



Plymouth Travel-To-Work Area Sectoral Workforce Development Programme

Medium- to Long-Term Skills Needs
Key Sector: Research & Development

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December 2002

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December 2002

Commissioned by:
Plymouth Learning & Work Partnership

Researched by:
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Executive Summary

- ❖ Research and Development (R & D) activities can be defined in at least two ways, either as R & D performed within businesses enterprises or R & D funded indirectly and performed in higher education institutions, government departments, agencies, and non-departmental public bodies, local authorities, and private non-profit organisations.
- ❖ R & D activities are notoriously difficult to profile and do not necessarily constitute a recognised sector in the UK economy in the same way as do the other sectors studied in this Series.
- ❖ There is also very little detailed information and data about the level of R & D activity performed at the regional, sub-regional or, especially, the PTTWA level. This situation creates difficulties in profiling R & D activities at these levels.
- ❖ For the purposes of this report the main area of focus is upon R & D activities undertaken within sector based business enterprises. Therefore, this report has utilised the findings relating to R & D activities performed in businesses enterprises from other sector based reports in this Series.
- ❖ Forecasts for R & D employment and occupational change have already been included within forecasts for other sectors studied in this Series. R & D activities performed in not-for-profit organisations have also been examined with both elements considered together at a higher level of aggregation, so that current trends in R & D provide an insight into the changing skills needs within this area of activity for workforce development. As a result, the structure of this report is very different from the one adopted in other reports in this Series.
- ❖ In 2000, £11.5 billion was spent on R & D performed within UK businesses and the Office for National Statistics (ONS) highlights that this is a rise of 2% at current prices compared with the 1999 total. Total R & D expenditure in 2000 represented approximately 1.2% of GDP and this proportion of GDP has remained relatively constant since 1993.
- ❖ The product group with the largest expenditure on R & D was pharmaceuticals, with expenditure in 2000 of £2,846 million, nearly 25% of all spending. Other major product groups were aerospace (£1,091 million, 9% of all spending) and radio, television and communication equipment (£1.024 million, again nearly 9% of all spending).¹
- ❖ The overall level of funding of R & D activities from businesses ‘*own funds*’ was £7,244 million in 2000, which constituted 63% of the total R & D expenditure from all sources in the UK in 2000. Funding of R & D in businesses in the UK from abroad was £2,470 million in 2000, which constituted 21% of the total R & D expenditure from all sources. In comparison, UK Government funding in businesses for R & D was £1,013 million in 2000, which constituted only 9% of the overall total.

- ❖ In terms of employment, the number of staff employed specifically on R & D decreased by 5% between 1999 and 2000 with scientists and engineers accounting for 59% of the staff employed on R & D in 2000. The remaining 41% of staff employed on R & D were split equally between technicians, laboratory assistants and draughtsmen and administrative, clerical, industrial and other staff.
- ❖ In general, many of those engaged in R & D activities will be highly qualified at least to degree level and possess a wide range of both specific technical and generic skills. The main occupations involved in R & D activities include:
 - ❖ Scientists and engineers: professionals engaged in the conception or creation of new knowledge, products, methods and systems.
 - ❖ Technicians: qualified personnel who participate in R & D projects by performing scientific and technical tasks, normally under the supervision of professional scientists and engineers. They will usually have a scientific or engineering qualification.
 - ❖ Administrative and other; other supporting staff, including skilled and unskilled craftsmen, secretarial and clerical staff participating in R & D projects or directly associated with such projects.
- ❖ Although there is very little information and data available on R & D activities at the regional level the ONS provides a regional breakdown of R & D performed within South West businesses. The ONS estimated that R & D expenditure was approximately £867 million in 2000 and that there were 12,000 people employed in South West businesses involved in R & D activities.
- ❖ However, in 2000 the level of R & D performed in the region only constituted 7.5% of the total UK R & D spend by businesses, in contrast, the top performing region was the South East at 25.8%.
- ❖ In addition to the internal R & D activities of businesses, R & D is also conducted in many regional higher education institutions, government departments, agencies, and non-departmental public bodies, local authorities and private non-profit organisations.
- ❖ There are 11 higher education institutions in the region, providing world class research expertise in key technology areas. The universities and colleges of the South West have a research income of over £75 million per year. There are a number of specialist centres where research is conducted in collaboration with high technology companies.
- ❖ There is an important relationship between the not-for-profit sector and the private sector in R & D. Exploiting the potential of university, industry and government relations is increasingly regarded as a centre piece of policies designed to promote the capitalisation of knowledge. A series of government White Papers and other reports have highlighted the economic animator role to be played by the university sector, in supporting local and regional economic development.
- ❖ Invest UK, a government body that promotes R & D in the UK, highlights the role of science and business parks in exploiting the potential of university, industry and

government relations and also the role that science parks have in supporting local and regional economic development through R & D activities.

- ❖ The PTTWA houses two of the sub-regional universities (one a university college) as well as a college of art and design and further education colleges that undertake a significant amount of R & D. The area, in fact, acts as a focus for higher and further education and R & D activities well beyond the boundaries of the TTWA.
- ❖ Another crucial R & D linkage is provided by the Tamar Science Park which houses many of the higher education R & D related '*spin-off*' companies, along with a significant number of private enterprises which undertake high levels of R & D. The Tamar Science Park is situated in the City of Plymouth near to the airport, Derriford Hospital and Derriford Business Park.
- ❖ There is also a significant level of R & D undertaken in the University of Plymouth itself as well as in its '*spin-out*' companies, and this includes both academic and more applied research. The University of Plymouth is increasingly becoming involved in transferring the knowledge, expertise and ideas which it generates to meet more closely the needs of industry and commerce.
- ❖ Apart from the University of Plymouth there are also many other not-for-profit R & D organisations based in the TTWA. The PTTWA has a particular strength in marine and maritime R & D.
- ❖ It has also been noted in many of the other sector-based reports in this Series that, locally, skills related to R & D are becoming crucial to the long term success of many businesses in the service sector and particularly those associated with manufacturing.
- ❖ Many local employers interviewed in this Series highlighted that manufacturing in general was likely to face a period of continued decline in the PTTWA. Employers also commented that structural change and rationalisation was resulting in a fundamental shift away from the production and manufacturing of goods in the PTTWA, with much of the production and manufacturing of goods moving to cheaper labour areas, such as the Far East and, increasingly, to the old Eastern Bloc countries.
- ❖ However, it was also pointed out by many employers from different sectors that there would be more research, design and development activities in the future in the PTTWA. The point was made that, while in general, the trend in manufacturing may be to change the physical location of production in other countries, there is a corresponding trend to base research, design and development operations in the UK. The PTTWA may be able to take advantage of this situation.
- ❖ In many sectors, new organisational patterns have already emerged or are emerging, which demand increased flexibility, multi skilling and increased efficiency with a shift in service and/or production to more '*value added*' products and processes, all of which impact on future skills needs.
- ❖ In many other reports in this Series employers, employers' representatives, trainers and educators highlighted that, adopting market strategies that focussed on knowledge driven '*value added*' services and products, require businesses to have an R & D

programme and an organisational culture and regime that allows freedom for innovation and creating novel products and services.

- ❖ Employers were increasingly looking to employees to be ‘*entrepreneurial*’, which effectively means being able to spot new business and/or product and service opportunities. Employers were also looking to employees to be able to suggest and create production and system efficiency and design improvements in a drive to reduce costs.
- ❖ Other skills relevant to R & D activities are highlighted in other reports in this Series: business, commercial and entrepreneurial skills, risk assessment and management skills, skills associated with Intellectual Property Rights (IPR), regulatory knowledge and partnership and alliance building skills, including managing sometimes complex strategic relationships with funding organisations, agents and partners. The Future Skills Grid below maps all of these skills, as well as more specialist R & D skills.

Future Skills Grid: R & D Activities

R & D Activities	
<i>Specialist Research Skills</i>	<i>Generic Skills</i>
Research context	Project management
Thorough subject knowledge	Business/commercial and entrepreneurial
Product/service system design skills	Understanding financial systems and budgetary control
Research strategies	People management
Scientific/research methods	Team working/building
Funding and proposal writing	Networking, partnership, alliance and relationship skills
Analytical	Understanding the projects purpose
Report writing	Planning and time management
Dissemination	ICT skills
	Quality Issues
	Risk assessment and management
	IPR
	Regulatory knowledge

Contents Page

	<i>page</i>
1. Introduction	1
1.1 The Plymouth Travel-To-Work Area (PTTWA)	2
1.2 Methods	3
1.3 The Structure of the Report	3
1.3.1 Section One	3
2. Section One	4
2.1 Section Definition: Research & Development	4
2.1.1 National, Regional and Sector Profile and Plymouth Travel-To-Work Area Profiles	5
2.1.2 General Research and Transferable Skills	11
2.2 Specific Issues for the Sub-Region and the Plymouth Travel to Work Area	12
2.3 Plymouth TTWA Sector Workforce Development Issues	19
3. Sources and References	21

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Plymouth Travel-To-Work Area Sectoral Workforce Development Programme Medium- to Long-Term Skills Needs Research & Development

1. Introduction

The newly created Learning and Skills Council has, as part of its remit, to carry out the annual skill assessment exercise from 2002 onwards. The Council acts as the umbrella organisation for the local Learning and Skills Councils. Both the National and the Local Councils have been tasked to carry out the following activities at their respective levels:²

- ❖ To raise participation and achievement by young people.
- ❖ To increase demand for learning by adults, and to equalise opportunities through better access to learning.
- ❖ To engage employers in improving skills for employability and national competitiveness.
- ❖ To raise the quality of education and training delivery.

At the grass roots level there is a series of local skills partnerships, usually based on particular travel-to-work areas, designed to better inform the Local Skills Councils about highly localised circumstances. For Plymouth, the Plymouth Learning and Work Partnership has been set up to perform this role. It has set itself the following '*key objectives*':³

- ❖ Create and continuously improve an integrated strategic Workforce Development system in the Plymouth Travel-to-Work Area (TTWA).
- ❖ Raise the overall level of skills and qualifications achieved locally, including job-related skills and entrepreneurship skills, and ensure that they meet career and industry standards.
- ❖ Provide education, training and other services necessary to assist individuals in moving into and along the wage and skill continuum in their employment and re-employment.
- ❖ Provide '*cradle-to-grave*' support for those capable of, and wishing to establish new, knowledge-based firms in the sub-region.
- ❖ Provide high quality, integrated skills training support for sub-regional SMEs and micro firms.
- ❖ Ensure inclusive and equitable access to training and employment opportunities, recognising differences in economic growth and employment patterns among geographic areas and population groups.

- ❖ Encourage and support proactive employer-based training initiatives, particularly among the area's larger employers.

In setting out to achieve these objectives, the Plymouth Learning and Work Partnership has commissioned a series of sector based studies to provide a more detailed understanding of each of the priority sectors in the Plymouth TTWA economy. And crucially, to identify the skills that employees of sector based firms will require in order to ensure that they are able to compete successfully on a global basis. This is the fourteenth report and final report in the series and covers **Research & Development** activities. The other reports in the series cover the other thirteen sectors as follows:

- ❖ Marine and Maritime
- ❖ Creative Industries
- ❖ Construction
- ❖ Defence
- ❖ Education
- ❖ Advanced Engineering
- ❖ Environmental Technologies
- ❖ Financial and Customer Services
- ❖ Food and Drink
- ❖ Medical and Healthcare
- ❖ New Technology Industries
- ❖ Retail and Distribution Services
- ❖ Tourism.

1.1 The Plymouth Travel-To-Work Area (TTWA)

The sector-based reports in the series focus on the Plymouth TTWA, which has been defined as consisting of the following local authority areas:

- ❖ Caradon District Council : 30 wards (all)
- ❖ Plymouth City Council : 20 wards (all)
- ❖ South Hams District Council : 10 wards (out of 33)
- ❖ West Devon : 8 wards (out of 21)

This gives a total of 68 wards. In terms of postcodes, the above area coincides to a large degree with the following two postcode blocks:

PL1 - 14 and,
PL17 - 21.

1.2 Methods

The research design for the project as a whole has utilised a structured and layered analytical approach, the national framework being used to provide an overall context within which regional and local analysis could take place. The contextualisation and anchoring of more localised data within a wider regional and national framework has been seen as crucial for both the description and analysis of the sectors included in the project.

Research across the sectors has used both secondary (desk based) and primary research (telephone surveys and interviews). A variety of sources has been used in this secondary analysis, including data from the Institute for Employment Research, and the Equifax data base. A survey data-set held by the Devon and Cornwall Learning and Skills Council was made available to the Social Research & Regeneration Unit for further analysis, and the results of this analysis were also used in the reports. Many of these data sources have proved to be problematic in the case of research and development (R & D) and the R & D report has, of necessity, taken a somewhat different approach from the others in the Series. It is also, consequently, much briefer.

Major problems were experienced at the data collection stage for R & D activities. R & D activities are notoriously difficult to profile and do not necessarily constitute a recognised sector in the UK economy in the same way as other sectors studied in this Series. There is also very little detailed information and data about the level of R & D activity performed either at the regional, sub-regional or especially the PTTWA level. This situation creates difficulties in profiling R & D activities at the regional, sub-regional and PTTWA levels.

Thus, for a number of reasons the methods employed for R & D activities are different from those used for recognised sectors in the Series. This is both because of the inaccessibility of the data and because there is a major danger of “*double counting*” of employees, skills shortages and training needs, as those who perform R & D activities have been covered in other sector reports.

1.3 The Structure of the Report

1.3.1 Section One:

Because of the problems experienced in the delineation of R & D activities, this report, unlike most others in the Series, is comprised of only one section. National issues are used as an immediate context for a consideration of regional and local issues, with the report being arranged under the following main headings:

- ❖ Definition: Research & Development.
- ❖ National, Regional and Plymouth Travel-to-Work Profiles.
- ❖ Specific Issues for the Sub-Region and the Plymouth Travel-to-Work Area.
- ❖ Sources and References.

2. Section One

2.1 Definition: Research & Development

Research & Development (R & D) activities can be defined in at least two ways, either as R & D performed within businesses enterprises or R & D funded indirectly and performed in higher education; government departments, agencies, and non-departmental public bodies; local authorities; and private non-profit organisations. R & D activities are notoriously difficult to profile and do not necessarily constitute a recognised sector in the UK economy in the same way as do the other sectors studied in this Series. There is also very little detailed information and data about the level of R & D activity performed at the regional, sub-regional or especially the PTTWA level. This situation creates difficulties in profiling R & D activities at these levels.

For the purposes of this report the main area of focus will be upon R & D activities undertaken within sector based business enterprises. Therefore, this report has utilised the findings relating to R & D activities performed in businesses enterprises from other sector-based reports in this Series. In taking this approach, no specific forecasts for R & D employment and occupational change have been made as they have already been included within forecasts for other sectors studied in this Series. Although, wherever possible, R & D activities performed in not-for-profit organisations have been examined, with both elements considered together at a higher level of aggregation, so that current trends in R & D can be analysed to provide an insight into the changing skills needs within this area of activity for workforce development. As a result, the structure of this report is very different from that adopted in most other reports in this Series.

R & D activities performed in business enterprises have been linked to their relevant Standard Industry Classifications (SICs) using the current 1992 UK classification of establishments. This classification is based on the type of activity in which organisations are engaged, essentially defined by the nature of the products and services produced. This classification has been used both for statistical purposes and again for consistency and comparison with other studies conducted on R & D activities. R & D activities are defined on this basis as consisting of organisations engaged in the following two (by SIC Codes) activities shown in Table One.

Table One: Research & Development SIC Classifications

SIC Classifications	Code
Research and experimental development on natural sciences and engineering	7310
Research and experimental development on social sciences and humanities	7320

It can be seen from Table One, that there are only two SIC codes covering R & D activities and these classifications are essentially based upon the primary activity in which organisations are engaged, and in this instance categorised as natural sciences and engineering or social sciences and humanities R & D. However, it must be borne in mind that this does not reflect internal R & D activities performed by businesses whose primary activities come under other SIC codes, which nevertheless undertake R & D. (For example, R & D undertaken in a business whose primary activity is in the manufacturing and processing of food and drink, SIC codes 1511-1598).

To reiterate, there is currently very little detailed information and data about the level of R & D activity conducted internally by businesses in all sectors, at the regional, sub-regional or especially the PTTWA level. Furthermore, it is beyond the remit and scope of the research undertaken for this Series to undertake an in-depth empirical study of current regional and sub-regional R & D activity by sector. The main concern of this report is of future skills needs. However, the following section provides a brief overview of internal business R & D at the national level and some further regional information is also contained in other sections.

2.1.1 National, Regional and Plymouth Travel-to-Work Area Profiles

In 2000, £11.5 billion was spent on R & D performed within UK businesses and the Office for National Statistics (ONS) highlights that this is a rise of 2% at current prices compared with the 1999 total. Total R & D expenditure in 2000 represented approximately 1.2% of GDP and this proportion of GDP has remained relatively constant since 1993. The product group with the largest expenditure on R & D was pharmaceuticals, with expenditure in 2000 of £2,846 million, nearly 25% of all spending. Other major product groups were aerospace (£1,091 million, 9% of all spending) and radio, television and communication equipment (£1,024 million, again nearly 9% of all spending).⁴

The overall level of funding of R & D activities from businesses 'own funds' was £7,244 million in 2000, which constituted 63% of the total R & D expenditure from all sources in the UK in 2000. Funding of R & D in businesses in the UK from abroad was £2,470 million in 2000, which constituted 21% of the total R & D expenditure from all sources. In comparison, UK Government funding in businesses for R & D was £1,013 million in 2000, which constituted only 9% of the overall total.

In terms of employment, the number of staff employed specifically on R & D decreased by 5% between 1999 and 2000, with scientists and engineers accounting for 59% of the staff employed on R & D in 2000. The remaining 41% of staff employed on R & D were split equally between technicians, laboratory assistants and draughtsmen and administrative, clerical, industrial and other staff.

Invest UK, an organisation that promotes the development of R & D activities in the UK highlights that, despite the decreasing levels of employment in R & D activities the UK is world renowned as having a long and highly successful R & D history, noted for innovation and invention. An increasing number of

international companies have established their R & D centres here. In particular the UK offers:

- ❖ Skilled researchers.
- ❖ Industrial links.
- ❖ An excellent academic environment.
- ❖ Government financing.

Many of the world's leading industrial companies have based their own teams in research centres, or sub contracted projects with, the UK's universities and research centres. A brief overview provided by Invest UK of R & D activities undertaken by 11 of the leading UK industrial sectors is given below:

Automotive

The UK automotive industry is the base for many of the world's leading automotive companies and 17 of Europe's prominent automotive component companies. The UK business environment is cost effective. In 1999 almost 2.2 million vehicles were registered in the UK. The UK is also conveniently placed and prepared for the export trade; automotive parts can be delivered quickly to mainland Europe.

Bio-technology

Britain has a world class reputation for research in the biosciences and is a popular location for companies seeking a European base. Research in life sciences in the UK has led to 20 Nobel prizes and recent breakthroughs include the discovery and structure of DNA to cloning and antibody engineering. The UK is the European leader in biotechnology and is a rapidly growing area for investment.

There are currently around 300 specialist biotechnology companies and more than 460 involved in bioscience-related activities. They are mostly concerned with research in diverse areas such as pharmaceuticals, chemicals, food, agriculture and the environment. It is recognised that the UK offers a balance between safety for the consumer and the environment without stifling innovation. There is a close partnership between the UK government, industry and the financial community which assists development.

Chemicals

The UK has the sixth largest chemicals industry in the world and is the largest export industry, generating a trade surplus of £1, 500 million. Approximately 60% of the UK's chemicals are exported within the EU which is the world's largest chemical market. There are 200 international chemical companies with manufacturing facilities in the

UK. The industry has business links with pharmaceuticals, textiles, paper, water treatment and coatings. Research and development in this industry is buoyant, with many projects in biological synthesis, catalysis, combinational chemistry, analytical science and physical organic chemistry.

E-Business

The development of e-business has altered the method of interaction between businesses and their customers. The UK is dominating the European market for electronic business solutions and applied research. Within Europe the UK is most advanced in the uptake and usage of ICT, it also has the most deregulated telecommunications market in Europe. Major companies have invested in the UK, for instance, Intel, CISCO, Exodux and Charles Schwab. Firms that have located in the UK have found an excellent and reliable telecommunications infrastructure.

Electronics

The UK's electronics industry is the fifth largest in the world for production, employing 400,000 people in manufacturing and a further 130,000 in software and services. The UK has benefited from investment by overseas producers and is a world leader in electronics development and applications. Engineering innovation has been strong in the UK for many years and there is a well established network of technical support. Specialist hi-tech companies have developed from the UK's defence sector. Major electronic companies in the UK include Compaq, Ericsson, Fujitsu, Samsung, Sharp, Sony and Toshiba.

Medical Systems

The UK's medical systems industry is highly competitive in design, manufacturing and development. There has been considerable foreign investment in this market especially from companies who regard the UK as their entry to the EU marketplace. The UK's strong scientific and technological tradition in information technology, material sciences and biotechnology has facilitated this inward investment from overseas. Over half of the larger companies in this sector represent investment by an overseas parent company which contributes more than 40% of the total UK production. Collaboration between industry and the clinical community has been strong and there are plans for government and industry investment in continued innovation in this sector.

Oil and Gas

The UK Continental Shelf has sustained the oil and gas industry for over 35 years. The industry is a significant sector of the UK economy and is estimated to support both directly and indirectly 200,000 jobs. In 1998 PILOT was launched, this is a joint initiative between government and industry to ensure the long-term continued success of the sector. The government is keen to encourage research into the exploration and development of oil and gas reserves to replace those being depleted in the mature fields.

Pharmaceuticals

The UK's pharmaceutical industry is one of the most successful in the world. Many leading medicines have been discovered in the UK. The UK has an excellent record of academic expertise combined with highly qualified specialists and skilled technicians. There is a good relationship between major universities, research centres and the pharmaceutical industries. Pharmaceutical companies spend \$11.2 million every day on research and development and there are more products here in development than any other country in the world. The UK is justifiably proud of its skilled workforce, 20% of UK graduates have degrees in biological, chemical or molecular sciences. Over 300,000 people work in the pharmaceutical industry.

Semiconductor Design

The UK has the world's fifth largest electronics industry with over 9,000 electronics companies employing over 500,000 people; it has Europe's largest semiconductor design industry. Over half of the market in integrated circuit applications design is based in the UK.

Software

The UK software industry is one of the fastest growing sectors in the economy. More than 30,000 software companies including Microsoft and Oracle and many smaller innovative companies are based in the UK. The UK also has a growing reputation for IT related fields like database packaging, virtual reality, multimedia applications based on neural networks and real-time and safety critical software. The UK equity market has created a separate stock sector for software shares which have performed well.

Over 600,000 people have computer-related jobs in the UK. The workforce is regarded as being highly skilled and flexible, increasing numbers of graduates and postgraduates have qualifications in software-related skills. Many universities have established science parks and created collaborations with commercial companies. The UK government strongly supports such partnership initiatives in the development of new software technologies.

Telecommunications

The UK has the most competitive environment for all telecommunications products and services in Europe. The leading telecoms operators have been attracted to the UK because of the technological advancements, deregulation and the encouraging business environment. There are over 250 companies with national or international licences. The UK is the world leader in mobile telecommunications, new wireless technology and 3G research and development. The government supports the early deployment of 3G technology. Internet access is growing and there is an enormous demand for increased bandwidth and access.

Further detailed information concerning the levels of internal business R & D investment in the UK is provided on a government on-line database Scoreboard, and shows company investment on R & D as a percentage of sales and the amount of R & D investment per employee for businesses operating in a number of sectors. Table Two, provides a summary of the top three businesses (by R & D spend) by activity in selected areas.

...../Table Two: Summary of R & D investment by the top three companies in various sectors in the UK

Plymouth Travel-To-Work Area Sectoral Workforce Development Programme
Medium- to Long-Term Skills Needs: Key Sector: Research & Development

Table Two: Summary of R & D investment by the top three companies in various sectors in the UK

Area of Activity	Company	2000/2001 R & D investment £'000	R & D % of sales	R & D per employee £'000
Aerospace and Defence	BAE Systems	987,000	10.2	11.6
	Rolls Royce	371,000	6.3	8
	Smiths	63,300	4.3	4.1
Automobiles and Parts	Ford	633,000	7.3	16.2
	GKN	88,000	2.1	2
	TRW	35,000	2.0	1
Beverages	Diageo	69,000	0.6	1
	Pepsi Cola	1,769	0.4	0.4
	Allied Domecq	1,000	0.0	0.1
Chemicals	ICI	176,000	2.3	3.8
	BOC	59,200	1.7	1.4
	Johnson Matthey	39,900	0.7	6.2
Construction	Pilkington	29,000	1.2	1.1
	Caradon (Novar)	27,200	1.6	1.6
	Hepworth (Vaillant, Germany)	9,100	1.2	1.2
Electronic/ Electrical	Ivensys	283,000	3.6	3
	Phillips Electronics	54,400	4.4	9.6
	Siemens	54,400	2.2	3.5
Engineering/Machinery	TI (Smiths)	42,400	1.6	1.1
	Cookson	41,100	1.7	1.9
	Cummins	28,509	4.4	6.6
Food Processors	Unilever	746,025	2.5	2.9
	Cadbury/Schweppes	25,000	0.5	0.7
	Hoops	23,976	1.3	4.3
General Retailers	Great Universal Stores	86,300	1.4	1.2
	Boots	25,500	0.5	0.3
	Body Shop International	6,700	1.8	1.2
IT Hardware	Marconi	669,000	10.1	12.9
	NCR	64,682	12.3	21.4
	Nortel Networks	64,500	3.5	6.4
Media/Photography	Reuters	323,000	9.0	19.1
	Kodak	26,200	2.1	4.5
	Aegis	22,400	0.4	4.1
Mining	Rio Tinto	26,108	0.5	0.9
	Anglo American	22,761	0.2	0.1
	Lonmin	1,339	0.2	0
Oil and Gas	BP	290,534	0.3	3
	Shell	260,410	0.3	2.7
	BG	34,000	0.7	2
Pharmaceuticals	GlaxoSmithKline	2526,000	14.0	23.3
	Astar Zeneca	1936,672	16.0	34
	Pfizer	373,241	39.2	84.3
Software and IT	IBM	107,400	1.8	5.5
	Misys	77,600	10.9	13.5
	ICL	76,300	2.8	3.4
Steel and Metals	Corus	106,000	0.9	1.6
	British Alcan Aluminium	2,900	0.5	1
	Kelsey	1,397	1.8	1.8
Telecommunication	BT	364,000	1.8	2.7
	Vodafone	72,000	0.5	1.4
	Cable & Wireless	3,000	0.0	0.1
Transport	BBA	19,000	1.2	1.4
	Civil Aviation Authority	15,155	2.3	2.4
	Powell Duffryn (Prestige)	2,900	0.7	0.7
Water	Thames Water (RWE, Germany)	9,000	0.7	0.7
	AWG	5,300	0.6	0.5
	Severn Trent	3,400	0.2	0.2

Source: Table Adapted from R & D Scoreboard Online Database 2001, <http://www.innovation.gov.uk>

The R & D Scoreboard also details the level of R & D spend by UK businesses. Businesses are grouped under broad areas of activity and on this basis the two leading sectors in the UK for R & D intensity (R & D as a percentage of sales) are pharmaceuticals and aerospace. More details of the level of R & D intensity and also the proportion of total R & D expenditure by broad sector is shown in Table Three.

Table Three: R & D in the UK by Broad Sector

Broad Sector	Proportion of total R & D Spend	R & D Intensity
Pharmaceuticals	37.7%	14.8%
Aerospace	10.0%	7.7%
IT hardware	7.5%	6.2%
Food processors	5.8%	1.6%
Automotive	5.5%	4.2%
Software and IT services	4.8%	4.2%
Electronics and electrical	4.3%	3.0%
Oil and gas	4.3%	0.3%
Telecoms	2.9%	1.0%
Chemicals	2.7%	1.4%
Engineering	2.8%	1.3%
Health	1.7%	7.2%
Others	10.0%	0.3%

Source: Research & Development Scoreboard 2001

2.1.2 General Research and Transferable Skills

In general many of those engaged in R & D activities will be highly qualified at least to degree level and possess a wide range of both specific technical and generic skills. The main occupations involved in R & D activities include:

- ❖ Scientists and engineers: professionals engaged in the conception or creation of new knowledge, products, methods and systems.
- ❖ Technicians: qualified personnel who participate in R & D projects by performing scientific and technical tasks, normally under the supervision of professional scientists and engineers. They will usually have a scientific or engineering qualification.
- ❖ Administrative and other: other supporting staff, including skilled craftsmen, secretarial and clerical staff participating in R & D projects or directly associated with such projects.

A recent study⁵ provides more specific detail of the types of skills employers of R & D staff look for when recruiting to R & D occupations. The study found that employers were looking for a number of competencies in the areas of:

- ❖ Personal and Interpersonal Skills.

- ❖ Project Management Skills.
- ❖ Research Skills (including dissemination skills).

The findings from the study relating to the desired competencies have been mapped to these three areas and are shown in Table Four.

Table Four: R & D Competencies - Skills Employers seek in R & D Personnel

Personal/Interpersonal	Project Management	Research
Networking Skills	Understanding Financial Systems/Budgetary Control	Research Strategies
Financial Management Skills		Ethical Issues
Time Management Skills	People Management Skills	Scientific/Research Methods
Assertiveness	Team Working/Building Skills	Philosophical/Technical Issues and Issues within Subject Area
ICT	Delegation/Support Skills	Research Context
Workload Management	Planning Skills	Dissemination Skills
Stress Management	Proposal Writing Skills	
Negotiation Skills	Quality Issues	
	Understanding the Projects Purpose	

2.2 Specific Issues for the Sub-Region and the Plymouth Travel-to-Work Area

In order to profile the number of enterprises in the South West Region and the Plymouth TTWA, the Equifax 'Yellow Pages' (Business Select) database has been chosen as the most appropriate data source for the following reasons:

- ❖ The database includes every business that has an entry in the Yellow Pages Directory.
- ❖ The information contained in the database is accessible by area postcode.
- ❖ The database records the relevant four-figure SIC code for all its entries.

Equifax also collects information (supplied on a voluntary basis by customers) on employment levels. This information is supplied in the form of seven employee bands plus a further band where customers (marked n/a in the table) have volunteered no information. Table Five shows the number of businesses within the relevant SIC classifications across the whole of the South West Region. Table Six shows employment bands for these businesses.

Table Five: Research & Development : South West Region

Sic 1992 Codes	SIC 1992 Classifications	Avon*	C'wall	Devon	Dorset	Glos	Som	Wilts	Totals
7310	R & D on Nat Sciences and Engineering	24	8	20	11	6	8	16	93
7320	R & D on Soc Sciences and Humanities	1	1	5	4	1	1	7	20
Total		25	9	25	15	7	9	23	113

* former county. Source: Equifax CD ROM, 2002, 1st Quarter

Table Six: Research & Development : Employee Bands : South West Region

SIC 1992 Codes	SIC 92 classifications	N/a	1-5	6-10	11-19	20-49	50-99	100-200	200+	Total
7310	R & D on Nat Sciences and Engineering	4	40	9	12	10	4	4	10	93
7320	R & D on Soc Sciences and Humanities	3	10	1	1	1	1	1	2	20
Total		7	50	10	13	11	5	5	12	113

Source: Equifax CD ROM, 2002, 1st Quarter

Tables Five and Six detail both the number of businesses and the employment levels for R & D activities in the region. However, it must be borne in mind that this does not reflect internal R & D activities performed in businesses whose primary activities come under other SIC codes, and which are located under other sectors of the economy. Thus, Tables Five and Six only show businesses which consider their primary activities to be R & D related.

Although there is very little information and data available on R & D activities at the regional level, the ONS provides a regional breakdown of R & D performed within South West businesses. The ONS estimated that R & D expenditure was approximately £867 million in 2000 and that there were 12,000 people employed in R & D activities in South West businesses. However, in 2000 the level of R & D performed in the region only constituted 7.5% of the total UK R & D spend by businesses, in contrast, the top performing region was the South East at 25.8%.

In addition to the internal R & D activities of businesses, R & D is also conducted in many regional higher education institutions, government departments, agencies, and non-departmental public bodies, local authorities and private non-profit organisations. Invest UK provides some detail about R & D activities carried out by all businesses and other organisations regionally.

Invest UK comments that the South West can offer businesses the intellectual resources required for profitable enterprise. There are 11 higher education institutions in the region, providing world class research expertise in key technology areas. The universities and colleges of the South West have a research income of over £75 million per year. There are a number of specialist centres where research is conducted in collaboration with high technology companies. There follows a brief description of some of the centres and the research interests as well as two case studies:

- ❖ The Centre for Communication Research (CCR) at the University of Bristol is a research centre with an international reputation. It currently has £7 million in grants.
- ❖ The National Centre for Computer Animation is at Bournemouth University. It is the UK's leading institution for teaching, research and production in digital media.
- ❖ The Polymer Centre based at the University of Exeter, with network links to the University of Plymouth and Trowbridge College provides support to the South West plastics industry through research, development and training.
- ❖ Hewlett Packard's laboratory in Bristol is responsible for 40% of the company's global strategic research. Bristol was chosen because of the University's research reputation.
- ❖ Industries in the South West invest an estimated £725m per year in research and development. The region's highly experienced workforce and universities interested in commercial research have facilitated these investments.
- ❖ The region has a significant cluster of semiconductor design expertise.
- ❖ Infineon Technologies (formerly Siemens Microelectronics) have established a new system-on-chip development centre in Bristol.
- ❖ ST Microelectronics has one of the largest R & D sites in the South West.
- ❖ Telecommunications R & D have centres for Motorola, Lucent technologies and Ericsson in Swindon, for Nortel in Devon, for Marconi in Dorset and for Toshiba in Bristol.

Arima Optoelectronics

The University of Bath has a clean room laboratory in the Physics department. The Taiwanese owned company, Arima Optoelectronics (UK) Ltd have invested £850,000 in a semiconductor growth system, in order to stay ahead of competitors in the development of blue light emitting diode (LED). This facility is the first of its kind in the UK, the company sponsors a professor and four researchers. The blue LEDS are currently the most efficient in the world. It is expected that future developments will produce commercially successful energy efficient light bulbs at a fraction of the current cost. This would have world wide savings on energy consumption and fossil fuels and potentially is the "greenest" of products ever produced.

Toshiba

Toshiba opened a pioneering research facility in Bristol in 1998, the Telecommunications Research Laboratory (TRL). Toshiba will invest £10million over five years to generate third generation wireless communications systems. Toshiba are based in Bristol to be close to the University of Bristol's Centre for Communication Research which has a global reputation for research into wireless communications, narrowband radio and mobile systems. Professor McGeehan who leads the specialist team of researchers said:

“When Toshiba were looking to site in Europe they very quickly decided on the Bristol region. First of all the region is very much an R & D island for high technology companies specialising in Communications, IT and multimedia technology. Furthermore the region is a great place to live and work and bring up a family. It also has a large number of high quality universities and this means that the companies who are located in the region have easy access to really first class graduates.”

Invest UK recognises the important relationship between the not-for-profit sector and the private sector in R & D and of exploiting the potential of university, industry and government relations, a factor increasingly regarded as a centre piece of policies designed to promote this capitalisation of knowledge. A series of government White Papers and other reports have highlighted the economic animator role to be played by the university sector in supporting local and regional economic development.

Invest UK highlights the role of science and business parks in exploiting the potential of university, industry and government relations and the role science parks can play have in supporting local and regional economic development through R & D activities. A Science Park is a business support and technology transfer initiative that:

- ❖ encourages and supports the start up, incubation and development of innovation led, high growth, knowledge based businesses.
- ❖ provides an environment where larger and international businesses can develop specific and close interactions with a particular centre of knowledge for their mutual benefit.
- ❖ has formal and operational links with centres of knowledge such as universities, higher education institutes and research organisations.

In the PTTWA, as at the regional level, very few R & D activities are identified by using SIC codes. The only R & D activities recorded relate to businesses which consider their primary activity to be R & D in either the natural sciences or engineering. These businesses are shown in Table Seven.

Table Seven: Research & Development by Employee Bands: Plymouth TTWA

SIC 1992 Codes	SIC 1992 classifications	n/a	1-5	6-10	11-19	20-49	50-99	100-200	200+	Totals
7310	R & D on Nat. Sciences & Engineering	0	3	1	1	2	1	0	1	9

Source: Equifax CD ROM, 2002, 1st Quarter

In addition to these businesses, the PTTWA houses two of the sub-regional universities (one a university college) as well as a college of art and design and further education colleges which undertake a significant level of R & D, covering a wide range of activities. The area, in fact, acts as a focus for higher and further education and R & D activities well beyond the boundaries of the TTWA. Another crucial R & D linkage is provided by the Tamar Science Park which houses many of the higher education R & D related '*spin-off*' companies along with a significant number of private enterprises which undertake high levels of R & D. The Tamar Science Park is situated in the City of Plymouth near to the airport, Derriford Hospital and Derriford Business Park. The resident companies and their broad research and/or business areas are as follows:

- ❖ Advanced Controls Research Ltd - advanced artificial hand research.
- ❖ AV Concepts - experienced in all aspects of audio-visual systems.
- ❖ Blueprint Electronic Commerce Ltd - B2B e-commerce solutions. Secure 24x7 document exchange offering any-to-any document conversion and one-to-many trading models.
- ❖ Cardio Analytics - cardiac data analysis for clinical research.
- ❖ Carval Computing Ltd - authors and suppliers of HR solutions to the business community. The leading sage solution centre in the SW.
- ❖ Defence Diversification Agency - a key government initiative to make defence research and development accessible to civil sector businesses.
- ❖ Digsweb - interactive accommodation.
- ❖ Eclipse Network - Internet services in the SW.
- ❖ Fastrack Geotechnical Services - geotechnical consultancy dealing with ground investigations for new developments, contaminated land subsidence.
- ❖ Gait Analysis, Plymouth Movement Analysis Lab - uses optoelectronic technology to improve the treatment of movement disorders, cerebral palsy and researches into normal pathological movement.
- ❖ Goss Interactive - Internet company providing content management applications, e-commerce solutions and mission critical systems management.

- ❖ ICO³ - a spin out company from the University of Plymouth, offering high quality, low cost internet solutions for small businesses, larger internet projects and the academic sector.
- ❖ Image Life - specialist digital scanning services to businesses who could not afford to buy their own equipment or wish to use their grants rather than purchase equipment.
- ❖ Infinite Pictures - television, video and digital media production company.
- ❖ Integrated Silicon Solutions Inc - ISSI designs, develops and markets high performance memory semiconductors used in internet access devices, networking equipment telecom and mobile communications equipment and computer peripherals.
- ❖ K2 Medical Systems - a spin out company from the University of Plymouth and Plymouth Hospitals NHS Trust. It markets products developed and proven by the Plymouth Perinatal Research Group.
- ❖ Medical Services Ltd - development of hospital beds and equipment.
- ❖ Merlin Systems - service robotics, sensors, actuators and control systems.
- ❖ Molecular Medicine Research Group - genetic disease research.
- ❖ Multiple Sclerosis Research - conducting research into the effects of cannabis on multiple sclerosis.
- ❖ Netserve (UK) Ltd - web development, data and hosting services for small to medium enterprises and blue chip companies.
- ❖ NeuVoice - supplies voice recognition technology across a wide range of electronic devices including cellular phones, in-car telematics systems to domestic appliances and MP3 players.
- ❖ PAS Replacement - NHS research into database compatibility.
- ❖ South West Information Services Ltd - internet business with pro-active post-production monitoring.
- ❖ Tel Communications - Intranet, extranet and web based e-business developments including interactive online database solutions. Static web design and development.
- ❖ UK-Explore (Holdings) Ltd - Web development, specialising in designing data and hosting facilities for the tourism industry.
- ❖ Western Biotech - a technology exploitation platform operated on behalf of the universities and hospitals in the area. They identify value, protect, develop and commercially exploit intellectual property arising from Biotechnology and Medical Research.

There is also a significant level of R & D undertaken in the University of Plymouth itself as well as in its '*spin-out*' companies. This includes both academic and more applied research. The University of Plymouth is increasingly becoming involved in transferring the knowledge, expertise and ideas which it generates to meet more closely the needs of industry and commerce.

Apart from the University of Plymouth there are also many other not-for-profit R & D organisations based in the TTWA. The PTTWA has a particular strength in marine and maritime R & D, which is unsurprising given its long marine and maritime history and heritage. Organisations involved in marine and maritime R & D include, Plymouth Marine Laboratory, The National Marine Aquarium, the Marine Biological Association and the Sir Alister Hardy Foundation for Ocean Science.

It has also been noted in many of the other sector based reports in this Series that locally, skills related to R & D are becoming crucial to the long term success of many businesses in the service sectors such as, Financial Services and particularly those associated with manufacturing. Indeed, both nationally and at the regional and sub-regional levels there has been a period of rationalisation with many manufacturers moving their production facilities abroad to cheaper labour areas.

The manufacturing sector in the PTTWA has not been immune to this trend and there have been a number of high profile business closures and '*downsizing*' activities in the PTTWA. The remaining businesses following the current '*shakeout*' in the manufacturing sector are adopting market positions which rely on moving to the higher value, lower volume, market '*niches*'. Businesses are focussing on innovation and the utilisation of R & D and product design skills. Other firms are taking the fast response strategy responding to fluid market change. In the main these businesses are manufacturing products with short production lifecycles, where production, marketing, logistics and delivery skills and especially skills related to R & D activities, are paramount.

The remaining businesses, although to a lesser extent, are adopting other market strategies and are trying to compete head on in the global marketplace through utilising '*lean manufacturing*' techniques such as team and cell manufacturing. Others are concentrating on less complex products in higher volumes from dedicated production lines at minimum costs. This form of production requires relatively low skilled operatives, however, some technically highly skilled people capable of keeping '*down time*' to a minimum are also required. Businesses adopting these two market strategies have tended to have been hit hardest in terms of business closures and job losses, both nationally and locally, in the face of cheaper competition from abroad.

Many local employers highlighted that manufacturing in general was likely to face a period of continued decline in the PTTWA. Employers also commented that structural change and rationalisation was resulting in a fundamental shift away from the production and manufacturing of goods in the PTTWA with much of the production and manufacturing of goods moving to cheaper labour areas, such as the Far East and, increasingly, to the old Eastern Bloc countries.

However, it was also pointed out by many employers from different sectors that there would be more research, design and development activities in the future in the PTTWA. The point was made that, while in general, the trend in manufacturing may be to locate the physical location of production in other countries, there is a corresponding trend to base research, design and development operations in the UK. The PTTWA may be able to take advantage of this situation.

2.3 Plymouth TTWA Sector Workforce Development Issues

The aims and objectives of this report for R & D activities are two fold:

- ❖ To undertake a study to provide a more detailed understanding of R & D activities in the PTTWA;
- ❖ And crucially, to identify the skills that employees of organisations that undertake R & D will require in order to compete successfully on a global basis.

In undertaking the analysis, a brief account of R & D activities has been provided. The examination of trends in R & D has provided an insight into the changing skills needs within the sector. This has crucially facilitated the identification of some of the skills that employees within the PTTWA and the sub-regional economy in which it operates, will require now and in the future in order to compete successfully in the market place.

A number of issues for workforce development for R & D activities in the PTTWA in the short-term and medium- to long-term have also been brought to light. The main issues for workforce development emerge from the following points:

- ❖ Very little is known about the nature and extent of R & D activities performed in the PTTWA. This situation makes it very difficult for the Plymouth Learning and Work Partnership to engage in workforce development activities for those employed in R & D.
- ❖ Much R & D related activity is performed internally by businesses whose primary activities place them in another specific sector. This situation may enable the Partnership to take a sector based approach when focussing on R & D rather than treating R & D as a sector in itself.
- ❖ Other R & D activities are performed in the not-for-profit sector which could also provide a focus for engagement with those employed in R & D activity.
- ❖ There is also an opportunity for an in-depth empirical study to be conducted on R & D activities in the PTTWA, and the workforce development needs of those employed in R & D related activities.
- ❖ Trends in other sectors highlight the importance of R & D activities to the growth and future competitiveness of national, regional and sub-regional businesses. These trends also indicate the potential for the future growth of R & D activities in the PTTWA.

Main Issues:

Skills Needs: Medium to Long Term

The examination of general trends, has identified some short- to medium-term skills needs for the sub-region and PTTWA. The national trends in R & D are largely reflected in the sub-region and PTTWA. Many of these trends have also been highlighted by the employers and in the interviews conducted with a range of industry educators, trainers and representatives in other reports in this Series. There is also an acknowledgement that R & D activities are crucial to the long-term health of many sectors.

In many sectors, new organisational patterns have already emerged or are emerging, which demand increased flexibility, multi skilling and increased efficiency, with a shift in service and/or production to more 'value added' products and processes, all of which impact on future skills needs. In many other reports in this Series employers, employers' representatives, trainers and educators highlighted that, adopting market strategies that focus on knowledge driven 'value added' services and products, requires businesses to have R & D programmes and organisational cultures and regimes that allow freedom for innovation, and creating novel products and services. Employers were increasingly looking to employees to be 'entrepreneurial', which effectively means being able to spot new business and/or product and service opportunities. Employers were also looking to employees to be able to suggest and create production and system efficiency and design improvements in a drive to reduce costs.

Other skills relevant to R & d activities highlighted in other reports in this Series include the importance of business, commercial and entrepreneurial skills, risk assessment and management skills, skills associated with Intellectual Property Rights (IPR), regulatory knowledge and partnership and alliance building skills, including managing sometimes complex strategic relationships with funding organisations, agents and partners. The Future Skills Grid below maps all of these skills as well as more specialist R & D skills.

Figure One: Future Skills Grid: R & D Activities

R & D Activities	
<i>Specialist Research Skills</i>	<i>Generic Skills</i>
Research context	Project management
Thorough subject knowledge	Business/commercial and entrepreneurial
Product/service system design skills	Understanding financial systems and budgetary control
Research strategies	People management
Scientific/research methods	Team working/building
Funding and proposal writing	Networking, partnership, alliance and relationship skills
Analytical	Understanding the projects purpose
Report writing	Planning and time management
Dissemination	ICT skills
	Quality Issues
	Risk assessment and management
	IPR
	Regulatory knowledge

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