met Office	2.2
DTI		10.5	DTI		1.9
NERC		52.2	NERC		51.2
ODA		1.8	DFID		2.1
HSE		7.5	HSE		5.4
Total		**264.2**			**272.8**

CEFAS Smartbuoy

Research and Development

This falls into three categories: University (Higher Education Institutions), Public Sector and Industry Sector research.

HEI Research

This is covered in detail in the analysis in the following chapter. As a minimum estimate, the 86 HEI departments which responded to the survey received direct grants and contracts of £58.0m for research in 1999-2000. This includes £20.2m (35% of the total) from Research Councils. Funding by Research Councils is excluded from the Public Sector totals in Table 2.2 (which explains why EPSRC's £13m is not included, but NERC in-house is). This exclusion is necessary to avoid double counting, as we include only the organisation that undertakes the research. The dual-funding nature of a university's HEI support means that these grant sums must be increased to account for additional support costs, so that the figures reflect an estimate of true total costs. On the basis of the 1994-95 analyses we use a factor of 1.1 of the direct grant. Applying this ratio to the total UK direct grants to HEI's gives a total of £118m, an increase of 21% from 1994-95, without allowing for inflation.

Public Sector Research

This is undertaken in support of Departmental policy objectives, to improve operational efficiency, or as a basic function (Research Councils). Details are summarised in Table 2.2, with allowances to avoid double accounting, for example where Departments fund research in industry or universities. Total spend in 1999-2000 was £273m.

Because of different Departmental accounting procedures, some of the figures are not strictly comparable with those published in 1994-95. Nevertheless, the general trend is for a reduction in Public Sector funding for marine-related research and development. The earlier NERC figures may have been relatively high because they coincided with the establishment of the Southampton Oceanography Centre. HSE figures have reduced because research undertaken post-Piper Alpha has been completed. Many of these figures are taken from Reference 14; the remainder are supplied directly by IACMST Members. For the major contributor, DERA (now moving into the private sector as QinetiQ), we have assumed a figure of 25% of the total operating expenses in 1999-2000 of £767m, noting a high level of marine activity related to the development of the trimaran RV *Triton*.

Industry Sector Research

Information in this sector is very difficult to obtain although the Office of Science and Technology within DTI publishes summaries and in some cases detailed company research and development returns (Reference 13 and the annual Research and Development Scoreboard of the DTI). Only one of the OST sectors, Ship Building and Repair, is specifically marine. This sector spent £76m on R&D in-house in 1999, substantially more than the £17m in 1994. £73m of this was on defence related R&D. (£47m applied research and £27m experimental development.)

The extractive industries, including solids, liquids and gases, spent £42m on R&D in 1999, down from £72m in 1994, and consistent with a long-term decline. The various Water Authorities spent a total of £25m on research and development in 1999, but only a small part of this will be marine. In general, the marine-related market sectors continue to look to the Public Sector for the needed research, in contrast with pharmaceuticals and aerospace, where 34% and 8% of sales in 1999 were spent on research and development by the companies themselves. Certain sectors operate, or are served by, specialised research companies including Hydraulics Research, GEOTEK, Fugro GEOS and British Maritime Technology. BMT now operates globally with a number of subsidiary companies promoted by research investment (6% of its annual turnover, which was £45m in 2000). Associated British Ports maintains a central research laboratory in Southampton, which now trades as ABP Marine Environmental Research Ltd, whose turnover was £1.6m. Some marine research is included in the work of the WRc Group, formerly the Water Research Centre at Medmenham, which employs 300 professional staff.

Many marine sectors are mature, or not appropriate for extensive research to underpin them, for example tourism. Others, such as equipment and leisure craft construction, are actively developing; the level of in-house R&D is estimated to vary between 1% and 10% with an average value near the lower end of the range. A total estimate based on informal discussions leads to a small increase of the 1994-95 estimates, to £220m.

Total for R&D

Turnover	**£609m**
Value-added	**£292m**

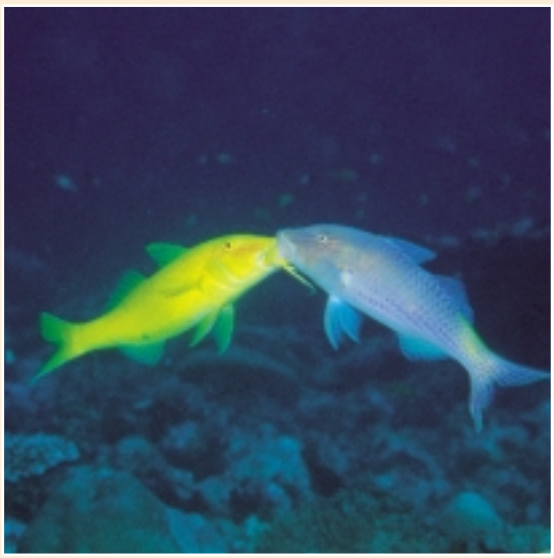
Associated British Ports

Table 2.3 Additional Information from "Public Bodies 2000"

Published by The Stationery Office

	Staff	Gross Spend £m	Of which from Govt £m
British Tourist Authority	418	50.2	36.0
English Tourism Council	55	14.0	11.7
Wales Tourist Board	119	17.3	15.4
Scottish Tourist Board	184	25.0	19.4
National Maritime Museum	384	17.2	10.9
Natural History Museum	720	43.6	29.6
Various naval museums (MoD)	79	5.5	1.9
Northern Lighthouse Board	220	27.2	Nil
Trinity Lighthouse Service	428	26.7	Nil
Engineering and Physical Sciences Research Council	289	401.5	401.5
Natural Environment Research Council	2,608	230.2	178.5
Sea Fish Industry Authority	147	10.5	Nil
Northern Ireland Fishery Harbour Authority	25	1.8	0.9
Fisheries Conservancy Board for Northern Ireland	25	0.8	0.5
English Nature	627	46.4	44.7
Environment Agency	10,296	626.0	149.3
Countryside Council for Wales	396	26.4	25.6
Scottish Environment Protection Agency	748	32.3	18.6
Scottish Natural Heritage	645	42.8	39.0
Scottish Enterprise	1,500	451.0	401.0

These public bodies all have a marine component of their activities. They are not explicitly included in the sector financial analyses. See Reference 15.



Submarine Telecommunications

(SIC (92): 31.30; 64.20)

There continues to be a strong demand for new submarine cables as the use of the Internet grows internationally. Reference 1 estimates the UK share of the world market at 9.3%, some £4.3bn. The manufacture, surveying, and laying of new cables is a growing industry in which the UK has a share, estimated at £497m per annum. A value added factor of 0.38 is assumed.

Total for Telecommunications

Turnover **£497m**
Value-added **£189m**

Safety and Salvage (SIC (92): 63.22; 75.24; 85.32)

This section includes a range of public and private sector activities whose roles are related to marine safety and to marine salvage.

Lighthouse Authority (63.22)

The activities of the three Lighthouse Authorities, The Corporation of Trinity House, the Northern Lighthouse Board, and the Commissioners of Irish Lights continue to be funded by a levy on ships using ports in the UK and the Republic of Ireland. These are collected and disbursed by the General Lighthouse Fund of the Department for Transport, Local Government and the Regions. The lights are now all unmanned, and staff levels have fallen substantially. Charges have remained constant for several years, and there is an increasing reserve (now ca £84m), the interest on which is available for operations. The Authorities operate a small research facility (£600k pa)on the Isle of Wight. Income in 1999-2000 was £71.1m and operating expenditure was £59.2m (Reference 14).

Turnover £59.2m
Value-added £32.2m

The Hydrographic Office (74.20)

The Hydrographic Office now operates as a Trading Fund within the Ministry of Defence. Its mission is to meet national, defence and civil needs for navigational charts, publications and other hydrographic information. Plans are defined in the National Hydrographic Programme.

Turnover 1999-2000 £44.9m
Value added = staff costs = £22.3m
Average staff employed = 838

In 1994-95 turnover was £33.4m, value added £17.1m, and average staff employed 823.

Maritime and Coastguard Agency (75.24)

The Coastguard also operates on behalf of the Department of Transport to minimise loss of life amongst seafarers and coastal users and to minimise pollution from ships to sea and coastline. Total staff 549.

This new Agency, now responsible to the Department for Transport, Local Government and the Regions, was formed on 1 April 1998 by a merger of the former Coast Guard and Marine Safety Agencies. It has responsibility for developing, promoting and enforcing high standards of marine safety; minimising loss of life amongst seafarers and coastal users; responding to maritime emergencies 24 hours a day; and minimising the risk of pollution of the marine environment from ships where pollution occurs, minimising the impact on UK interests.

Turnover 1999-2000 (operating costs) £98.8m
Value added = staff costs = £26.3m
Average staff employed = 1045

In 1994-95, 956 staff were employed.

Health and Safety Executive

This includes the Hazardous Installations Directorate - Offshore Division. Staff levels have fallen from a peak of 398 in 1995, after implementation on of Piper Alpha recommendations. The level was 257 in 1999-2000, with a turnover of about £25m.

Turnover £25m
Value added = Staff costs = £9m

Royal National Lifeboat Institution

The Royal National Lifeboat Institution operates to save lives at sea around the United Kingdom and the Republic of Ireland. In 1999 the receipts were £86.7m, falling to £78.9m in 2000. Fluctuations are in part due to changing values of legacies as the stock market varies. Operating costs in 1999 were £57.8m and in 2000 £72.7m.

Turnover £57.8m
Value added £20.5m

SOC

Commercial Salvage

This is a difficult sector to separate from 'towage'. One major company, Howard Smith Towage, operates 45 tugs and employs 480 people. The Salvage Association, the world's premier marine casualty surveying organisation, is now a part of British Maritime Technology, whose annual turnover is around £45m. In the absence of a recent detailed analysis for salvage we use the same figure as in 1994-95.

Turnover	£30m
Value Added	£15m

Total for Safety and Salvage sector:

Turnover	**£316m**
Value added	**£120m**

Crossings (SIC 63.21)

These are the revenues generated by bridges, tunnel or ferry tolls. We are not now convinced that this is a "marine-related" sector, but include the 1994-95 figures here for the overall comparison.

Turnover	**£155m**
Value added	**£87m**

Aggregates (SIC (92): 13.21)

Offshore extraction for 1999 totalled 13.4 million tonnes, 15% of the total Great Britain production. The value for 2000 for UK landed aggregates was 14.4 million tonnes, 16%. This had a landed value of £75.3m, compared with landed values of £83.2m in 1994. The processed value is scaled as in 1994, by increasing the landed value by 75% to give £131.8m. Value added is then calculated assuming a factor of 0.52.

An alternative estimate is given by the Crown Estate (personal communication), which estimates 13 million tonnes landed for UK construction, and 6-7 million tonnes exported, mainly to Holland and Belgium. Some is also used directly for beach nourishment. The total is about 22 million tonnes. The Crown Estate gets a return of around 10% on all extracted offshore aggregates. Dock gate prices are about £6 per tonne, giving a turnover of £132m.

There has neither been a dramatic increase nor decline in the rate of extraction of marine aggregates in the last decade, although there has been a switch from UK landings to exporting.

Turnover	**£132m**
Value added	**£69m**

Education and Training (SIC (92): 80.30/2; 80.30/3)

In the Higher Education sector there are many courses which are specifically marine. Many of these are attended by overseas students, and are an earner for the UK economy.

Our university survey has shown 538 academic staff in the marine area, which on a staff:student ratio of 1:10, and using the Southampton University 1999-2000 'overseas' fee for science based courses of £9,050, gives a turnover of £48.7m. We apply a value added factor of 0.51 as an average for the Education sector.

Training is assumed to be included within the individual sectors. Reference 1 estimates UK-based seafarer training at £65m per year, and offshore industry training at £24m per year.

Turnover	**£48.7m**
Value added	**£24.8m**

3
MARINE RESEARCH AND DEVELOPMENT ACTIVITIES IN UK UNIVERSITIES

3.1 Introduction

The results presented in this section were obtained from a survey of the marine science and technology activities in UK universities carried out by IACMST for FY 1999–2000. Questionnaires were sent to university departments requesting information on their research interests in marine science and technology, staff and postgraduate student numbers, and sources and levels of funding for research purposes. The information requested in the questionnaire was for the financial year 1999–2000. The format of the questionnaire was similar to that used in previous surveys carried out for the financial years 1988–1989 (Reference 16) and 1994–1995, so that where possible, comparisons could be made with previous surveys.

Altogether questionnaires were sent out to 165 university departments thought most likely to be actively engaged in teaching and research in some aspect of marine science and technology. This was a considerably smaller number than was sent out previously, but it was felt that the experience gained in the earlier surveys allowed for a much more focussed approach to the university departments most likely to contribute useful information.

The response to the questionnaires produced a total of 102 replies, ie an overall return of about 62%. Of these replies, 86 departments returned a completed questionnaire and 16 indicated that their MST interest had either lapsed or that the department had been closed. Whilst this is a better result than that obtained in the last survey (ie 42%) we were disappointed that the overall response had not been higher.

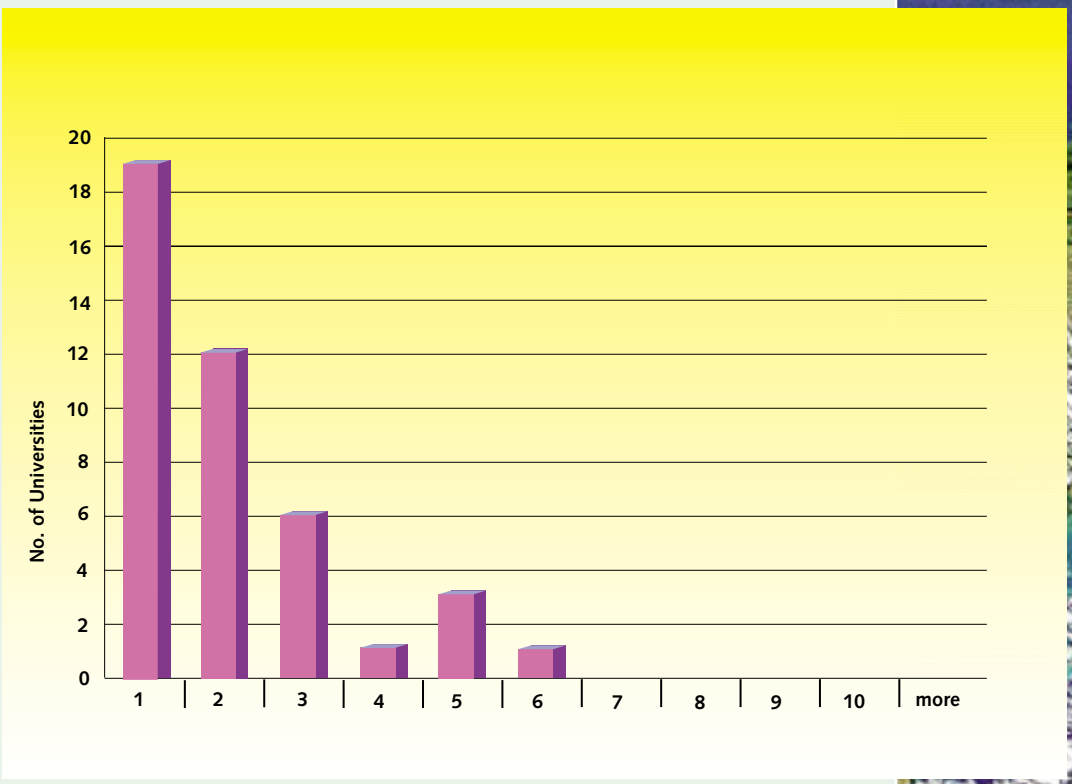
All departments that did not respond to the questionnaire were sent reminder letters. In some cases, these were followed up by e-mails and visits in order to get a response. A detailed examination of the replies revealed finally that responses had been obtained from all of the larger departments included in the survey. This "chasing up" may have introduced some bias into the statistics because necessarily we had to concentrate on obtaining responses from the larger departments. Whilst it is not possible to account fully for all of the "missing" replies, some are due to changes in university structure, eg the amalgamation of departments into multidisciplinary schools and others due to a lapse of MST interests or departmental closure. This seems to be particularly true for a number of departments in the Physical Sciences and Mechanical Engineering disciplines.

The departmental replies came from 41 universities or university colleges and one institute of higher education. The regional distribution of these departments is given in Also shown is a comparison with the distribution from the 1994–1995 survey. It can be seen that virtually all the "missing" responses are from English universities.

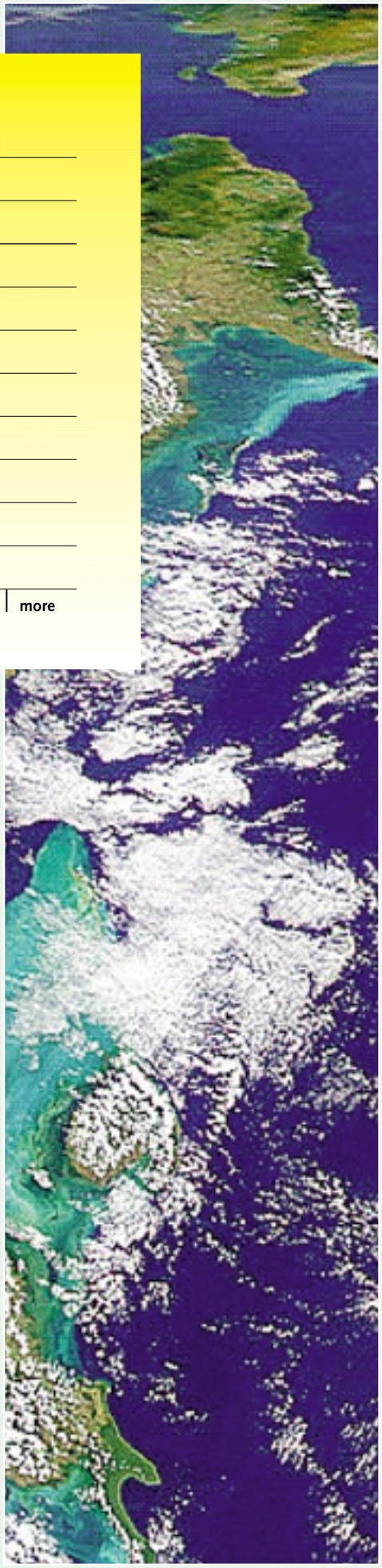
Table 3.1
Regional Distribution of Responding Departments within the UK

Region	Questionnaires Received	
	FY 1994–1995	FY 1999–2000
England	87	56
Scotland	22	24
Wales	3	3
Northern Ireland	3	2
Isle of Man	1	1

Fig 3.1 Distribution of MST Departments in Universities



Overall the survey indicates that a considerable resource is invested in marine science and technology research in the UK. The sample represented by the returned questionnaires shows that at least 2,238 researchers of all types are active in the field and these are supported by research grants and contracts at a level of nearly £58m. This funding is in addition to that received from the HEFC or regional equivalents, and local authority support. No attempt has been made to estimate and include the additional contribution to these figures in respect to non-responding departments; the figures presented here are minimum values. However we believe that virtually all the major departments are included in the responses.and contracts at a level of about £46m. This funding is in addition to that received from the HEFC and local authority support. No attempt has been made to estimate the additional contribution to these figures in respect of the non-responding departments, the figures presented here are minimum values. However, we believe that virtually all the major departments are included in the responses.



NASA/SeaWIFS

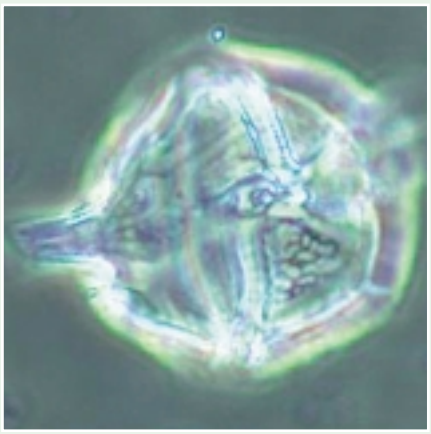
3.2 Departments

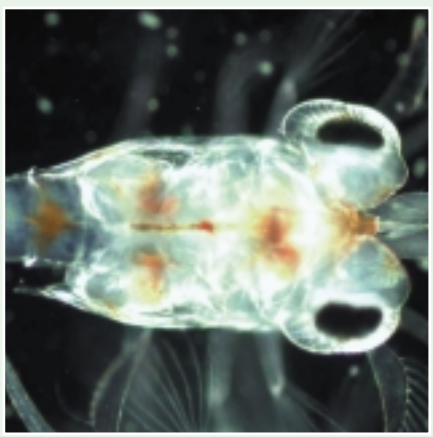
Compared with the earlier surveys there is an increasing tendency within the universities to form multidisciplinary schools. This is perhaps most marked in both the biological sciences and engineering sciences. Another development which appears to be on the increase is the formation of inter-departmental specialist research or technology centres. Both of these developments tend to decrease the overall number of departments engaged in MST in the universities without decreasing the overall effort.

The distribution of departments contributing to MST activity within the universities is shown in **Figure 3.1.** This shows that in half of the universities engaged in MST activity the research is carried out in just one or two departments. In contrast one university (Plymouth) has six departments involved in MST research and three universities (Glasgow, Heriot-Watt and Liverpool) have five. The scale of MST research within a university cannot be inferred from these data since departmental activity can range from the peripheral interest of a singleton staff member to that of a large multidisciplinary school. In order to get a better insight into the level of research activity carried out within a department it is useful to consider the resources available to it.

3.3 Total Researchers

Some measure of the scale of the MST research can be obtained by looking at the total number of researchers employed, both overall and within the department. In this context the total number of researchers is defined as the sum of the number of academic staff, technical staff, postdoctoral researchers and postgraduate students. **Table 3.2** shows this information as recorded in the 1999–2000 survey and compares it with that obtained previously.





Karl Embleton/SAHFOS

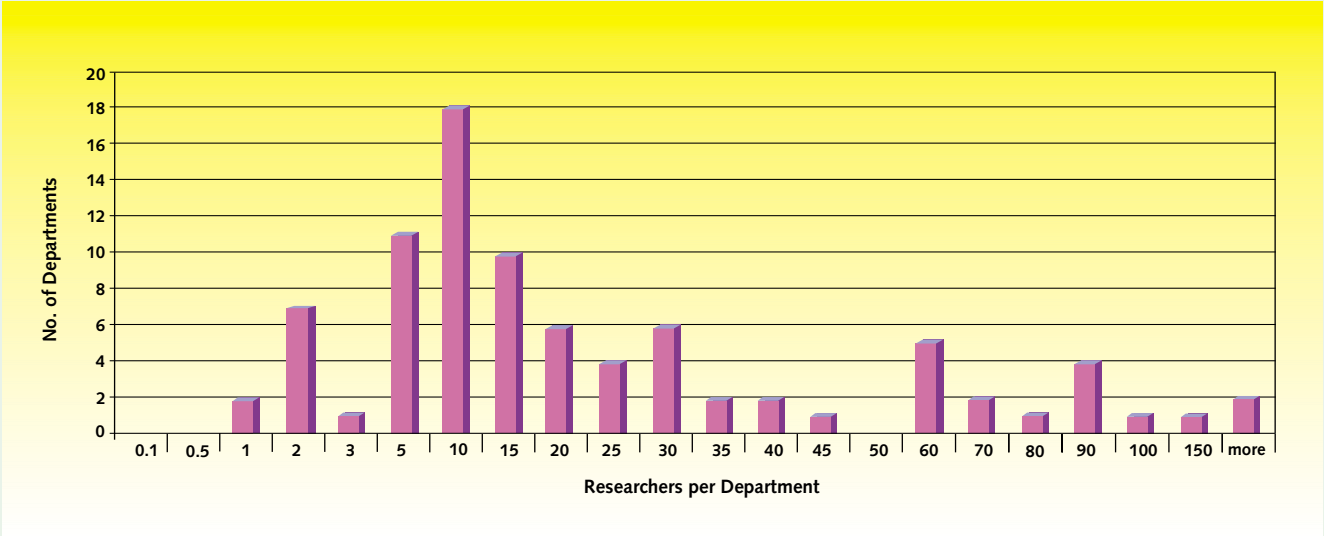
Table 3.2 Total Researchers

Type of Researcher	FY 1999–2000	FY 1994–1995	FY 1988–1989
Academic Staff	538	586	575
Technicians	328	341	385
Postdoctoral Researchers	350	435	281
Postgraduate Students	1022	1,088	683
Total Researchers	**2,238**	**2,450**	**1,924**

Because of differences in the number of returns it is not possible to make direct inferences about the possible changes that may have occurred between the different surveys. Also in this respect there are other special circumstances that need to be taken into account, eg the transfer of staff and resources from the research councils into the university domain since the last survey. A consideration of the possible changes between the different types of researcher is also important. Usually the academic staff and the technicians form the core staff of a department and in particular the academics provide the main engine driving the research work. The other two categories tend to be more transient and might be expected to have wider fluctuations.

In the present survey if the individual staff numbers are normalised by dividing by the total number of researchers then the individual normalised totals are virtually identical to those obtained from the previous survey, eg the academics form 24% of the total staff in both surveys. Within a per cent or two the same is true for each of the other

Fig 3.2 Distribution of all Types of Researchers against Number of Departments



categories of staff. At first sight taking into account the smaller sample size, this would imply that the way the departments organise their research work has not changed substantially between the two surveys. It is estimated that university totals have been increased by at least 140 staff by transfers from research councils and departmental expansions. Estimates of potential staff numbers from the "missing" responses must be of approximately the same order. Although the staff ratios are being maintained, there has been a drop in total staff numbers that more than offsets the gains by transfers from other organisations.

It is useful to look at two further aspects of university staffing. Firstly the overall distribution of researchers across departments, this is shown in **Figure 3.2**, and secondly the actual staffing levels in the largest university departments.

The distribution shown in **Figure 3.2** is double humped and is essentially the same as that obtained from the 1994–1995 survey. This shows that the most common departmental staffing level is about ten researchers of all types. Another significant feature is that there is a large peak at the interval 50–100 researchers and three departments are in intervals above this.

This survey produced a list of 17 schools or departments with more than 40 research workers. These are shown in **Table 3.3**.

Fig 3.3 Research Funding by Source (£m)

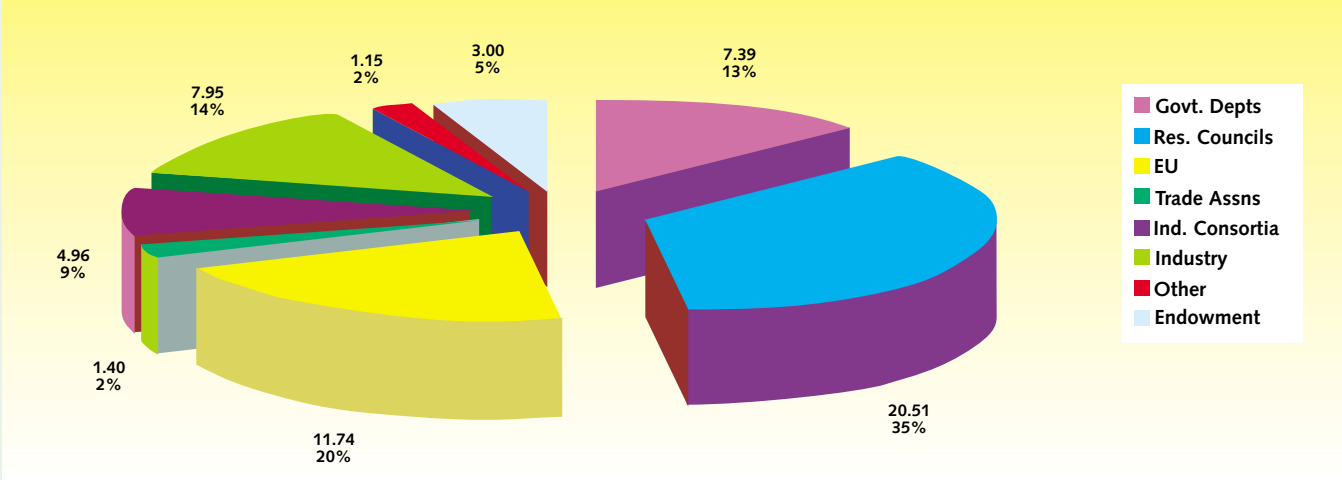


Table 3.3 Schools or Departments with more than 40 Research Workers

University	Department	Total Researchers
University of Southampton	School of Ocean and Earth Science	188
University of Wales Bangor	School of Ocean Sciences	185
University of Stirling	Institute of Aquaculture	110
University of Plymouth	Department of Biological Sciences	93
University of Aberdeen	Department of Zoology	89
University of Plymouth	Institute of Marine Studies	88
University of St Andrews	School of Biology	86
University of Highlands & Islands	Dunstaffnage Marine Laboratory	83
University of Southampton	School of Engineering, Ship Science	74
Heriot-Watt University	Department of Petroleum Engineering	62
University of East Anglia	School of Environmental Sciences	61
Cardiff University	Department of Earth Sciences	58
University of Newcastle	Marine Sciences and Coastal Management	55
University of Liverpool	Port Erin Marine Laboratory	53
University of Newcastle	Department of Marine Technology	53
University College London	Department of Mechanical Engineering	51
Imperial College	Petroleum Engineering Research Group	45

In the previous survey there were 19 departments listed as having more than 40 research workers compared with 17 here. Eleven departments appear in both lists, but some of these show large fluctuations from their previous staffing levels, eg the University of Stirling, Institute of Aquaculture and the University of Plymouth, Department of Biological Sciences show significant increases in their totals, whereas the University of Aberdeen, Department of Zoology and Heriot-Watt University, Department of Petroleum Engineering show significant decreases. Overall the science base of these large departments shows very little change from that of the previous survey.

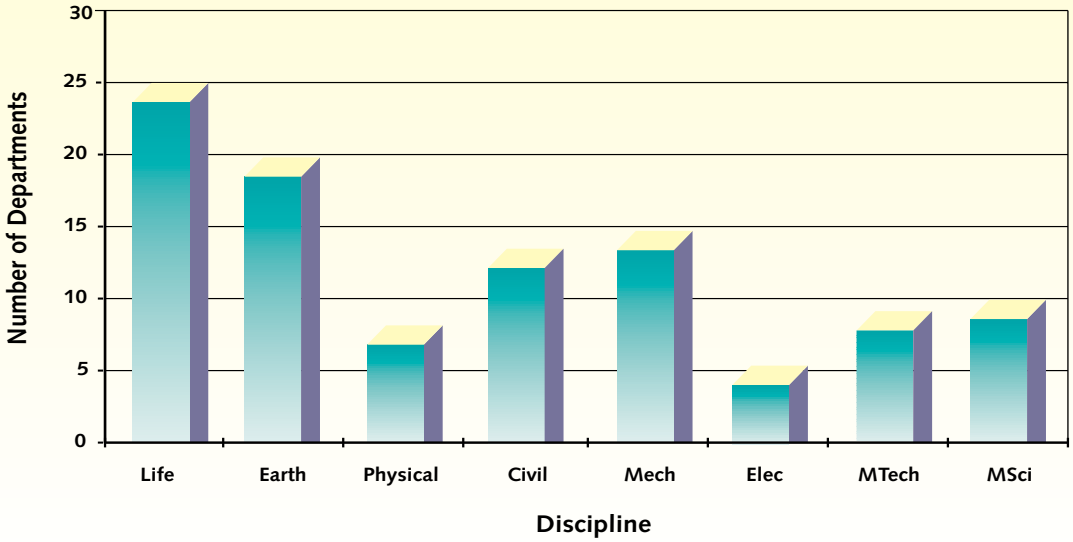
3.4 Funding

The total research funding by source is shown in **Figure 3.3.** Overall the funding from contracts, grants, endowments etc was just over £58m. This compares with the figure of £52.9m (adjusted into 1999 prices) reported in the previous survey and represents a real increase from these sources of about 10% over the period or just under 2% per year. This is a very similar increase to that reported in the previous survey. Overall about 68% (£39.6m) of the total funding is provided by the public sector (Government Departments, Research Councils and the European Union), 25% (£14.3m) by the Private Sector (industry, industrial consortia and trade associations) and the balance 7% (£4.2m) is from endowments, trusts and charities.

The largest single source of funding is the contribution from the Research Councils which amounted to £20.5m, ie 35 % of the total. In real terms there has been an increase in the Public Sector contribution. This mainly arises from an increased contribution from European Union funds, which had more than doubled from the previous survey.

The contribution of £14.3m from the Private Sector compares with the £15.5m (revalued to 1999 prices) from the previous survey. This downturn, in part, probably reflects a decrease in research activity due to the maturity of the North Sea oil and gas fields.

Fig 3.4 Departments by Discipline

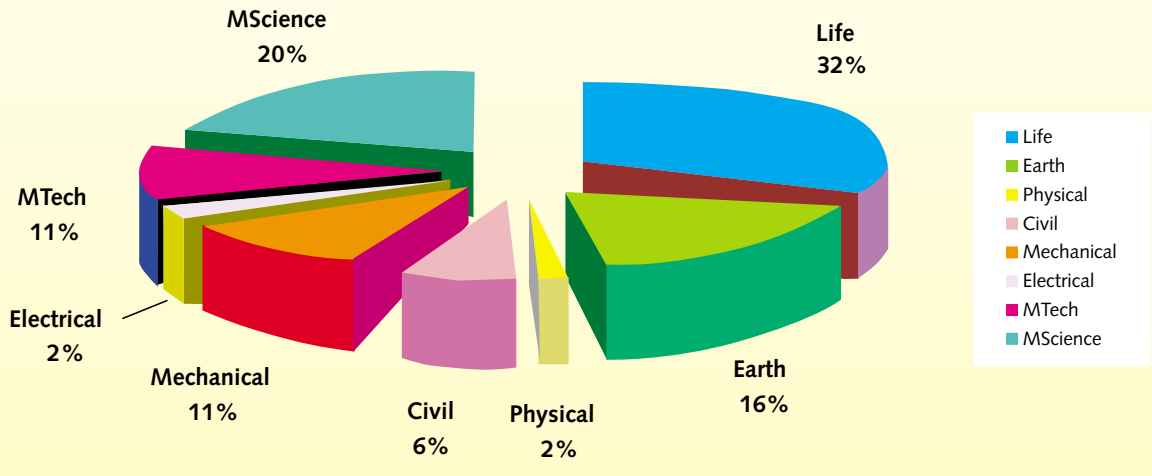


A detailed breakdown of the Endowments received is given in **Table 3.4**. The picture is rather mixed. Compared with the previous survey the funds for Endowed Chairs/Professorships and Facilities/Buildings are substantially increased especially considering the smaller sample size of the present survey. Conversely the Endowed funds for Lectureships and Studentships show a significant decline.

Table 3.4 Endowments

Endowments	FY 1999–2000	FY 1994–1996	FY 1988–1989
		(Revalued to 1999 Prices)	
	£(k)	£(k)	£(k)
Endowed Chairs/Professorships	692	663	441
Endowed Lectureships	70	492	531
Studentships	776	1,527	652
Endowment for Facilities /Buildings etc	1,462	980	730
Total Endowments	**3,000**	**3,662**	**2,354**

Fig 3.5 Researchers by Discipline



3.5 Disciplines

As in the previous surveys the data have been broken down and reallocated into a number of disciplinary groupings. There are several methods by which this could have been done and the preferred one would have been to use the departments' responses to the research topic list. However in order to maintain comparability, the method used in the earlier surveys was retained (See **Table 3.5**). Departments were classified into eight disciplines according to their departmental title: Life Sciences, Earth Sciences, Physical Sciences, Civil Engineering, Mechanical and Chemical Engineering, Electrical and Electronic Engineering, Marine Technology and Marine Sciences. This method has the merit of great simplicity and it works well when dealing with the old traditional style of department, but it does suffer from difficulties when considering the modern interdisciplinary approach to research activities used in some schools and departments. This is particularly evident with schools that cover many traditional disciplines. There are also some difficulties when considering the divide between marine technology and marine science.

Using the above method the number of departments working in the various disciplines is shown in **Figure 3.4**. The distribution of the total number of research workers is given in **Figure 3.5** and the breakdown of the total funding amongst the disciplines is shown in **Figure 3.6**.

An examination of **Figure 3.4** shows that the four disciplines with the largest number of departments are the Life Sciences (25%), Earth Sciences (20%), Mechanical Engineering (14%) and Civil Engineering (13%). Therefore about 72% of the departments engaged in MST are encompassed by these four disciplines. The remaining departments are shared by Marine Sciences, Marine Technology, Physical Sciences and Electrical and Electronic Engineering. The distribution is similar to that recorded in the previous survey except for the following differences. Firstly the number of departments working in the Physical Sciences has fallen rather dramatically dropping it from fourth to seventh place. Secondly the number of departments engaged in Mechanical Engineering has fallen to some extent, but in spite of this it still remains in third place.

The distribution of research workers over the disciplines is given in **Figure 3.5**. The largest numbers of research workers are involved with the Life Sciences (32%), Marine Sciences (20%) and Earth Sciences (16%). This ranking is identical to that in the previous survey; however, the relative number of researchers in the Life Sciences has markedly increased by 7%.

Fig 3.6 Funding by Discipline

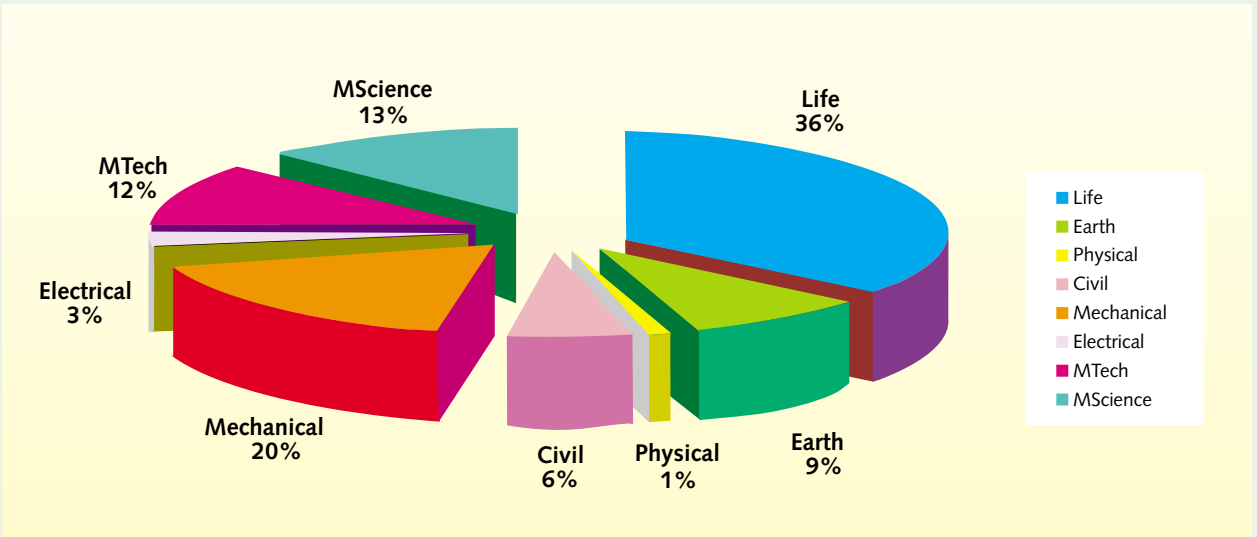


Table 3.5 Disciplines and Sub-Disciplines

Life Sciences & Medicine
Agriculture/Veterinary
Pharmacology
Hyperbaric Physiology
Biology
Zoology
Biochemistry
Aquaculture
Physiology
Marine Biology
Botany/Microbiology
Genetics

Earth Sciences
Polar Research
Quarternary Research
Land Surveying
Geography
Applied Geology
Geophysics
Geology
Earth Sciences

Physics, Maths & Chemistry
Science/Technology
Fluid Mechanics
Corrosion Studies
Aeronautics
Materials
Atmospheric Physics
Chemistry
Physics
Maths

Civil Engineering
Civil/Offshore Engineering
Mining Engineering
Physical Engineering
Concrete Structures
Engineering
Civil Engineering

Mechanical & Chemical Engineering
Sound/Vibration Studies
Petroleum Engineering
Chemical Engineering
Mechanics/Materials
Mechanical Engineering
Aeronautical Engineering

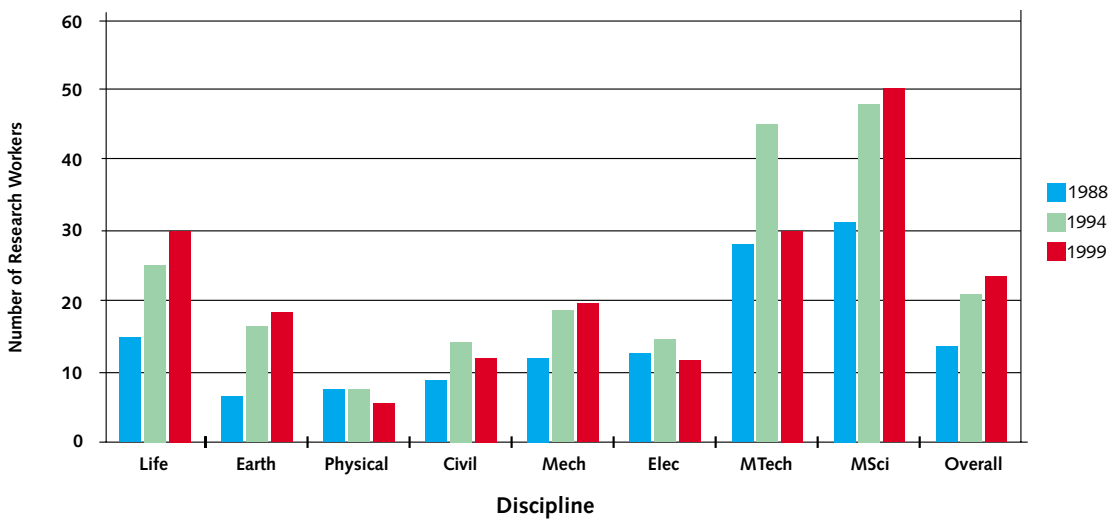
Electrical & Electronic Engineering
Electrical Engineering
Electronic/Electrical Engineering

Naval Architecture & Marine Technology
Marine Technology
Marine Engineering
Offshore Engineering
Shipping/Transport
Naval Architecture/Shipbuilding

Marine Sciences
Space Science
Marine Science/Marine Technology
Environmental Sciences
Oceanography
Maritime Studies
Meteorology

The distribution of funding for the disciplines is given in **Figure 3.6**. As with the number of research workers, the Life Sciences attract the largest share (36%) of the funding. This represents a large increase over that produced for the previous survey. The funding increase coupled with that of the number of researchers reported in the previous paragraph implies a very significant boost of research activity in the Life Sciences. The funding order for some of the other disciplines is: Mechanical Engineering (20%), Marine Sciences (13%) and Marine Technology (12%). Apart from Marine Technology, the relative funding of these disciplines is down from the previous survey, with Mechanical Engineering showing the largest fall.

Fig 3.7 Average Number of Research Workers per Department



Southampton Oceanographic Centre

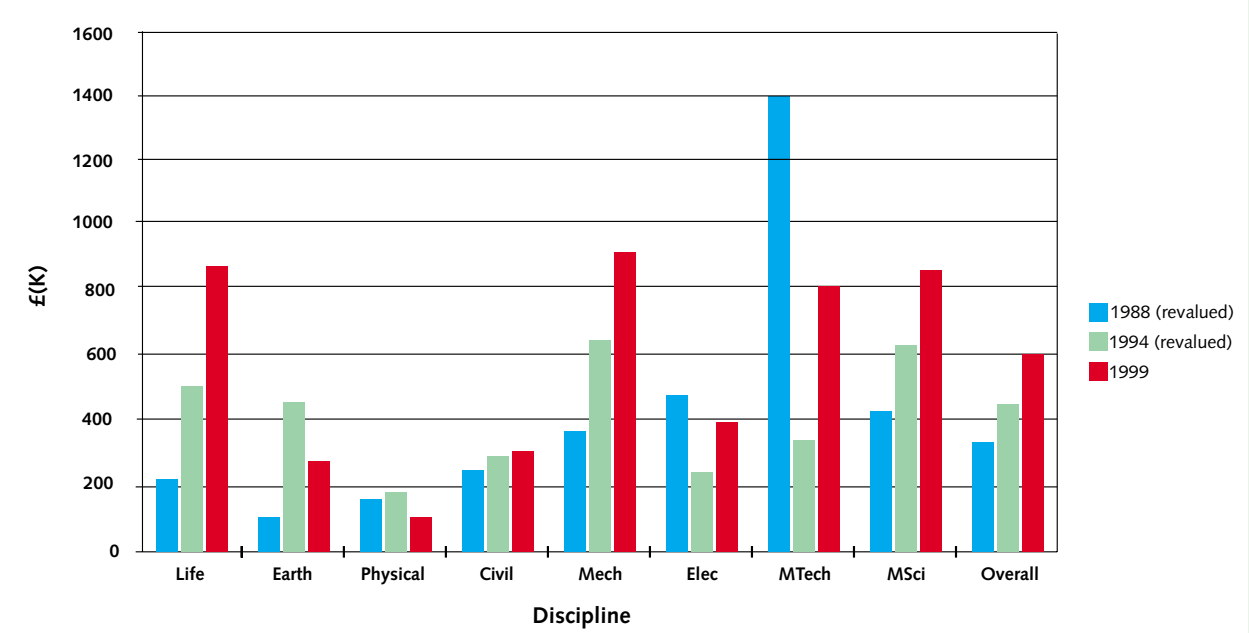
Before seeking any further conclusions from these data it is useful to examine two other parameters for the disciplines. These are: the average number of researchers per department and the average funding per department. The former is shown in **Figure 3.7** and the latter in **Figure 3.8**. In order to facilitate comparisons, the values from the previous surveys are also shown.

Figure 3.7 shows that overall there has been an increase in the average number of researchers per department from 21 to 23 compared to the previous survey. This is not as great an increase as achieved between the earlier surveys, but nevertheless it is significant, ie nearly 10%. Taking into account the smaller sample size, this may imply a real reduction in the number of departments involved in MST coupled with an increase in their size. When one examines the changes for the individual disciplines the fluctuations deviate markedly from the overall value. The Life Sciences, Earth Sciences, Marine Sciences and Mechanical Engineering all show increases of varying degree. The increase for the Life Sciences is over twice that for the overall figure, whereas Mechanical Engineering has barely changed. The Physical Sciences, Civil Engineering, Electrical and Electronic Engineering, and Marine Technology all show decreases. The most dramatic is in the change of Marine Technology which shows a decrease of nearly 35% in the average staff numbers per department.

The changes in average funding per department are shown in **Figure 3.8**. The average funding over all disciplines shows an increase of just over 34%. Since the growth in funding in real terms for MST research activities as a whole given in Section 3.4 was only 10% over the period of the last two surveys, it implies the concentration of resources into fewer departments. A trend continued from the early surveys. The changes in funding are far from uniform across the disciplines. Although most are winners, the increases vary quite widely. Marine Technology, Mechanical Engineering and the Life Sciences all do better than the overall figure. Civil Engineering virtually stands still and, the Earth and Physical Sciences show significant losses from the previous survey.

The average funding per head by discipline for all types of research worker is £26k. Mechanical Engineering, Electrical Engineering, Life Sciences and Marine Technology all show funding above the overall average. The Earth, Physical and Marine Sciences are well below the average. Life Sciences have the largest number of postgraduate students with an average of 2.37 postgraduates per academic. The Physical Sciences has the lowest with a ratio 0.7. The ratios for the rest of the disciplines lie between 1.58 and 1.89.

Fig 3.8 Average Research Funding per Department per Year



3.6 Priorities of Research Topics

Respondents were asked to list the research topics that were most important to the work of their department. Summing all of the replies to this question provides a simple measure of the overall popularity of the individual research topics. A list of the most popular research topics obtained in this way is given in **Table 3.6**. This shows Estuarine Studies in top place followed by research in the Coastal Zone and then Seabed Studies. It would appear that these topics have displaced the biological sciences recorded in the top places of the previous survey.

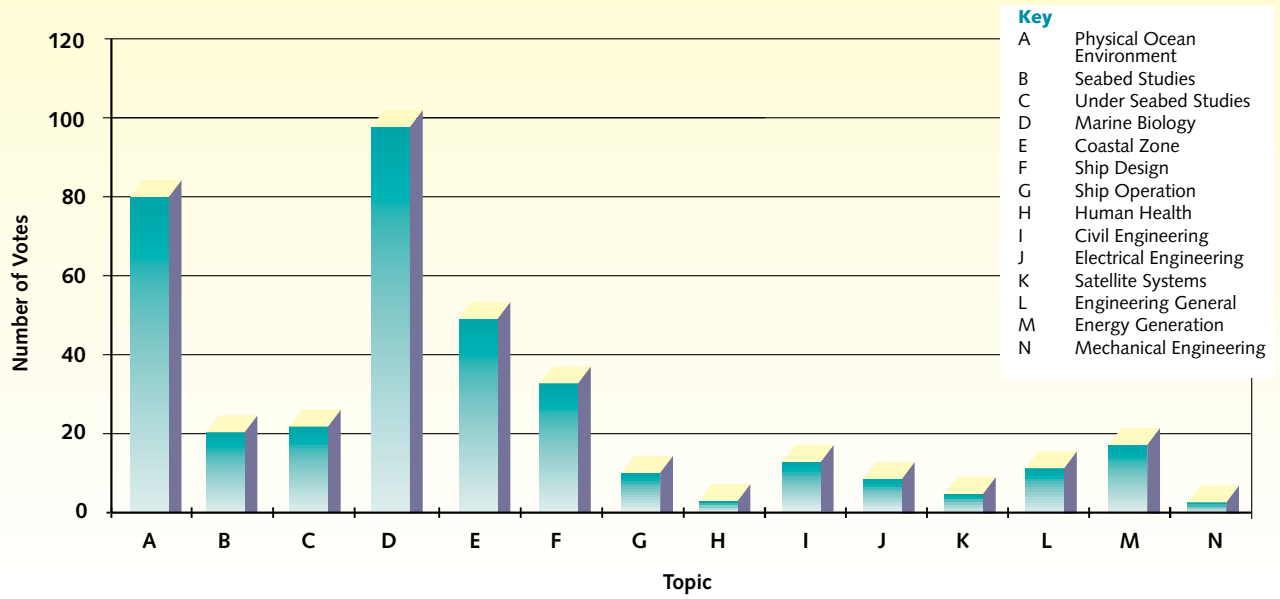
This direct approach suffers from the defect that in their choice of topics some respondents chose to use the more general subject heads to describe their work, while others used the more detailed sub-divisions. To overcome this problem, all of the votes in the sub-divisions were summed within a subject head. The results are given in **Fig 3.9**. This shows that the four most popular subjects were: Marine Biology, the Physical and Chemical Ocean Environment, the Coastal Zone and Ship Design. These results are very similar to the last survey except that the Coastal Zone has displaced Under Seabed Studies. It also re-emphasises the relative importance of the biological sciences.

In the above all departmental responses have been treated equally and no account has been taken of the relative size of the department which voted for a particular topic. To estimate the relative effort going into a particular topic it is necessary to weight the responses to take into account departmental size. If this is done, then the relative positions of the main topics remain largely the same. However, if one also looks at the sub-levels in the topic list in addition to the main topic heads then some changes become apparent. When this is done, the ranking of the ten top research topics attracting most research effort is: Marine Biological Studies, Seabed Studies, Physical and Chemical Ocean Environment, Coastal Zone, Under Seabed Studies, Aquaculture, Biology of Marine Organisms, Ecotoxicology, Ecology and Satellite Systems.

Table 3.6 Most Popular Research Topics in Universities

Rank	Topic
1	Estuarine Studies
2	Coastal Zone
3	Seabed Studies
4=	Ecotoxicology
4=	Ecology
6=	Physical and Chemical Ocean Environment
6=	Environmental Impact Studies
8=	Ocean/Atmosphere/Climate
8=	Waves
8=	Sediments
8=	Marine Biological Studies
8=	Aquaculture
8=	Physiology of Marine Organisms
8=	Beach Processes
8=	Sedimentation and Erosion
8=	Inter-Tidal Coastal Management

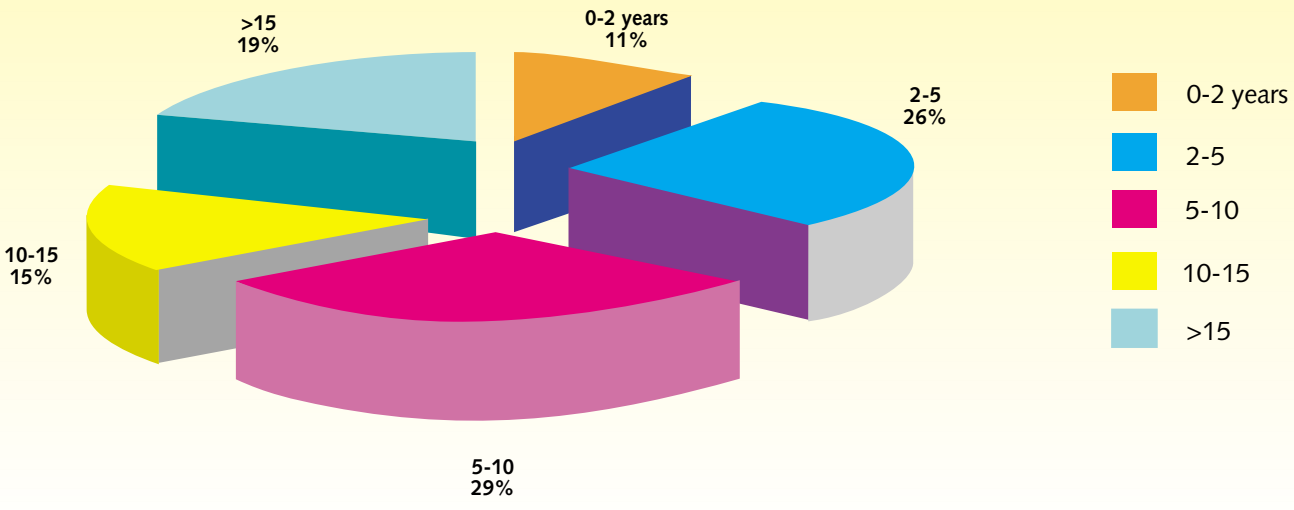
Fig 3.9 University Priorities



3.7 Timescales

Departments were requested to include information on the time scale of their research work in their selected topics using intervals 0–2, 2–5, 5–10, 10–15 or >15 years. The replies are shown in **Figure 3.10**. The peak response was in the interval 5–10 years closely followed by those in the interval 2–5 years. The present survey shows that just under two thirds of the research topics are planned to last 10 years or less, a very similar result to the previous one, which recorded a slightly larger figure. Short-term research work increased to 11% of the total responses. This probably indicates the continuing need for departments to increase their funding by undertaking contractual work of short duration.

Fig 3.10 Time Scale of Research Effort



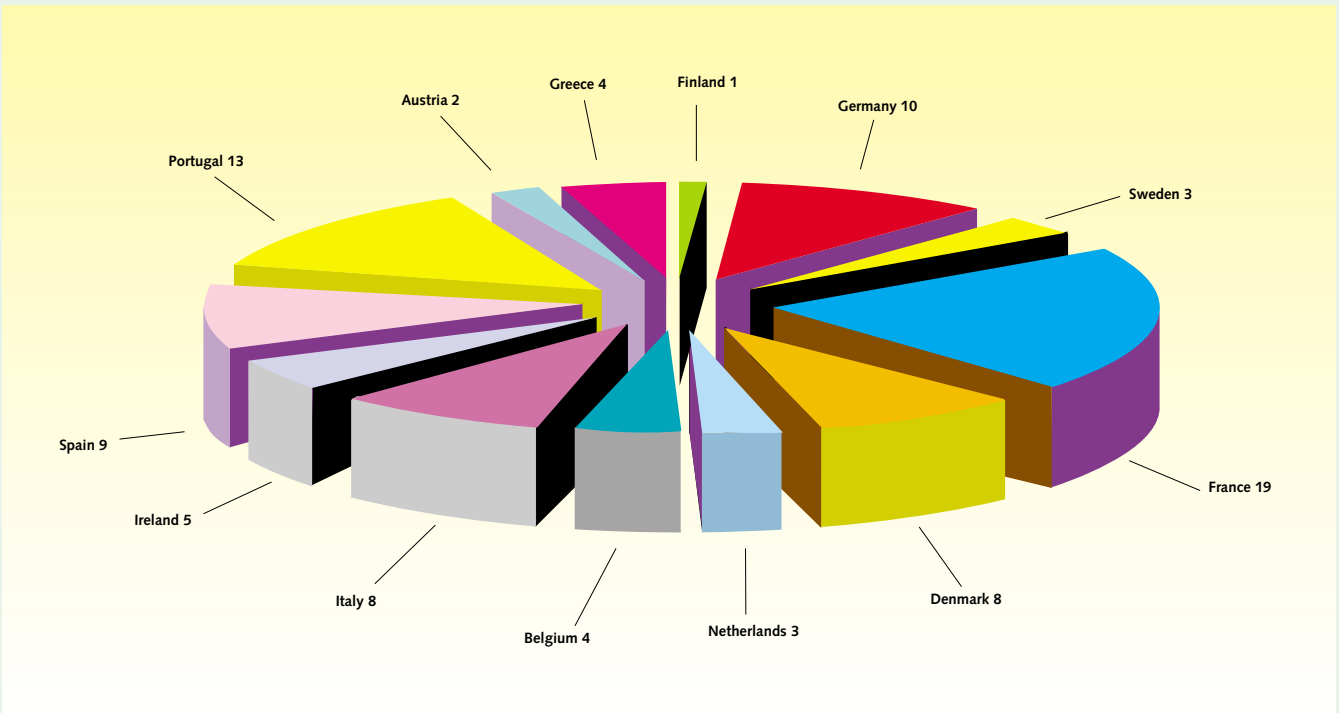
3.8 Use of Resesearch Vessels

Only 28, ie just under one third, of the responding departments said they were using research vessels for their MST research activities. The vessels ranged from the larger ocean going variety to smaller vessels for inshore and shelf seas use. Mainly the larger vessels were provided by organisations such as NERC, with an apparent increase in the use of the BAS vessel the *James Clark Ross*. Eighteen departments reported this type of sea time usage. Three departments said they were using foreign research vessels for their sea time.

Twelve departments working in the shelf seas and coastal or estuarine waters were by far the largest users of ship time. At least four of the departments involved in this type of research reported using between 200–400 sea days per year. The vessels used in this case were principally owned by the departments or universities concerned. Some of the sea time on the smaller vessels was used for the training of both undergraduate and postgraduate students.

RV *Scotia*/TG McInnes, Fisheries Research Services

Fig 3.11 Collaboration with EU Countries



3.9 Collaboration

Eighty-one of the eighty-six respondents listed some collaboration with other university departments. In total they cited 378 collaborating departments producing an average of 4.7 collaborating departments per department. The departmental spread ranged from just one, to collaborations with over 20 other departments. There were 179 citations of collaboration with other UK university departments and 199 for collaboration with overseas universities. These data represent a significant increase in reported collaboration with other universities over the previous survey, especially with those from overseas.

The collaborative departments were then grouped into universities. The following table shows the ten universities with the largest number of collaborative citations from other UK universities. For collaboration with overseas universities, the largest number of citations were for universities in the European Union (89), followed by citations for universities in the USA (40) and for other countries (70). Citations in this latter group included a number of universities in the Far East, particularly from China and Japan.

A breakdown by country for collaboration with the European Union is shown in **Figure 3.11**. The largest numbers of collaborative citations were recorded with organisations from France followed by Portugal, Germany and Spain

3.7 Universities with the Largest Number of UK Collaborative Citations

University	No of Citations
University of Plymouth	21
University of Southampton	20
University of Newcastle	13
University of Wales, Bangor	10
Imperial College	9
Heriot-Watt University	8
University of Edinburgh	8
University of East Anglia	7
University of Cambridge	7
University of Aberdeen	6

This table does not include overseas links.

4
CONCLUSIONS

4.1

The total annual turnover in marine-related sectors, estimated for 1999-2000 is shown in **Figure 4.1** and summarised in **Table 4.1**. This total marine-related turnover for 1999-2000 is £69.2bn. The value added by each sector is estimated in **Table 4.1** based on factor analysis and information from a wide range of sources as discussed in Chapter 2. The total marine-related value added is estimated at £38.9bn. For reasons which we will discuss below, these figures are not directly comparable with the figures we published earlier for 1994-95. Nevertheless, they do confirm that marine-related activities remain an important contributor to the overall British economy.

Table 4.1 Turnover and Value Added by Marine Sector

revalued to1999 prices **all £ million**

	1994-5		1999-2000	
Sector	**Turnover**	**Value Added**	**Turnover**	**Value Added**
Oil and Gas	15295	12310	20597	14810
Leisure	10129	6859	19290	11770
Defence	6762	2703	6660	2531
Business Services	6417	1099	4535	1080
Shipping	5007	2317	5200	2400
Ship building	4002	1875	3172	1574
Equipment	3565	1438	2326	1358
Fisheries	2392	822	2447	825
Environment	1380	460	1050	435
Ports	1311	918	1690	1183
Construction	826	231	500	190
Research	645	309	609	292
Telecommunications	460	230	500	190
Safety	336	138	316	129
Crossings	178	100	155	87
Aggregates	168	87	131	69
Education	54	28	49	25
total	**58927**	**31923**	**69227**	**38948**

Fig 4.1 Turnover and Value by Sector

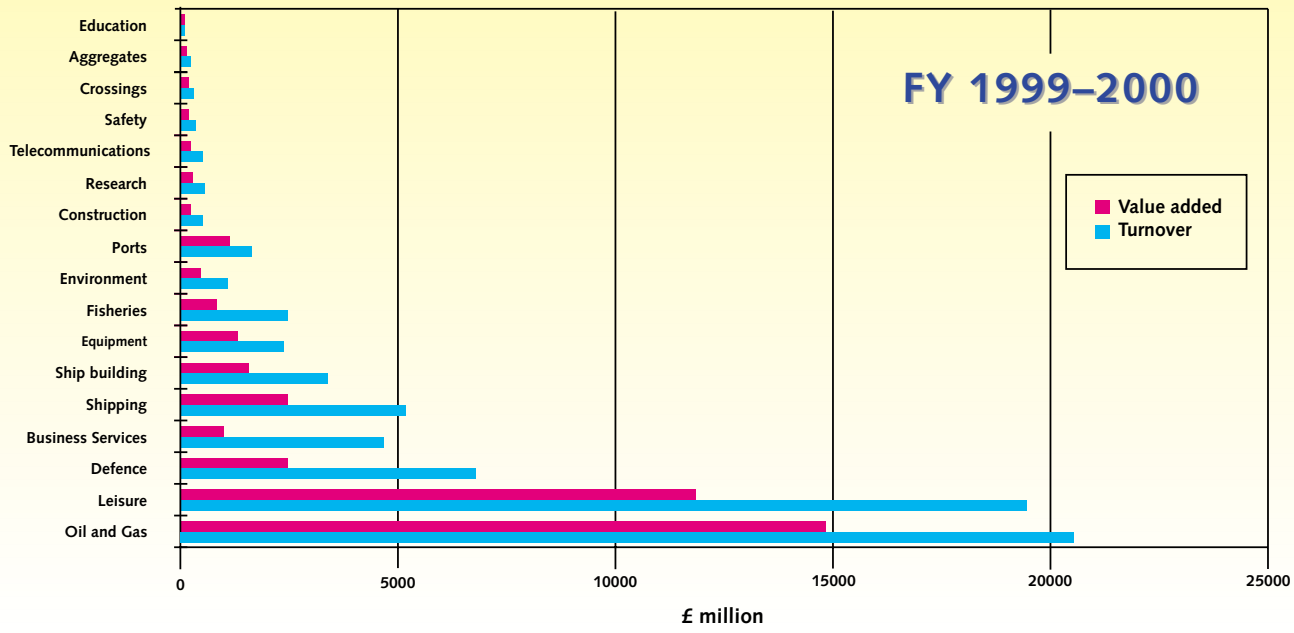


Fig 4.2 Percentage of Total Marine-related Turnover by Sector

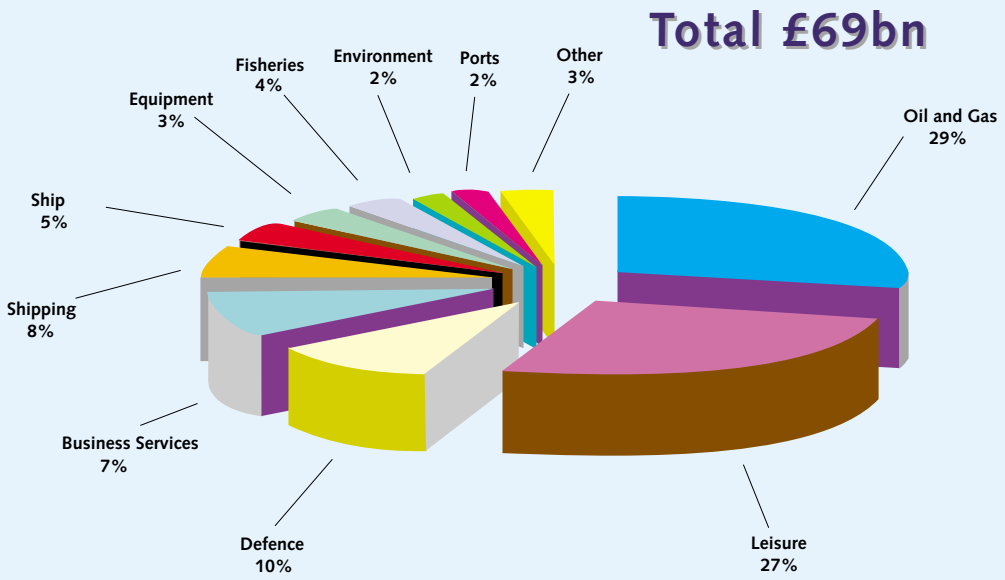
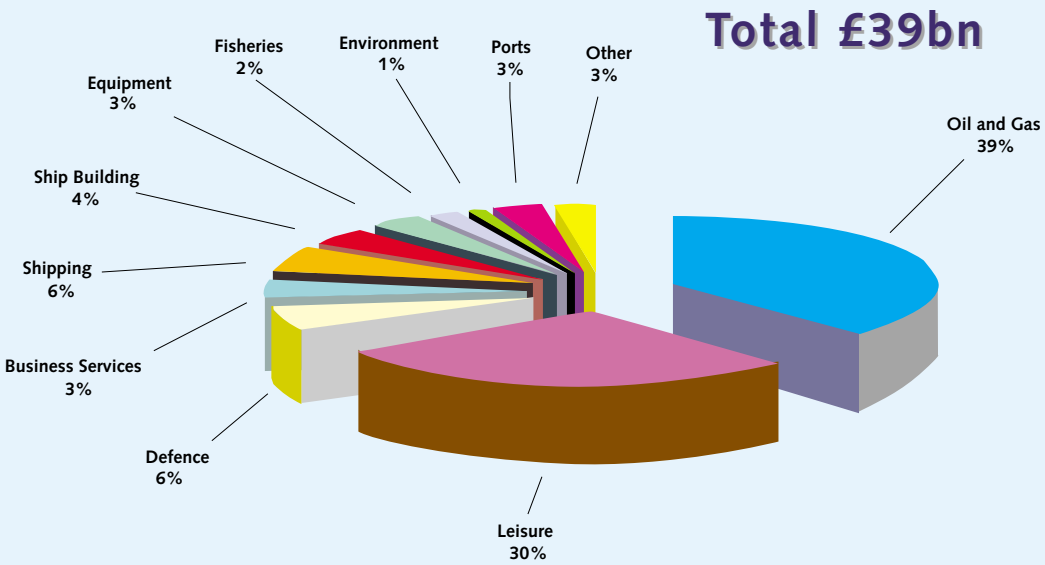


Fig 4.3 Percentage of Total Marine-related Contribution to GDP by Sector



4.2

In 1999-2000 the GDP based on income analysis was £788bn, of which the marine-related component is 4.9%. In **Table 4.2** the marine-related contribution to GDP has been adjusted to £44.0bn for comparison with GDP at market prices; GDP at market prices exceeds that based on income factor analysis because it includes taxes on expenditure and subsidies enforced during the period of account. Again, although this figure is similar to the 4.8% we estimated for 1994-95, and the 5% estimated by CCMST for 1988 (Reference 16), different sources and procedures have been involved in each case, although we have tried where possible to maintain consistency. The estimated marine-related spend on research and development in 1999-2000 was £609m, 1.4% of the total marine-related contribution to GDP at market prices. As **Table 4.2** shows this is less than the overall average of 1.86 spent within the United Kingdom on R&D, as a proportion of the total GDP. In slightly different terms, the marine-related R&D is 3.7%of the total UK R&D, almost identical with the 3.8% in 1994-95. This 3.7% spent

Table 4.2
Comparisons of R&D Spend and Levels of Economic Activity

Table 4.2 (a)
1999-2000

	Total UK	Marine UK	Marine
GDP(£bn)	896	44.0	4.9%
R&D(£m)	16663	609	3.7
R&D %	1.86	1.4%	

Table 4.2 (b) (seaside tourism excluded)
1999-2000

	Total UK	Marine UK	Marine
GDP(£bn)	896	31.9	3.6%
R&D(£m)	16663	609	3.7
R&D %	1.86	1.91%	

1994-1995

	Total UK	Marine UK	Marine
GDP(£bn)	666.2	26.5	4.0%
R&D(£m)	14613	561	3.8
R&D %	2.19	2.12%	

on R&D is significantly lower than the 4.9% marine-related contribution to GDP. Again, we must emphasise that these figures are based on estimates, and that marine-related R&D has been particularly difficult to estimate in the commercial sector. **Figures 4.2 and 4.3** show the percentage contributions by each sector to turnover and to GDP.

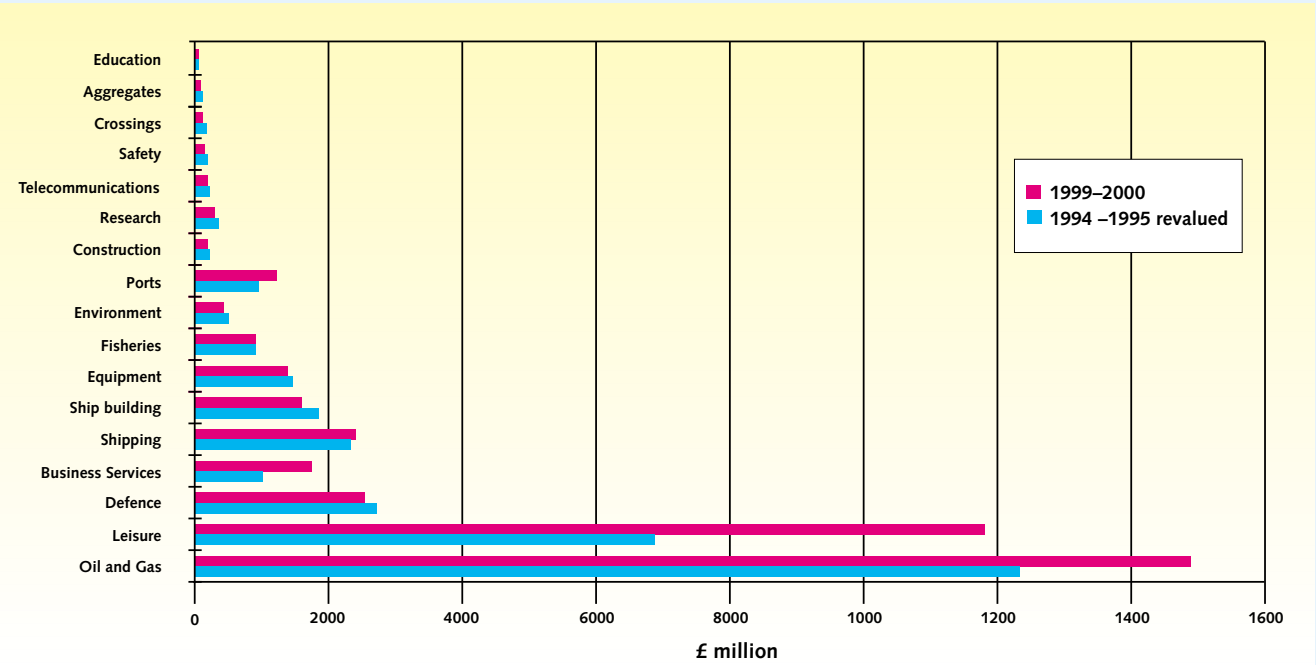
4.3

One of the most controversial components of the analysis which we published in 1994-95 was the estimated contribution for seaside tourism. This sector was included for consistency with the earlier CCMST analysis (Reference 16); it was argued that it is a major industry dependent on a healthy marine environment. This time we consulted the British Tourist Authority which produced estimates much higher than those which we had prepared for 1994-95. The difference between the two surveys is responsible for a large part of the increase from 1994-95 to 1999-2000, over and above an estimated inflation of 15%. In order to provide comparable statistics, particularly for that part of the marine-related sector which is supported by marine-related R&D, the second part of Table 4.2 recalculates the figures for both 1994-95 and 1999-2000 with the seaside tourism excluded. Marine-related R&D is not a major factor for the development of the seaside tourism sector. The lower figure of 3.6% of UK GDP being marine-related in 1999-2000 is not significantly different from the 4% for 1994-95. Also, the marine R&D activities of 3.7% and 3.8%of the total R&D activity in the two sample years are consistent. The fall in marine-related R&D from 1994-95 to 1999-2000 almost exactly matches that for R&D in the total UK economy.

4.4

Value added by sector is shown for both the survey years in **Figure 4.4**. (See also **Table 4.1**) We have already discussed the difference in the figures for the leisure sector. The oil and gas contribution to GDP fluctuates depending on the price of oil as explained in Chapter 2. These fluctuations are virtually independent of the steadily increasing levels of production. Other sectors which are well documented include defence (a reduction), ship building (a reduction), fisheries (level, but with significant changes within the sector) and construction (a reduction). Shipping invisibles, renamed "Business Services" is based on a different method of evaluation which suggests that the earlier estimates may have been low.

Fig 4.4 Value Added by Sector (1999 prices)



4.5

The contribution of a marine-related sector to GDP is a measure of its wealth creation capabilities, in a strict economic sense. However, there are many examples of marine-related activities which contribute to the quality of life of UK citizens, but which are not themselves classified as economic goods because no charge is made. Many of these are indirectly linked to economic activities, such as seaside tourism and boating. The importance of these non-goods is increasingly recognised in overall assessments of environmental value (Reference 17). The Annual Value of the so-called Ecosystem Services (AVES) has been estimated at many times the calculated national GDPs. For example, a recent report to the Scottish Coastal Forum (an initial assessment of the socio-economic and environmental benefits from ICZM in Scotland) estimated the annual AVES from Scottish waters within only 1km of the coastline to be around £4.5bn, or 7.3% of Scotland's GDP.

4.6

Our two detailed surveys of R&D in universities allow some comparisons, although the number of questionnaires returned was reduced for 1999-2000. Overall, there is a consolidation into larger departments with more money available for each researcher. Allowing for inflation there has been a real increase of marine-related R&D in universities in terms of money spent of about 10%. University research funding for the financial years 1999-2000 and 1994-1995 is shown in **Figure 4.5**. It can be seen that the overall increase in the total funding for 1999-2000 is principally due to the growth in financial support from the EU.

Fig 4.5 University Research Funding by Source

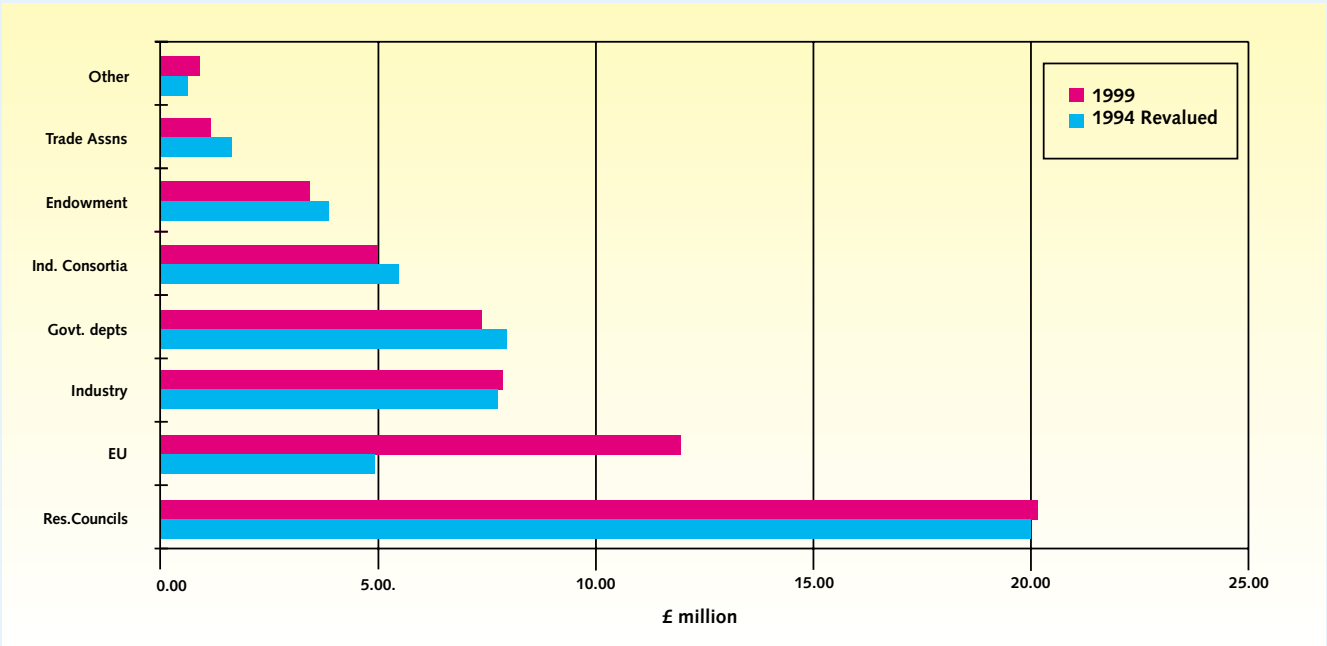
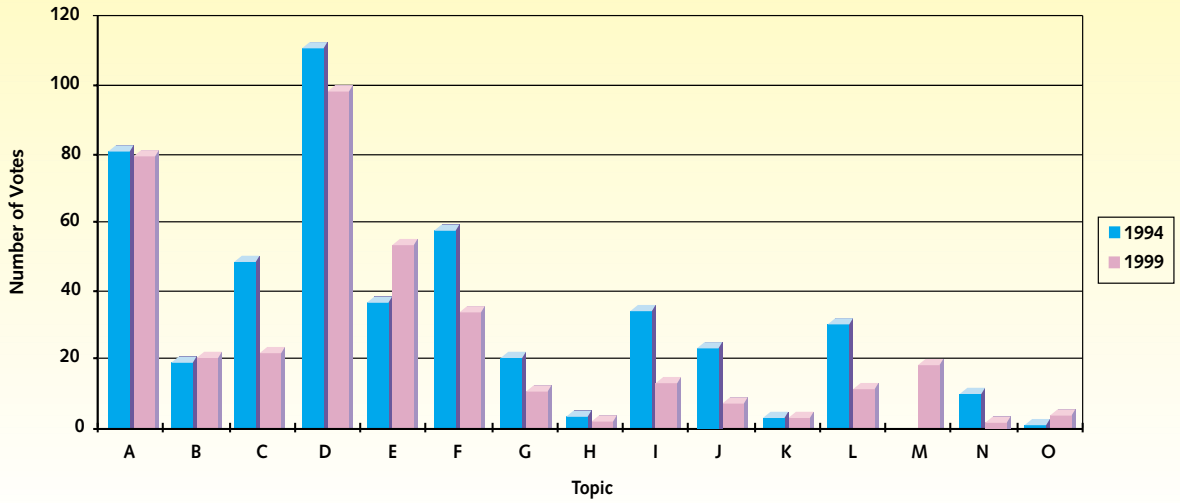


Fig 4.6 University Priorities



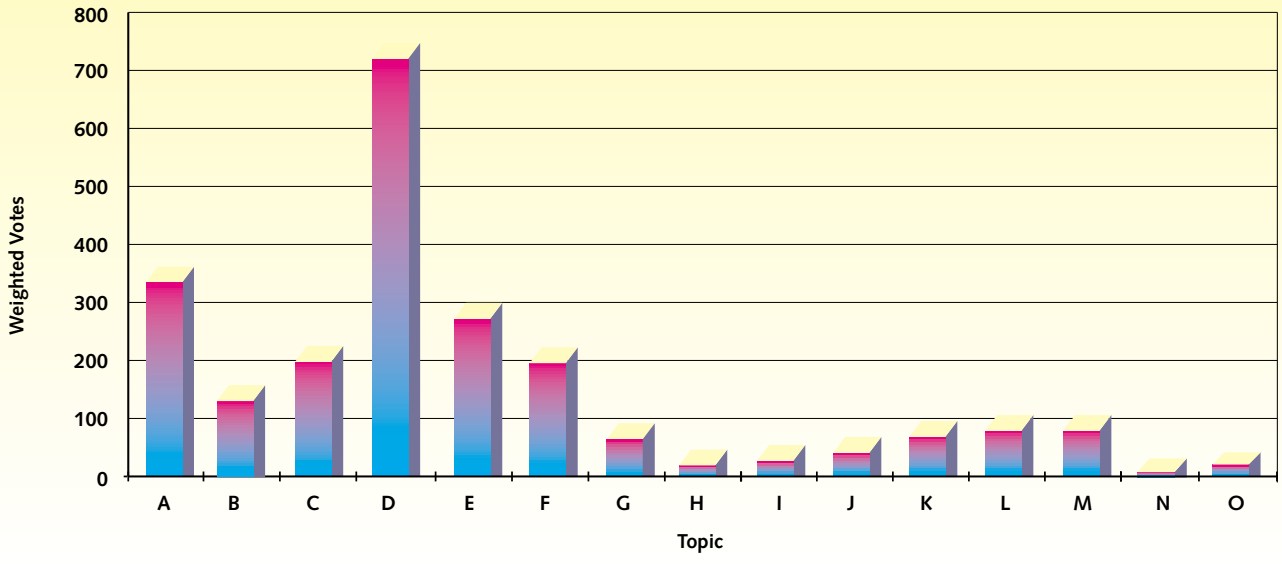
Figs 4.6 and 4.7

Key	Topic
A	Physical Ocean Environment
B	Seabed Studies
C	Under Seabed Studies
D	Marine Biology
E	Coastal Zone
F	Ship Design
G	Ship Operation
H	Human Health
I	Civil Engineering
J	Electrical Engineering
K	Satellite Systems
L	Engineering General
M	Energy Generation
N	Mechanical Engineering
O	Holistic Marine Studies

4.7

University research priorities for 1994-1995 and 1999-2000 are compared in **Figure 4.6**. The chart shows that Marine Biological Studies and the Physical Ocean Environment are in the top two places for both financial years with quite a large margin over all the other topics. These are followed by the Coastal Zone, which moves up a place from the previous survey to third place and Ship Design which drops back into fourth place. If the university responses are weighted by taking into account departmental size, then although the relative priorities of the various research topics remain largely unchanged, the importance of Marine Biological Studies as the top university priority is clearly emphasised. This is shown in **Figure 4.7**.

Fig 4.7 University Priorities (Weighted)



4.8

Information gathered in the survey has also been used to compare the relative R & D resources available to the separately aggregated Science and Technology disciplines. The results for the number of departments, research staff and total funding from both the current and previous surveys are shown in **Table 4.3**. This shows a rather complex picture.

There has been a large drop in the number of science departments, some of which can be attributed to the amalgamation of departments to form large multidisciplinary schools. It also appears from the returns that part of the decrease relates to a reduction in the small group or singleton researcher working in a department whose main interest is not in MST. The fall in the number of technology departments has been much smaller although similar pressures to form multidisciplinary schools and amalgamations exist. By contrast the drop in research staff numbers has been much greater in the technology sector (14%) compared with the science sector (6%). The overall position is further complicated in that although science has a much larger total funding, technology funding has increased much more sharply over the period between the two surveys. This fall in staff numbers coupled with the increase in technology funding is a factor in explaining why the funding per researcher in this sector remains high in MST. The fall in the number of technology departments has been much smaller although similar pressures to form multidisciplinary schools and amalgamations exist. By contrast the drop in research staff numbers has been much greater in the technology sector (14%) compared with the science sector (6%). The overall position is further complicated in that although science has a much larger total funding, technology funding has increased much more sharply over the period between the two surveys. This fall in staff numbers coupled with the increase in technology funding is a factor in explaining why the funding per researcher in this sector remains high.

Amec Wind

Table 4.3 Comparative R & D Resources for University Science and Technology, 1999 Prices

	Science		Technology		Total	
	1994-1995	1999-2000	1994-1995	1999-2000	1994-1995	1999-2000
Departments	78	59	40	37	118	96
Staff	1653	1555	797	684	2450	2239
Funding (£m)	33.5	34.8	19.4	23.3	52.9	58.1
Funding/Researcher (£k)	20.3	22.4	24.3	34.1	21.6	25.9

Table 4.4 Comparative Breakdown of University R&D Funding Between Science and Technology, FY 1994-1995 and 1999-2000

Funding Source	Science (£m)			Technology (£m)		
	1994-1995	1999-2000	Change	1994-1995	1999-2000	Change
Government Depts	5.5	5.4	-0.1	2.5	2.0	-0.5
Research Councils	13.5	14.7	1.2	6.5	5.8	-0.7
EU	4.4	7.5	3.1	0.5	4.2	3.7
Trade Associations	2.0	0.4	-1.6	0.1	1.0	0.9
Industrial Consortia	1.7	1.0	-0.7	3.8	4.0	0.2
Industry	4.0	3.1	-0.9	3.9	4.9	1.0
Endowment	1.6	1.7	0.1	2.1	1.3	-0.8
Other	0.8	1.0	0.2	0.0	0.1	0.1
Total	**33.5**	**34.8**	**1.3**	**19.4**	**23.3**	**3.9**

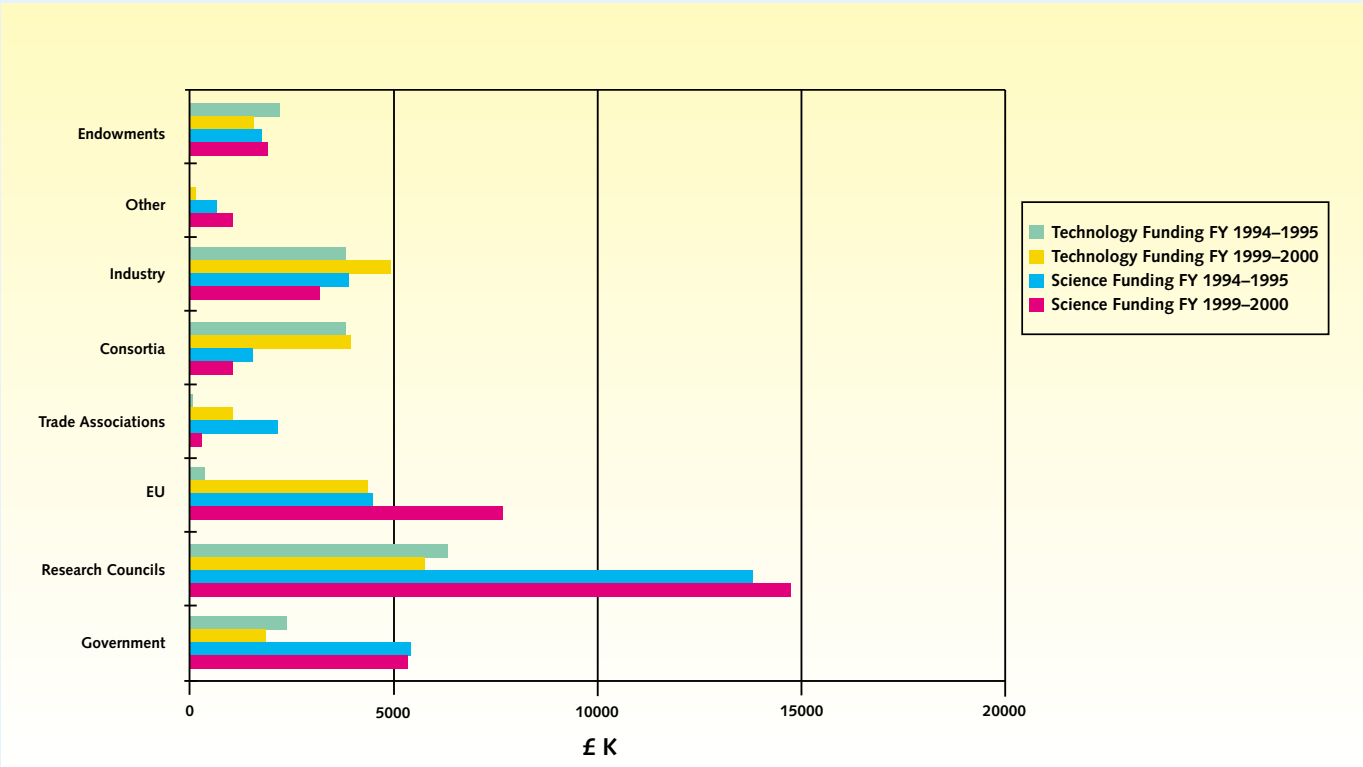
A comparative breakdown of R & D Funding for the financial years 1994-1995 and 1999-2000 is given in **Table 4.4**. The data are also plotted in Figure 4.8. Overall the main sources of funding in the science sector are the Research Councils, the EU and Government Departments. The increases in funding for this sector come principally from the EU and the Research Councils. Funding from the private sector has decreased.

The most important funding sources for technology are the Research Councils, the EU and the industrial sector. Technology has gained most from the EU and Industry. Funding from Government Departments and the Research Councils has dropped.

4.9

This survey has attempted to repeat the analysis we published for 1994-95, probably as an interim before a more substantial update for 2004-05 or later. Because many of the statistics which we gather come from unofficial sources and through different procedures, the process is inherently noisy statistically, and so any trends must be interpreted with caution. Unexpectedly, we found that the work involved in this revision was comparable with that of the initial survey. There have been increasing delays in the publication of official statistics, in part due to the Government reorganisation following the General Election of 2001. Also, many of the university responses had to be chased on several occasions: it appears that the Research Assessment Exercise, also in 2001, relegated less formal questionnaires to a lower priority. Nevertheless, we believe that the figures we have prepared will be of general interest. In addition, they can be used by IACMST and other research-funding bodies to identify the size of the various marine-related sectors in the UK economy. A more detailed linking between these sectors and associated R&D is a subject for further analysis.

Fig 4.8 Sources of Funding for University Marine Science and Technology



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