



Industrial Placements in the Life Science Sector:
the Evidence-base and Strategy for the future
Full Report

Industrial Placements in the Life Sciences Sector: Evidence Based Report

**Report of the Life Sciences Advisory Council Placements Working Group
February 2012**

Foreword

In December 2011, the Department for Business, Innovation and Skills (BIS) and the Office for Life Sciences (OLS) released the *Strategy for UK Life Sciences*¹. As part of this work, Cogent was asked to develop a strategy to increase the number of industrial placements in the UK.

Industrial placements are a key priority for the life sciences sector for a number of reasons: not only do they help embed key practical and highly sought employability skills into programmes of learning, particularly at undergraduate and postgraduate levels, but they also drive forward innovation through industry and academic collaborations.

At a time when the Government has asked Professor Sir Tim Wilson to review Business University Collaborations, it is hoped that the findings of this report will encourage greater industry exchange in this key sector in the future².

Everyone agrees that the challenge is to develop an infrastructure which connects academics, industry, investors, clinicians and crucially, the NHS. If we can become better at recognising and rewarding innovation; ensure that good ideas don't get lost; and adopt them more quickly and efficiently across the NHS, then we can deliver better patient outcomes at home and take a leading role in life sciences globally.

I welcome this report at this critical time – it provides the evidence base for what is already happening in the sector, promotes examples of best practice, and looks to new ways of working.

It reflects the experiences and needs of academics and industry, bringing together views from across the sector. Through greater collaboration, a stronger support system can be delivered for future graduates and postgraduates, and for wider engagement with postdoctoral and clinical industry exchange.

Through collaboration, we can help achieve the Government's ambition to make the UK "*the best place in the world to do science*", driving forward greater collaboration of business with universities, delivering high-tech opportunities, supporting jobs and boosting economic growth, with the UK being the preferred location for R&D³.

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Acknowledgements

In preparing this report there has been significant input from a broad group of stakeholders from industry, academia, Research Councils and stakeholders. This input is gratefully acknowledged, as are the contribution of ideas and feedback through meetings and written submissions.

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Aesica Pharmaceuticals Ltd	Novartis	BioIndustry Association	Forth Valley College	Cogent SSC
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GlaxoSmithKline	Scottish Stem Cell Network (SSCN)	Ethical Medicines Industry Group	The Royal Veterinary College	Lantra
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1. Introduction

In December 2011, the Department for Business, Innovation and Skills (BIS) and the Office for Life Sciences (OLS) released the *Strategy for UK Life Sciences*¹. As part of this work, Cogent was asked to develop a strategy to increase the number of industrial placements in the UK.

Minister for Universities and Science, David Willetts, at the launch of the Life Sciences Strategy on 5th December 2011, stated that the life sciences industry *“delivers vital growth and employs tens of thousands of people. But this is rapidly changing. We need help to keep ahead of the game and make the UK one of the best places for companies to invest in innovation. To do this we need to create the right environment for scientists and business to work together and translate research into new, cutting edge technologies and medicines. This will boost our economy, create new jobs, and lead to better treatment for patients”*⁴.

Industrial placements are a key priority for this industrial sector for a number of reasons, including driving forward innovation through industry and academic collaborations, and helping to embed key practical and highly sought employability skills into programmes of learning, particularly at undergraduate and postgraduate levels.

In taking this Government policy forward, David Willetts stated in January 2012 the Government’s ambition to make the UK *“the best place in the world to do science”*. This statement generated a number of drivers to push forward greater collaboration of business with universities, delivering high-tech opportunities, supporting jobs and boosting economic growth, with the UK being the preferred location for science R&D³.

In addition, Prime Minister David Cameron stated: *“We can be proud of our past – but we cannot be complacent about our future. The industry is changing; not just year by year, but month by month. We must ensure that the UK stays ahead, yes, we’ve got a leading science base, we’ve got four of the world’s top ten universities, and we have a national health service unlike any other. But these strengths alone are not enough to keep pace with what’s happening – we’ve got to change radically – the way we collaborate, the way we open up the NHS.”*⁴

With current constraints on the public purse, there is a clear aim for greater collaboration between industry and higher education through new ways of working, from undergraduate teaching through to the commercialisation of research and development.

With the emphasis on science-based industry collaboration with universities, the Life Sciences Advisory Council, facilitated by Cogent, established a ‘task and finish’ group to investigate the benefits of and barriers to industrial placements. This group has considered issues related to industry placements, their uptake and delivery; their findings are documented in detail in this report.

The recommendations from this report are detailed below. In addition, a strategy is proposed to support an increase in placements provision and uptake.

At a time when the Government has asked Professor Sir Tim Wilson to review Business University Collaborations, it is hoped that the findings of this report will encourage greater industry exchange in this key sector².

2. The UK Life Sciences Sector

The UK Government facilitates interaction across the life sciences through the Office for Life Sciences (OLS), created by the Government under Lord Drayson's leadership in January 2009.

In July 2009, following several months of intensive joint working by Government, industry and academia, the Office published the *Life Sciences Blueprint*: a set of actions designed to improve collaboration between industry and academia; strengthen the partnership between industry and the NHS; benefit patients; and enhance significantly the environment for medical biotechnology, pharmaceutical, medical devices and diagnostics businesses in the UK⁵.

In January 2010, the Government outlined the proposed actions for this partnership model in a further report, *Life Sciences 2010*⁶. The process also demonstrated how the aims of the *Life Sciences Blueprint* were to be delivered.

The key actions for the Office for Life Sciences are to improve the environment for Life Sciences in the UK through the facilitation and delivery of:

- UK Life Sciences Super Cluster
- Patent Box
- RegenMed Programme of Investment
- Innovation Pass
- NHS Life Sciences Innovation Delivery Board
- Industry and Higher Education Forum
- Accreditation of bioscience degrees
- Life Sciences Business and Leadership Programme
- UK Innovation Investment Fund
- Life Sciences marketing programme

Throughout these publications, the UK Government considers the life sciences industry to include the areas of:

- Pharmaceuticals
- Medical biotechnology
- Medical technology & diagnostics
- Industrial biotechnology
- And the NHS

In a more recent publication, *Strength and Opportunity 2011*, the Government details areas of significant potential for growth in this sector⁷. The report also shows that these life sciences subsectors are responsible for some of the largest turnovers in the UK, the employment of thousands of employees, and investment in education and research and development. The industry details are noted in table 2.1.

Sector Information		Number of Companies	Turnover	Number of Employees	Investing in Research and Development	Less than 250 Employees
Pharmaceuticals Medical Technology Medical Biotechnology Industrial Biotechnology	Production of medicines through chemical and/or biotechnology driven means R&D through to Manufacturing; Regulatory Affairs. Moving into biologics through application of biotechnology. High Usage of Contract Research Organisations.					
	Products/services for global healthcare industry and NHS Imaging, diagnostics (<i>in vitro</i>), instruments, devices, single use technology.	2771	£10.6bn	52,000	25%	98%
	Application of life science for production of new medicines/therapies From discovery and development through to manufacture of biopharmaceuticals. Companies use a range of technologies such as chemistry, stem cell science, gene therapy, small molecules. Largest segment within this category is specialist services which include Good Manufacturing Practice, act as legal consultants, and deliver contract research and manufacturing, through to suppliers of specialist technical services e.g. proteomics, genomics and bioinformatics. Companies have a track record of research into development.	777	£4.2bn	24,000	86%	99%
	Application of life science for industrial processes or products Fine and specialty chemicals industries, developing food & drink, and bio-fuels technologies	64	£230m	1,600	66%	98%

Table 2.1: Industry Sector Information (Source: Strength and Opportunity, 2011⁷)

Within the UK life sciences sector, a small number of major pharmaceuticals companies carry out a significant amount of research and development, including in collaboration with universities. The sector as a whole, however, is dominated by a wide range of small and medium enterprises, as demonstrated in figure 2.1a and 2.1b.

In terms of employment, these subsectors are covered by the following Standard Industry Classification (SIC) Codes:

2110 – Manufacture of Basic Pharmaceutical Products
2120 – Manufacture of Pharmaceutical Preparations (including Diagnostics)
2660 – Manufacturing of Irradiation, Electromedical and Electrotherapeutical Equipment
3250 – Manufacture of Medical and Dental Instruments and Supplies
7211 – Research and Experimental Development on Biotechnology
7219 – Other Research and Experimental Development on Natural Sciences and Engineering

A more detailed picture of employment, recruitment and skills needs in the life sciences sector can be gained through the use of these SIC codes to analyse national data sets such as the National Employers Skills Survey (NESS), the Labour Force Survey (LFS) and the Annual Business Inquiry (ABI) ⁸. Data from these sources is presented in figure 2.1.

As shown in figure 2.1e, such analysis reveals that the proportion of employees in the 35-44 age range is 40%, twice the UK average. It also demonstrates that the sector requires high levels of qualifications, particularly university-level qualifications, across a range of job profiles, as shown in figure 2.1c.

Many of these employees will retire in the next few decades, resulting in a large number of highly qualified staff leaving the sector. Replacing them will not be a quick or easy task, given the length of time required to gain the requisite high-level academic qualifications and experience.

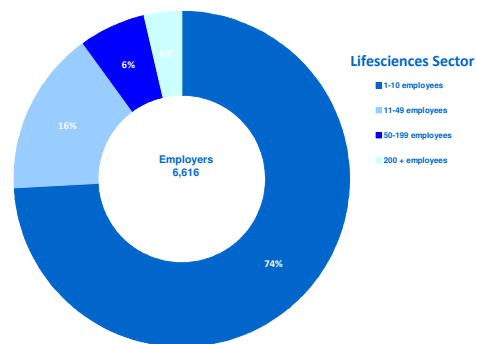
2.1 The Life Sciences Industry Invests in Education

The industry invests in a number of schemes aimed at increasing awareness and attraction to the sector, and takes an active part in education and in the development of the curriculum. It also invests in mentoring and outreach programmes, including STEM ambassadors, Young Enterprise, CREST awards and the Young Foresight schemes⁹.

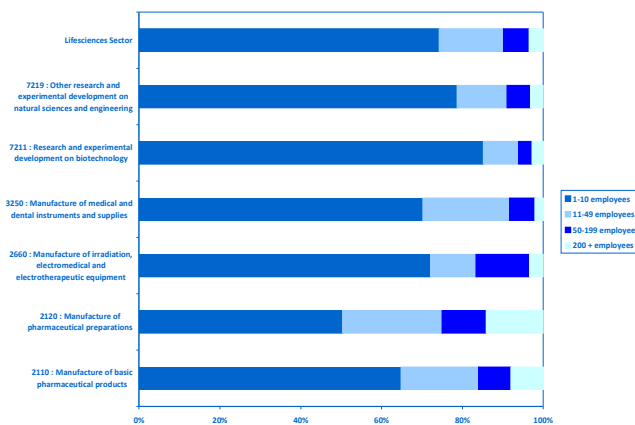
In addition, the pharmaceutical industry invests over £1.75m in educational activities that reach schoolchildren and universities, with an aim of increasing the uptake of STEM subjects vital for the industry, and to attract more potential employees to the sector⁹.

The sector's health and future depends on attracting graduates and postgraduates with the right skills at the right time, and their subsequent retention as employees.

Careers in the life sciences sector are wide ranging and demand many types of skills and qualifications, from the highly specific to the ability to perform multiple tasks across small businesses.



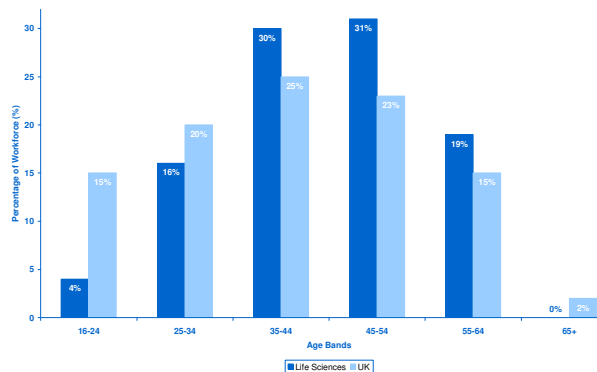
(a)



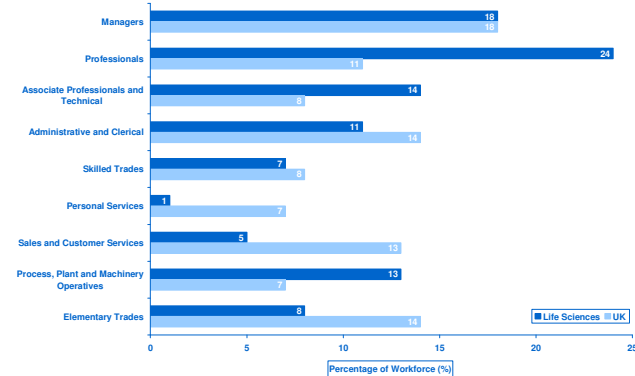
(b)



(c)



(d)



(e)

Figure 2.1: Life Sciences Industry Information⁸ (a) Life sciences employers by company size; (b) Company size by SIC; (c) Number of companies and employees by SIC; (d) Age profile of employees in the life sciences sector; (e) Level of workforce employed in the life sciences sector.

2.2 Careers within the Life Sciences Sector

Work currently being undertaken by Cogent will clarify the career pathways available in this sector, but some common themes are already evident from the work of the Association of the British Pharmaceutical Industry (ABPI) and others¹⁰. These themes are listed in table 2.2.

Research & Development Research and Development (R&D) covers the initial search for a molecule to treat the disease, through to having a product ready to market. Most of this work is carried out by scientists, mainly biologists and chemists, with a variety of specialist qualifications in, for example, toxicology, pharmacology, genetics, statistics, mathematical modelling and animal technology. There are a wide range of disciplines, but all have a role to play in the development of a new medicine. Employment Roles include: Drug Safety; Genetics; Healthcare Economics; Imaging; Medical Writing; Regulatory Affairs; Statistics; Archiving; Patenting; Research Information; Pharmacy; Biology (Animal Technology, Drug Metabolism, Pharmacokinetics, Pharmacology, Toxicology); Chemistry (Synthetic and Medicinal Chemistry, Computational Chemistry, Analytical Chemistry); Clinical Studies (Clinical Trials, Data Management, Clinical Medicine).	Manufacturing & Supply Discovering and developing a new medicine calls for scientific skills and investment, but it's only the first stage in making a medicine available to patients. Equally vital are the jobs of the manufacturers, engineers and quality professionals who support the production of medicine, so that not only is it available in large enough quantities to meet worldwide demand, but also meets regulatory demands which require the highest possible standards of safety and quality. It is fast paced with strong commercial pressures; there are constant advances in technology which must be harnessed to improve efficiency. Employment Roles include: Engineering, Manufacturing and Quality
Commercial Within the commercial side of a company there are a large number of people working towards promoting the medicines their company produces. Prescription medicines are not allowed to be advertised to the general public in the UK. Instead they must be promoted to doctors, who then choose whether to prescribe them. Adverts in medical journals, conferences and presentations tell doctors about the medicine, but most information comes from medical representatives. Medical representatives visit clinicians on a regular basis to tell them about their company's new products, and to answer any questions they have. Sales managers, health economics experts, healthcare communication professionals and product managers work together with the aim to promote new medicines for the benefit of patients. Employment Roles include: Healthcare communications; Medical Information; Pharmacovigilance; Sales and Marketing	Support Functions As with all organisations, companies need an infrastructure to run them. Within the life sciences industry, there are many people who are there to support the work of the scientists and manufacturers; for example: Legal experts are involved from ensuring that appropriate patents are taken out for the molecule and the process for making it, to generating contracts for suppliers Statisticians are involved at all stages from ensuring that the animal studies will provide valid results, to monitoring process controls Regulatory affairs pull together all the information that is needed for a medicine to be approved for marketing And, every large company needs departments such as Human Resources, Training & Development, IT and Finance. Employment Roles include: Human Resources; Finance; Information Technology; Training and Development

Table 2.2: Careers in the Life Sciences Industry (Source: ABPI Careers Website¹⁰)

The wide range of research and development sites and employment figures shown in table 2.3 clearly demonstrates the sectoral requirement for employees with a high level of scientific skills and education. It also clearly demonstrates that the industry invests in research and development for the purposes of manufacture and commercialisation.

Detailed analysis of employment in the life sciences sector has been undertaken by Cogent and Semta in recent years^{11,12}.

	Sites		Employment		Employment Role	Employed in R&D		Not Employed in R&D	
	Number	%	Number	%		Number	%	Number	%
Life Sciences	68	18	5,185	22	Managers and Senior Staff	1,510	38	2,454	62
Pharmaceutical- including R&D	25	7	2,275	9	Professional Engineers, Scientists and Technologists	3,059	59	2,168	41
					Associate Professionals and Technicians	409	21	1,562	79
Pharmaceutical- excluding R&D	40	11	5,135	21	Skilled Trades	82	7	1,070	93
					Process, Plant and Machine Operatives	37	2	1,971	98
Biotechnology	39	10	2,620	11	Administrative and Secretarial Occupations	67	3	2,222	97
					Sales and Customer Services	13	1	998	99
Medical Devices	208	55	8,879	37	Elementary Occupations	12	4	272	96
					Personal Service Occupations	1	<0.5	246	>99.5
Sample Base	380		24,094		Total (Sample base 356 sites)	5,190	29	12,963	71

Table 2.3: Industry Employment Information (Source: 11, 12)

2.3 Investment in Research and Development

The R&D Scorecards produced by BIS demonstrate that the pharmaceutical and biotechnology sector is a large investor in R&D in the UK.

The following facts reveal the significance of the sector's contribution to innovation in the UK^{13,14}:

In 2008:

- The pharmaceutical and biotechnology sector was the largest contributor to R&D in both top 850 and top 1400 companies in the UK;
- Pharmaceuticals and biotechnology companies accounted for 37% of R&D spend of top 850 companies;
- 8 of top 25 R&D investors globally are pharmaceutical companies: they include two firms with major UK-based facilities: GSK and AZ;
- GSK and AZ dominate R&D spend in the UK pharmaceuticals sector, with 89% of the sector total, and 37% of UK top 850 spend;
- R&D in the pharmaceuticals and biotechnology sectors continues to grow more quickly than sales among the largest investors.

In 2010:

- The pharmaceuticals and biotechnology sector continued to be the largest contributor to R&D in both the UK1000 and G1000 in 2009;
- The global pharmaceuticals and biotechnology sector increased R&D expenditure by 5.5%. The UK sector, however, recorded growth of just 0.9% in 2009;
- R&D spending by pharmaceuticals and biotechnology companies based in the UK is highly concentrated. GlaxoSmithKline and AstraZeneca account for 71.4% of R&D expenditure in the sector, and 25% of overall UK1000 R&D spending.
- Six of the 25 largest investors in R&D in the UK and eight of the 25 largest global investors are pharmaceuticals and biotechnology companies. Roche and Pfizer lead the way in the G1000 at second and fifth place, respectively. Only one UK company, GlaxoSmithKline, is in the 25 largest global R&D investors;
- There are significant differences between the two largest spenders in the UK. GlaxoSmithKline saw its R&D expenditure and sales increase by 10% and 16%, respectively, for a boost in operating profit of 6%. AstraZeneca, however, reduced its R&D expenditure by 12%, while growing sales by 4%, resulting in an increase in operating profit of 24%;
- There are 129 pharmaceuticals and biotechnology firms in the UK1000 and 112 in the G1000. Shire and Merial join GlaxoSmithKline and AstraZeneca as the only UK pharmaceuticals and biotechnology companies in the G1000;
- Smaller UK companies also did well - Shire grew its R&D spend by 16% and although sales decreased by 1%, operating profit grew by 90%. Another high performer was Eisai Europe, which increased its R&D by 42%, sales by 30%, and recorded a growth in operating profit of 125%.

UKTI estimates that UK pharmaceutical companies account for 40 per cent of all products in the pipeline by European public companies. It also states that “the country's success in life sciences – with UK companies accounting for 45 per cent of new biotechnology drugs in late-stage clinical trials in Europe – is driven by its rich pool of talent and skills. Its world-class scientific institutions, impressive research base and track record in product development continue to attract and retain healthcare innovators.”¹⁵

2.4 The Skills Landscape in the Life Sciences Industry

With such a high demand for a scientifically competent workforce, the need to recruit graduates, postgraduates and postdoctoral researchers to operate in this environment is critical to business operation. However, a number of reports over recent years have highlighted areas of concern, not only in terms of levels of skills and scientific knowledge, but also in the ability of recruits to apply this knowledge, practically. Some areas are particularly difficult to recruit to^{11,12}.

A recent employer survey reported skills gaps across a range of job roles (shown in table 2.4) and listed the scientific subject areas where skills mismatches occur (shown in table 2.5). These include clear mismatches in the fields of chemistry and biological science.

The survey also reviewed recruitment trends within the sector over the previous 12-month period.

Job Role	% Skills Gap
Corporate Managers	19% (increasing to 25% in SIC 73.1)
Scientific Researchers	15% (increasing to 20% in SIC 73.1)
Sales Representatives	7%
Science and Engineering Technicians	6%
Chemists	6%
Customer Care	6%
Laboratory Technicians	6%
Medical and Dental Technicians	4% (both cases in SIC 33.1)
Precision Instrument Makers and Repairs	4% (both cases in SIC 33.1)
Engineering Professionals	4%
Marketing Associate Professionals	4%

Table 2.4: Reported Skills Gaps by Job Role (Source: 11,12)

Recruitment of graduates, postgraduates and postdoctoral researchers is essential across these job roles and subject areas, as shown in figure 2.2.

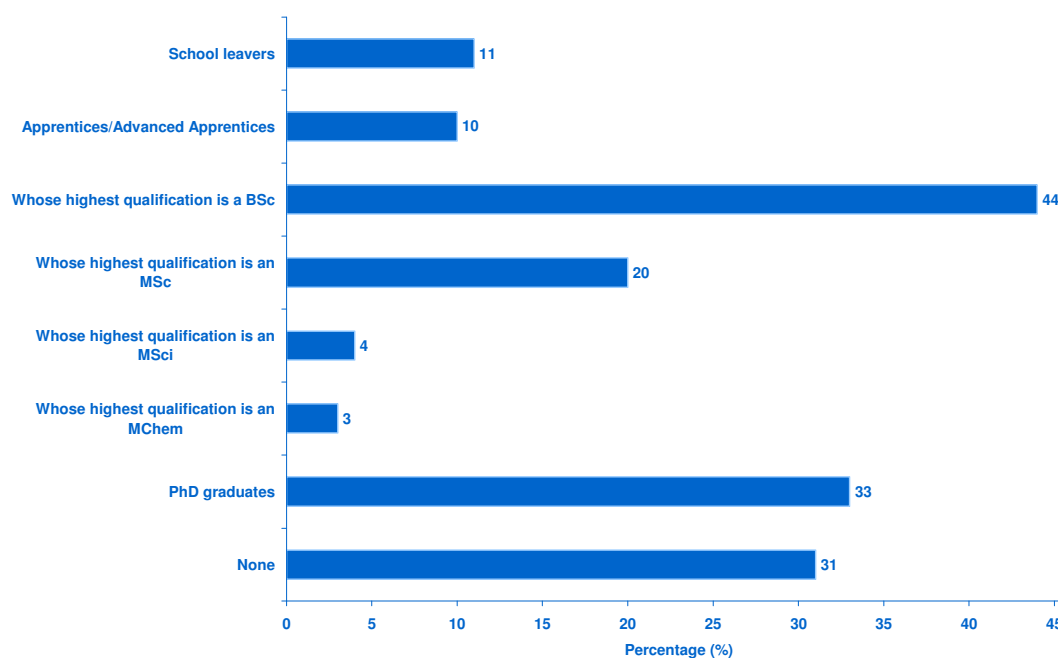


Figure 2.2: Recruitment into the Life Sciences Sector (Source: 11,12)

An assessment by qualification level demonstrates that the recruitment of graduates, postgraduates and postdoctoral researchers is commonplace (figure 2.2). Nonetheless, the industry also declares not only that both scientific and technical occupations are hard to fill, but also that there is evidence that 25% of those graduates may be being directed to occupations that are lower than the indicative level of their qualification.

The results of further analysis of these recruitment issues are presented in figures 2.3a-c. The main issues relate to low levels of applications from potential employees with the ability to demonstrate

the required skills for the job role on offer or the experience expected by the company. This trend is particularly noticeable where job roles require technical, practical and job-specific skills.

The companies surveyed attempted to overcome these issues by increasing their recruitment efforts to attract new entrants or by training existing employees. Rarely did they increase the salary on offer or recruit less-qualified, skilled or experienced personnel.

In some cases, companies also sought to recruit from overseas; the sectoral trend for overseas recruitment of scientists and graduates is discussed later, in section 7.

2.5 Future Skills Needs in the Life Sciences Sector

The ABPI has undertaken a number of member surveys in recent years to explore skills needs and the extent to which these are being met. In 2008, the publication *Skills for Biomedical Research* detailed specific areas of research and development areas where skills deficits were found⁹; these were wide-ranging and included:

• Clinical pharmacology/experimental medicine • Drug metabolism and ADME • Pharmacokinetics, pharmacodynamics and modelling • <i>In vivo</i> and supporting animal technology • Chemical & process engineering • Statistics • Computational chemistry • Translational science • High-value manufacturing (including biopharma)	The survey further segmented these areas into the following: • Translational & biomedical sciences • Clinical pharmacology/translational medicine • Molecular & translational toxicology • Biomedical imaging/physics • 'omics' • Drug metabolism & ADME • Biochemistry • Bioscience & molecular biology • <i>In vitro</i> pharmacology • Pharmacy • Medicine • Biotechnology & biopharmaceuticals • <i>In vivo</i> physiology • <i>In vivo</i> pharmacology • Toxicology • Pathology • Veterinary medicine & science • Animal technology • Chemical sciences • Engineering • Mathematical sciences & statistics
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As the industry alters in structure to ensure global competitiveness, the emphasis on R&D areas is essential. However, this R&D takes place in the context of the need to develop new products and services whilst introducing new working practices. As new technologies are introduced from the research areas listed above, a wider range of skills will also be needed to address and support these research areas. Higher-level skills in wider (interdisciplinary) fields are also required as demand grows for new treatments and replacement of outmoded technologies and products. These are shown in table 2.6^{11,12}.

To support the changing business environment, a combination of highly specialised subject areas and the wider skills sets identified above is required.

The age profile of the current workforce also suggests that there will be a significant workforce replacement demand due to retirement in the years leading to 2020. As a result, while employment levels will remain stable, recruitment will need to increase to sustain them; sufficient scientists and other personnel must therefore be trained and available to meet this need.

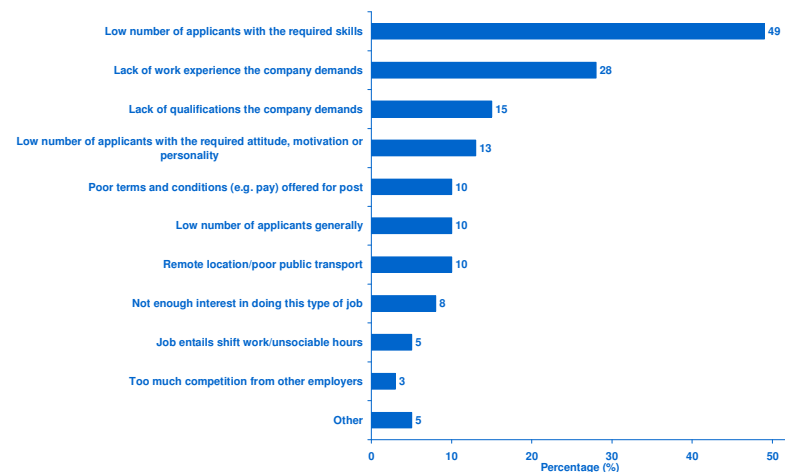
As the industry begins to move towards greater open innovation, working with higher education will be essential in understanding and delivering these skills to the new workforce, enabling growth and innovation.

This new environment brings a critical need to address the delivery of education and experience to support a stable UK industry and it is here that greater emphasis on work experience and global awareness is required. A collaborative model of working across industry and academia is essential, bringing the industry into direct contact with students and researchers for mutual benefit.

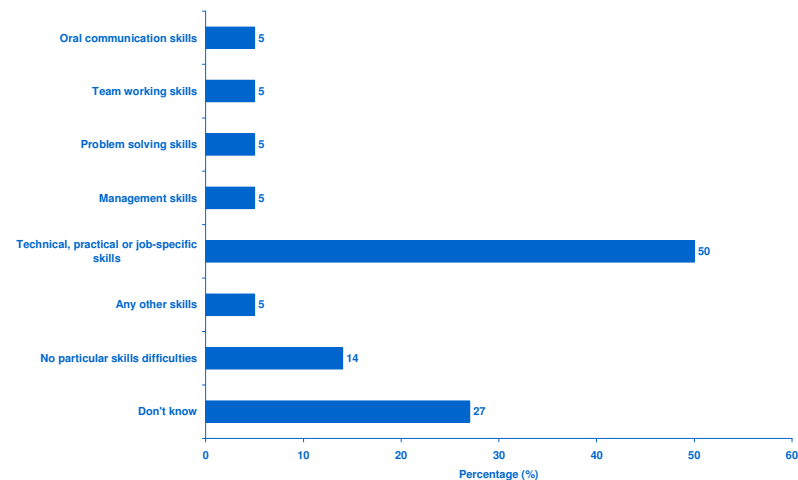
The following chapters will address why placements and people movement need to be increased.

Scientific Employment ^a	Scientists % intake 2008	Graduates % intake 2008	Supply by 2020	Reported Areas of Science with Skills Gaps ^b	Sectors with Skills Gaps			
					All	24.4	33.1	73.1
Chemical Sciences ¹	28	13	2,000	Chemistry	20	25	0	40
Biological Sciences ²	23	11	1,700	Biology	9	0	5	20
Pharmacology & Toxicology ³	15	7	1,000	Genetics	2	0	0	5
Molecular Science ⁴	6	3	500	Microbiology	2	8	0	0
Engineering ⁵	5	2	300	Pharmacology, Toxicology & Pharmacy	6	0	0	15
Mathematical Sciences ⁶	4	2	300	Medical Technology	2	0	5	0
Subjects allied to Medicine ⁷	3	1.5	230	Molecular Biology, Biophysics & Biochemistry	2	8	0	0
Physical Sciences ⁸	2	1	150	Electronic and Electrical Engineering	2	0	5	0
	86%	41%	6,180	Chemical, Process & Energy Engineering	2	0	0	5
Source: HESA 2008 Data; subject areas include: 1. Medicinal Chemistry, Analytical Chemistry, Biological Chemistry, Pharmaceutical Chemistry 2. Microbiology, Genetics, Applied Biology, Applied Biological Sciences, Animal Sciences, Physiology 3. Pharmacy 4. Molecular and Applied Biology, Biophysics, Biochemistry 5. General Engineering, Chemical, Process & Energy Engineering, Mechanical Engineering 6. Statistics 7. Clinical Medicine 8. Excluding Chemical Sciences				Physics	2	0	5	0
				Physical & Terrestrial Geographical & Environmental Sciences	2	0	0	5
				Computer Sciences	2	0	5	0
				Industrial Biotechnology	2	0	0	5
				Other	28	8	50	15
				None	35	50	36	25
				<i>Sample Bases</i>	<i>54</i>	<i>12</i>	<i>22</i>	<i>20</i>

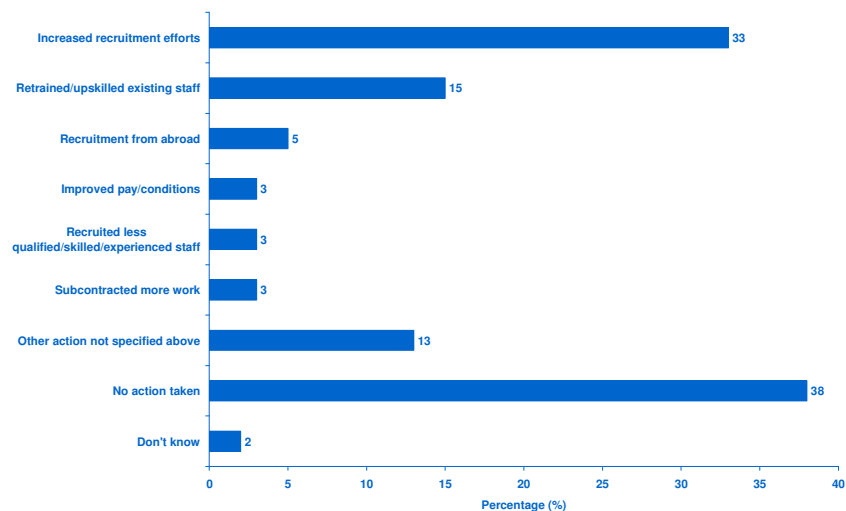
Table 2.5: (a) Scientific Employment by Subject Area and Employer Intake (Source: 15); (b) Science areas in which skills gaps have been experienced – unprompted, multiple response, by sector (%) (Source: 11,12).



(a)



(b)



(c)

Figure 2.3: Recruitment issues in the Life Sciences Sector (Source: 11,12). When employers were asked about Hard to Fill Vacancies, the following responses were made when questioned on (a) causes of hard to fill vacancies; (b) Specific skills sought in these hard to fill roles; (c) the action undertaken to overcome and avoid recruitment issues.

		The Development of New Products and Services	The Introduction of New Working Practices	The Introduction of New Technologies or Equipment	New Legislative or Regulatory Requirements	Other	Do not Expect Employees to Acquire New Skills/Knowledge	Sample Bases
Sector (%)	24.4	51	49	52	52	6	28	69
	33.1	57	41	52	41	4	27	162
	73.1	54	37	51	40	7	29	121
Number of Employees (%)	1-4 employees	42	29	40	30	5	42	83
	5-49 employees	59	46	51	45	4	24	186
	50-249 employees	61	48	67		7	20	54
	250+ employees	52	38	62	48	14	24	29
	Total	55	41	52	43	5	28	352
New Skills or Knowledge Areas		(%)						
Update existing skills/knowledge/ ongoing training		15	21	20	36			
(New) Product/Services knowledge		16	-	3	1			
Dependent on changes/new machinery/software		15	16	13	14			
Technical Skills		5	-	2	1			
General knowledge/skills		2	4	2	2			
General IT Skills		4	4	9	-			
(New) Regulation/Legislation awareness		4	6	-	10			
New technology/equipment training		6	2	23	1			
Manufacturing Processes		3	1	2	2			
Chemistry		3	-	1	-			
CAD/CAM		3	1	1	1			
Marketing/Sales		3	1	-	-			
Engineering		2	1	1	1			
Health and Safety Regulations		1	7	1	6			
Improvements to Customer Service		1	3	2	-			
Administrative Skills		-	2	-	1			
Other		24	17	19	15			
None		1	16	2	3			
Sample Bases		192	146	182	151			

Table 2.6: Reasons for anticipated skills need changes in the next 2–3 years – prompted, multiple response (all respondents; sample base of 352), with specific skills or knowledge areas reported by reason (%) (Source: 11,12).

3. Placements in the UK Life Sciences Sector

It is well known that the life sciences industry is a key economic sector in the UK: it drives forward innovation, invests heavily in research and development, and places key emphasis on working with and recruiting from higher education institutions.

Over recent years, the life sciences sector has altered in size and shape, with a change from global businesses incorporating business, development and manufacturing sites, to more focused operations and therefore greater collaboration with supply chain companies and research facilities.

A growing need to meet global drivers through a wider variety of employers has emerged, reducing the reliance on global industry partners. As such, new ways of working are now required and the skills needs of this industry have become less defined.

As the funding environment of higher education changes, more emphasis will be placed on the interaction of universities with businesses, driving forward greater collaboration with industry from research and development, to knowledge transfer, to postgraduate and undergraduate provision.

In addition, learners of all types will be looking more to programmes that deliver education and skills development to enable them to compete in the future job market, whether in industry or in higher education itself.

By enabling people movement between industry and academia, placements of all types provide essential knowledge and understanding of this new environment; deliver skills relevant for the future of the sector; increase employability; and improve links between industry and academia.

3.1 What do we mean by Placements?

Placements take many forms, but their common focus is people movement.

People movement provides opportunities to accelerate the two-way flow of ideas, people and skills through individuals moving between different disciplines and sectors of employment at all career stages (for example, movement between universities and government, business or the third sector within and beyond the UK). This movement benefits the individual and their skill set, the research agenda, the organisations for whom they work, the economy, and the society as a whole. It should therefore be championed and supported in all its manifestations.

The focus of this report is 'structured work experience' undertaken by students progressing through Higher Education (HE), from first degree level (e.g. sandwich courses and summer placements) through to postgraduates degrees (e.g. CASE studentships), but also those engaged in graduate internships, Knowledge Transfer Partnerships (KTPs) and postdoctoral researcher exchange programmes.

There is a lack of formal definition for the range and complexity of work experience on offer, leading to inconsistency in terminology. This report builds on and complies with the work undertaken by the National Council for Work Experience and the Science Council^{16,17}. This report defines work experience placements as follows:

A work experience placement is a specific, organised period of work for an employer, paid or unpaid, the chief purpose of which is educational, i.e. for the participant to gain knowledge, skills and experience. Clearly, the employer also gains from work undertaken by the participant. It may be integral to the student's course (e.g. a 'sandwich' placement), in which case it may be compulsory and is likely to be assessed.

An *internship* was originally considered to be a sponsored trial by an employer of a potential employee (usually a student or graduate). The term is increasingly, but not exclusively, used for graduate placements as opposed to those undertaken by students. The 'sponsoring' aspect seems also to be diminishing, as a significant proportion of 'internships' are unpaid and this is a topic of current political campaign. These origins suggest that internships should primarily be for the employer's benefit; however, the intern gains greatly if they are accepted for long-term employment and/or from the ability to cite relevant experience in future job applications.

Some students or graduates undertake a distinct *project* hosted by and/or for an employer, which in some cases is effectively a form of consultancy. The participant might consider this to be work experience in a structured form. Where it is consultancy, the primary beneficiary is clearly the employer, but the purpose is knowledge transfer rather than employment-related. Prominent examples include Knowledge Transfer Partnerships and CASE studentship, which are underpinned by a programme of training for the learner. Equally, some HE courses involve an integral, assessed project hosted by an employer, where the primary beneficiary is the student, but for the purpose of attaining their degree rather than primarily employment-related.

Finally, there are people movement programmes aimed at research and development staff undertaking *secondments*. These schemes are open to industry and academic staff who interchange between these environments. They are often sponsored by Research Councils and charitable trusts, but can be delivered through other funding opportunities. Interchange programmes have traditionally been known as Fellowships, but the terminology of 'Industry Interchange' is now commonplace.

The Confederation of British Industry (CBI) reports that employers link with universities across this spectrum of definitions¹⁸. Of those employers surveyed, almost a half provide work experience opportunities; a third offer internship opportunities; two-fifths partner for research and development; and a third offer real life projects and resources.

The reasons for their participation include the ability not only to attract and improve the quality of graduates and postgraduates coming into employment, but also to influence the relevance of the course provision, and to access research and development in universities.

3.2 Aims of Placements

High-quality placements are valuable to multiple parties. For example, the student/graduate gains in terms of skills development, enhanced employability and more informed career decision-making. The participant is offered an insight into the industrial environment they are placed in, while the provider can gain from the knowledge brought in, as well as potential future employment opportunities. Placements also enable relationships to be built between industry and academia, with the potential for these to diversify and to access a wide range of funding opportunities.

Having completed a year long industrial placement can vastly improve a candidate's employability. The value of industrial placements extends beyond practically benefiting individual students and companies; placements serve as a valuable connection between industry and academia.

By committing to an industrial placement, employers can identify suitable candidates for employment, reduce recruitment costs whilst improving the skills of the candidate for their particular work environment.

In addition, employers can build relationships with education partners, develop research programmes and potentially access a wide range of further public funding opportunities.

*The changing shape of academic collaborations, ABPI, August 2010*¹⁹

3.2.1 Improving Skills

Across the life sciences industry, a number of employer surveys have highlighted areas of specific skills needs^{9,15,20-23}. These areas are summarised in table 3.1. Alongside the subject specific knowledge required to work in this industry, a number of reports have highlighted a shared concern over the practical skills and mathematical ability of recruits, and their ability to apply their scientific and mathematical knowledge.

These reports particularly relate to graduates, but also affect the ability of those graduates to carry on to postgraduate education and to work in the technically challenging research and development environment.

While employers recruiting science-based graduates may well use the degree subject as a precondition, they seek additional characteristics to identify the right candidate for their environment. These include a range of technical competence and analytical skills, through to problem-solving and numerical skills.

In addition, employers often recruit candidates who have evidence of work experience, can demonstrate their practical and laboratory skills, and show that they have wide-ranging employability skills^{24,25}. A summary of this skills portfolio is shown in table 3.2.

As such, what makes one recruit different from another is not only their individual motivation and commitment to the position on offer, but also their ability to evidence their technical and workplace experience, and their generic employability skills.

Skill Level	Type of Skill Required	Comments
Scientific and Technical Skills		
Ultra High Level Skill Needs	Postgraduate scientists in a range of biological and physical sciences	Generally required in small numbers with highly specialist skills, but critical to the future of the industry
High Level Skill Needs	Graduate level scientists	Better laboratory skills Improved overall scientific and mathematical literacy
	IT Skills	Needed to develop improved communication between people and devices – a general requirement for the industry over the medium term.
	Statisticians and Mathematicians: graduate and postgraduate level	Processing of data. Use of simulation models.
	Engineering	Nanotechnology skills, design and use of new materials/biomaterials. Software and IT. Existing demand for chemical engineers.
	Economists: graduate level	Required to assess the cost-benefit of any new development and its application to the healthcare system.
Intermediate Level Skill Needs	Graduate and Level 3 Apprenticeship Skills	Required to support manufacturing process. Especially important in niche production if the future of the manufacturing sector is based on this form of production.
Operative and Assemble Line Skills	Typically level 2	Skills at level 2 are typically employed in the production of a range of bio-medical goods. A shift to more niche production is likely to limit the capacity of automation to replace these jobs. These are at potential risk of being transferred to lower labour cost countries.
Generic Skills		
Management and Leadership	Graduate level	Managing across multi-disciplinary teams Managing across organisations, networks, particularly where outsourcing is required. Procurement skills Negotiating with healthcare systems.
All	All levels	Improved levels of scientific and mathematical literacy. Quantitative skills.

Table 3.1: Summary of Sector Skills Needs (Source: 15)

Reasons Employers Value STEM-Skilled Employees (%)							
Skills		Science, High Tech and IT	Manufacturing	Energy and Water	Construction	Banking, Finance and Insurance	All
Technical Competence	- Plan, carry out, analyse and report the results of an experiment or investigation - Produce clear and accurate scientific reports	83	80	81	85	45	73
Analytical Skills	- Analyse critically the results of an experiment or investigation and draw valid conclusions - Develop skills of independent investigation - Develop computing and IT skills in a variety of ways, including appropriate programming languages and packages	69	73	88	63	90	69
Problem Solving Skills	- Develop the confidence to try different approaches in tackling challenging problems - Solve problems by making assumptions and approximations based on scientific and technical knowledge and data	58	66	81	77	50	61
Numeracy Skills	- High levels of numeracy and literacy - Use mathematics - Manipulate numerically and present and interpret information graphically	53	50	75	54	65	51
Intellectual Rigour	- Work independently, using initiative, planning and organising to meet deadlines, and interact constructively with other people - Communicate well, listen carefully, read demanding texts, and present complex information clearly and concisely - Manage own learning	50	40	63	44	50	42

Table 3.2: Reasons employers value the scientific skills of STEM-skilled employees (Source: 24, 25)

3.2.2 Enhancing Employability

The CBI defines employability as a set of attributes, skills and knowledge that all labour market participants should possess to ensure they have the capability of being effective in the workplace – to the benefit of themselves, their employer and the wider economy²⁴. These attributes are shown in figure 3.1.

While employers may use degree subject as a precondition, these employability skills are critical to develop in future employees of all types. Employers are expecting to see these evidenced at recruitment stage as part of a wider skills portfolio.

The sector as a whole is keen to recruit individuals with high levels of practical ability, and companies offer placements of all types to aid the development and application of these skills needs.

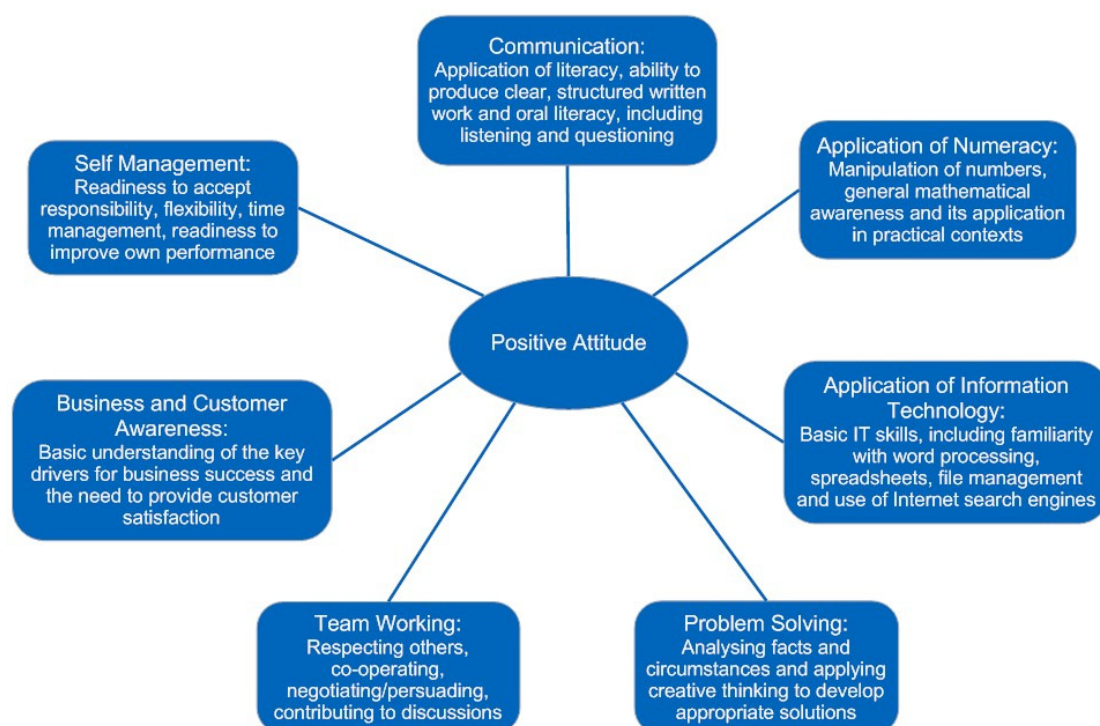


Figure 3.1: Employability of STEM Graduates (Source: 24)

3.3 Placements in the STEM Industries

A clear picture of supply and demand in STEM placements is difficult to achieve in the absence of a definitive method for collecting data across the wide range of placement types or among the various stakeholders, including higher education, the Research Councils and the employers themselves. For the purposes of this report, some assumptions must therefore be made on the basis of a composite but necessarily partial picture.

However, in 2011 the Careers Research and Advisory Centre (CRAC) reported findings from their extensive research in this area, and this data was further segmented by The Science Council and the Research Councils^{16,17,26}. This analysis is shown in figure 3.2.

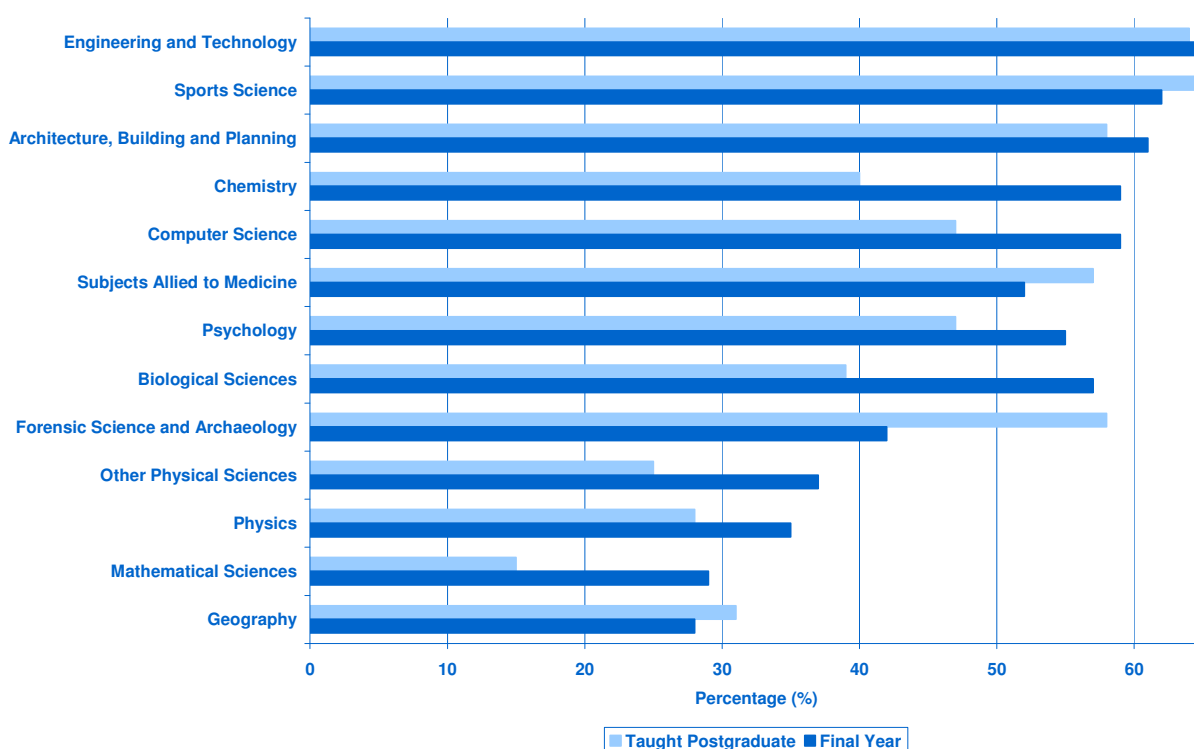


Figure 3.2: Percentage of UK final year and taught postgraduates with degree-related work experience, by undergraduate subject (Source: 17)

Across the STEM disciplines, there is evidence relating to degree-related work experience at undergraduate and taught postgraduate level. For those who started their degrees in 2002, there were 22,000 sandwich placements, four-fifths of which were in the STEM disciplines. Of these, 90% were considered full-year placements.

Annually, between 2003 and 2005, an estimated 17,500 placements were available through STEM sandwich courses. There were also an additional 8000 ERASMUS overseas placements available, although very few of these were taken up by STEM students^{16,17}.

In terms of postgraduate placements, the Research Councils have recently collated data across their people exchange schemes²⁶. Around 1500 placements are available each year, through a combination of CASE studentships and industrial doctorates, internships, secondments and fellowships, and KTP placements.

Other placement activity not accounted for here includes internships, summer vacation and block (rotational) placements, but also formal schemes such as the STEP and EDT programmes.

Not all placements are sponsored by industry, higher education or Government; the contribution of professional bodies and charitable trusts should also be acknowledged.

Employer demand can only be judged by supply. Conversely, there is no data available that highlights the demand for placements from students themselves.

3.4 Placements in the Life Sciences Sector

The ABPI undertakes a member survey every two years to seek information relating to placement activity¹⁹. Some key trends emerged from the 2007 and 2009 surveys:

- There was a 33% decrease in undergraduate placements
 - In 2007 there were 530 places versus 355 in 2009
 - The universities of Bath and Manchester offer 20% of these placements
 - The major pharmaceutical industries dominate this provision
- There were stable PhD studentships
 - There was a 10% increase in student numbers, but a 6% reduction in industry sponsored places since 2003
- There was an increase in postdoctoral research collaboration
 - Over two years, there was a 17% increase in postdoctoral research collaboration, with 384 collaborations with 127 academic organisations
 - Imperial College London, Manchester and Cambridge universities undertook 25% of collaborations
 - 50% of postdoctoral researchers were not supported by industry funding
 - Full economic costing of research collaborations with higher education has led to a rise in the cheaper alternative of academic consultancy and thus to a one-way flow of knowledge from university into company rather than two-way engagement and the benefits of 'joined up' R&D
- Companies are investing more overseas
 - 25% of reported postdoctoral grants were awarded to overseas institutions; in 2007, it was only 10%
- Sharing costs through joint ventures has increased collaboration in the UK

Table 3.3 details the breakdown of placement activity by university partner in 2009. Although not an exhaustive list, it shows the main partners engaged. It should be noted that, as yet, Oxford and Cambridge do not offer undergraduate placements.

In the more recently released ABPI report, a number of further observations have been made²⁷. Partnerships and outsourcing of research and development have increased, the in-house capacity of many pharmaceutical companies has decreased, leading to some sites closing and fewer scientists being employed at others. These changes have impacted on the capacity of companies based in the UK to support undergraduate, postgraduate and postdoctoral training. As a consequence, industry-academic partnerships continue to decrease, as shown in figure 3.3. In addition, there remains a core group of research intensive universities that take up and promote industrial placements, and these are shown in figure 3.4. Further key trends, reported in 2011 are:

- There has been a 50% decrease in undergraduate placements between 2007 and 2011
 - In 2011, there were 268 placements in 2011 versus 355 in 2009
 - The universities of Bath, Manchester and Sheffield provide nearly a quarter of undergraduate placements between them
 - The major pharmaceutical companies still dominate in the provision of these placements
- Postgraduate training continues to be supported by the industry
 - 65% of PhD studentships are now being funded for a 4-year period rather than 3 years
 - There has not been an increase in those funded by industry, but the level of support from the RCUK has increased

- Companies identified the BBSRC as the funding partner for 32% of their studentships; the EPSRC for 20%, and the MRC for 11%
- Companies continue to invest overseas, with figures for research collaborations at around 20%.

Number of Placements	Institution	
65-100	University of Manchester	
55-64	Imperial College London University of Bristol	
45-54	University of Bath University of Oxford University of Cambridge	• Oxford and Cambridge do not as yet offer undergraduate placements
35-44	University of Nottingham University of Leeds Kings College London	• Bath and Manchester offer over 20% of the 355 undergraduate placements recorded in 2009
25-34	Cardiff University University of York University of Sheffield University of Strathclyde University of Glasgow University of Liverpool University of Southampton	• Over a third of PhD placements are offered through Imperial College London, Manchester, Oxford and Cambridge
15-24	Newcastle University University College London University of Birmingham	• Over a quarter of postdoctoral research collaborations are undertaken with Manchester, Imperial College London and Cambridge
5-14	University of Edinburgh University of Kent University of Warwick Loughborough University University of Surrey University of Leicester University of Dundee University of Durham CPE Lyon Queen Mary, University of London University of St Andrews	

Table 3.3: Combined number of studentships and placements at UK universities in 2007 (Source: 19).

The life sciences industry is working in new ways, and the reliance on the major pharmaceuticals companies to support the majority of industrial placements, PhD studentships and research is not sustainable. Placement availability has fallen due to site closures and reorganisation of the industry, so there is now a real need to encourage a wider range of employers, particularly contract research organisations (CROs) and small and medium enterprises (SMEs), to begin or expand placement programmes.

There is also a need to address the perceived expense of placements; they are usually fully funded by industry and students often need training and time to adjust to the industry environment before businesses begin to see a return on their investment.

With this decline in placements, there will also be a decline in highly skilled future employees. With most employers stating that they will only consider graduates who have undertaken at least a summer placement, a solution to delivering the practical skills and industry knowledge is urgently required. While universities are increasingly under pressure to develop employability and technical skills in their graduates, they cannot solve this dilemma alone.

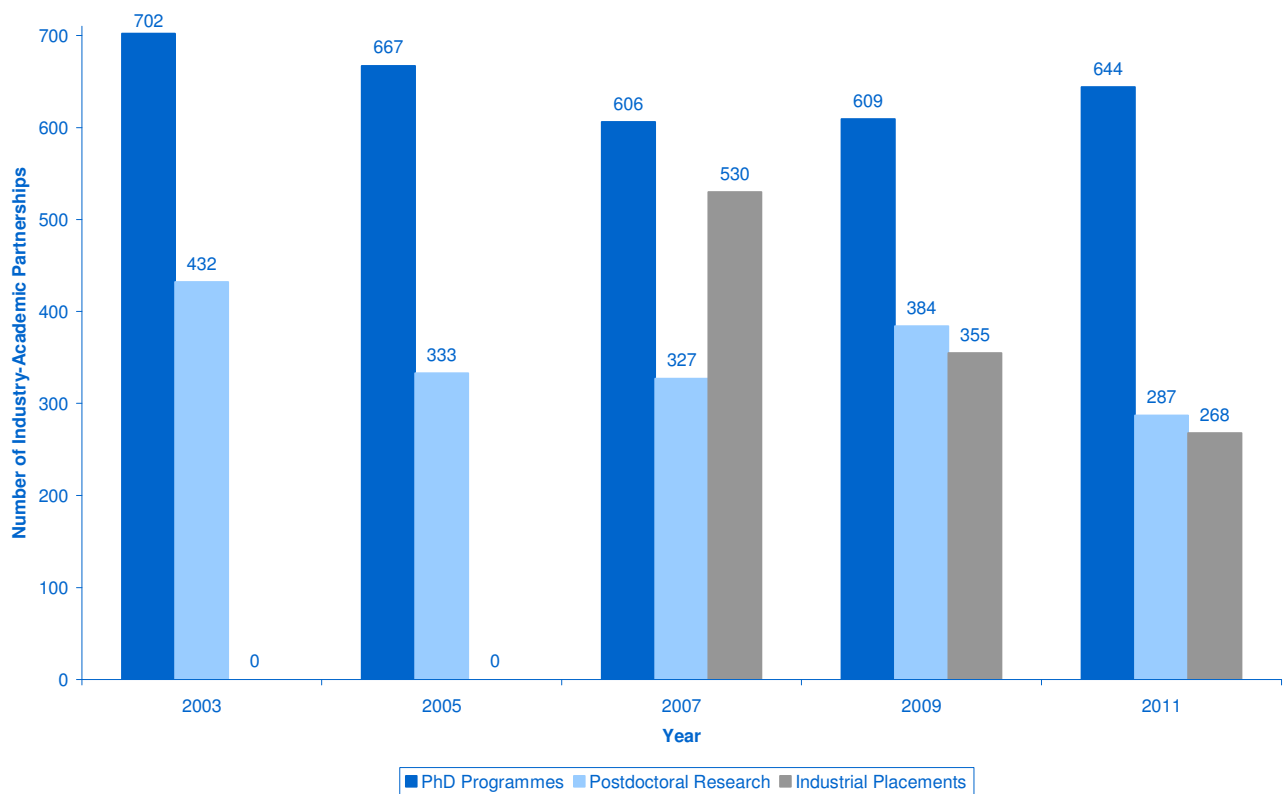


Figure 3.3 – Overview of industry – academic partnerships (Source: 27)

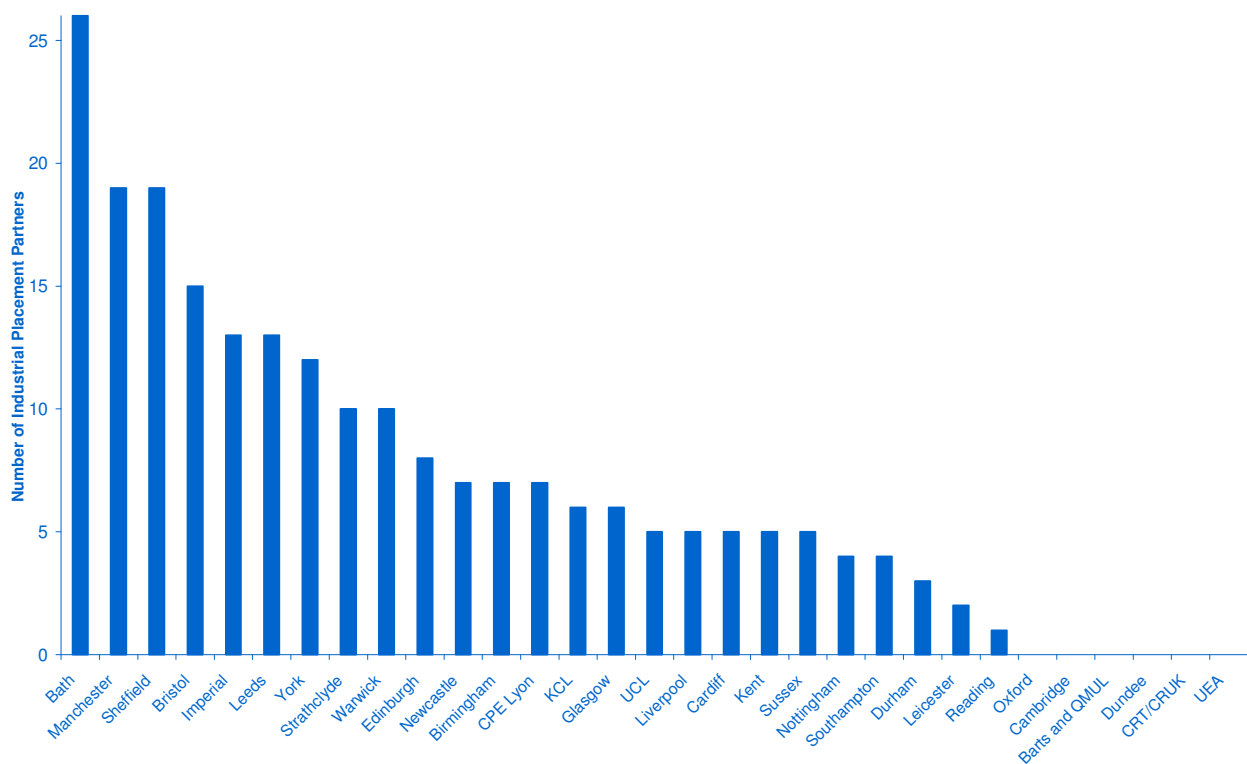


Figure 3.4 – University industrial placement partners in 2011 (Source: 27)

3.4.1 Types of Roles for STEM Placements

It is also worth noting the types of role available to placement participants. The options for an undergraduate or recent graduate range from pure laboratory investigations through to business functions¹⁷. These are summarised in table 3.4.

Through the research undertaken by CRAC, employers and participants noted improvements in several areas as a result of a placement, including problem-solving, prioritisation, team-working and ICT skills. In addition, commercial and customer awareness was also developed, albeit to a lower extent in STEM students than in other disciplines¹⁷.

There is skills development to some extent across the types of placement on offer. Even a short placement allows participants to understand the nature of the workplace and contextualise the skills actually required there, and how different these can be from their use of the same skills at university.

3.5 Improving Career Planning and Recruitment

Placements also aid participants with career planning¹⁷; Table 3.5 shows how their perceptions are changed through placements. For employers, there is an advantage in recruiting someone who has experienced and understands the industrial environment and is therefore more likely to be committed to the career on offer.

	Undergraduate Placement Availability	Graduate Internship Availability	Comment
Explorer ("Blue-Sky" Researcher)	Very rare	Very rare or absent	Occasional project-based placements; More likely as HE exchanges
Investigator (research leader or research scientist)	Rare	Rare	Research assistant roles in or associated with HE are promoted by many scientific societies to give undergraduates some experience of research and commercial laboratories also offer summer research placements
Developer/Transitional (Product development or R&D scientists/engineer)	Some (R&D teams; STEP Projects)	Some	Most common form of scientific placement
Service provider/operational (Laboratory scientists and technicians)	Some	Some	Some public sector positions
Monitor/Regulator (Government and other agency specialists; test and measurement)	Rare	Rare	Some public sector positions
Entrepreneur (R&D and innovation managers)	Absent	Absent	Skills of students or graduates insufficient
Communicator (Public engagement, journalism and media)	Absent at high level; Some at lower levels	Absent at high level; Common at lower levels	Scientific publishing or museum explainers (often unpaid)
Teacher (HE and school/college educators)	Limited	Some	Positions in HE during HEFCE schemes
Business and Marketing (Commercial functions which require some STEM background)	Most common	Most common	The majority of placements in private sector are of this nature
Policy maker (Government and NGO specialists)	Rare	Some	Some public sector positions

Table 3.4: Summary of availability of 10 types of scientist as undergraduate work placements or graduate internships (Source: 17).

	Subjects allied to medicine	Biological Sciences	Psychology	Chemistry	Physics	Mathematical Sciences	Computer Sciences	Engineering and Technology	All
Career plan when first went to university									
Definite career in mind	38	19	22	11	16	18	14	24	19
Considering several career alternatives	18	29	28	24	19	21	29	30	26
Only vague idea of possible careers	27	34	35	45	36	30	40	35	35
No idea at all	17	18	16	20	28	31	17	11	20
Current career plan									
Definite career in mind	48	35	31	24	34	35	28	34	32
Considering several career alternatives	27	40	44	49	34	30	43	48	42
Only vague idea of possible careers	22	21	22	25	27	24	25	16	22
No idea at all	3	5	3	1	5	11	4	2	4
Count	146	371	309	213	236	233	272	578	2969

Table 3.5: Percentage of students with career plans when they entered HE and currently: all final year STEM students and for selected major subjects (Source: 17).

In summary, through placements, **employers** are seeking to ease recruitment of qualified and experienced personnel who are committed to a career in their industry. They are also seeking new ways of working to meet the demand for placements in a cost-effective manner, including, potentially, a move away from the traditional long-term placement in a single location to more flexible models that better match business demands and constraints and thereby enable participation.

Participants are seeking a route into a career that interests them, whilst developing their skills and employability. They are also seeking to clarify if this is the career for them. Undergraduates will be seeking programmes of learning that demonstrate clear employability through industry engagement, including industry placements, internships, and exchange programmes, thus providing them with the opportunity for long-term employment.

Universities seek to provide their students with education and knowledge relevant to the sector, to work with industry to deliver the practical and employability skills required for a long term career, and to increase collaboration for knowledge transfer and research and development. They may also wish to deliver and enhance capacity for employer engagement supported by training and a commitment by employers to financially support programmes which provide clear benefit to industry.

- Can the recruit apply their technical knowledge?
- Can the recruit work in their environment?
 - Self starters, flexible and on time
 - Team workers
 - Communication, literacy and numeracy
 - IT skills
 - Managing business and customer need
- Easy access to placement opportunities
 - Where can I find the recruit?
 - Where can I find the right company?
- Easy administration
 - HR and Salary
 - Intellectual Property
- Is this the right candidate for my company to invest in?

4. Undergraduate Placements in the Life Sciences Sector

As stated in section two, the UK life sciences sector needs highly qualified employees, with many of these requiring a degree level qualification. The industry recruits graduates, particularly STEM graduates, to fulfill these roles across the sector.

In 2011, graduate employment in the pharmaceuticals sector alone was reported at 7644, with the need increasing by 126 in the following 12 months²⁸.

However, the demand for graduates across UK industry is high and competitive. Research by the Royal Society into the destinations of 2007 graduates across a wide range of occupations shows many entering the service sector, which in itself is responsible for 75% of the UK GVA and 81% of the total jobs in the economy. Manufacturing (which covers the STEM-based industries) accounts for only 11% of the total jobs taken up²⁹. This is shown in figure 4.1.

Although employers do not necessarily require the specific subject knowledge of many STEM graduates, employers value the skills and attributes offered by STEM graduates, and often recruit these graduates for their analytical, problem-solving and numeracy skills, and for the intellectual rigour that comes with studying a STEM subject to this level²⁴.

STEM graduates may therefore choose between careers that make use of their subject knowledge and others that do not, as shown in figure 4.2³⁰.

However, the life sciences sector relies on STEM graduates in order to compete in a global market, delivering research and development and manufacturing supported by business and commercial functions. Attracting the right graduates with the right skills is therefore a highly competitive and business-critical affair.

4.1 Graduates Relevant to the Life Sciences Sector

The life sciences industry recruits from a wide range of subject disciplines; for example, in 2007/8 the pharmaceutical industry recruited graduates from the STEM and non-STEM disciplines and employed them in a number of functions, as shown in figure 4.3a³¹. The number of students studying degrees relevant to the life sciences industry is shown in figure 4.3b³¹.

There are large numbers studying STEM subjects, including biological and clinical sciences, physical sciences and mathematics, but also economics, engineering and IT¹⁵. In its broadest definition, biological sciences accounts for approximately 10% of all degrees awarded every year, as reported by the UKCES and demonstrated in table 4.1.

Nonetheless, the life sciences industry – looking for more than degree relevance – has difficulty recruiting the right graduates. It has now become commonplace to hear that there are not enough graduates with the right skills, while graduates are unable to find suitable employment in this sector. At the same time, employers compete with universities searching for PhD students, who also wish to recruit graduates with experience gained through courses that offer industrial placements, to ensure these recruits have the desired skills.

Employers also note that graduates need to undertake additional training upon recruitment, particularly in practical, technical and mathematical skills, whilst also improving their leadership and management skills. Employers also need to raise industry awareness in new recruits and improve related behavioral skills, such as problem-solving.

4.2 Graduate Skills

There is a well-recognised need to improve the quality of graduate skills in the undergraduate population, particularly for those wishing to carry on with postgraduate study or work within the laboratory and research and development environments offered in industry, and currently, the NHS.

These deficits have been reported by the ABPI, The Royal Society of Chemistry and the Society of Biology over recent years^{9, 20-23}.

In 2008, the ABPI detailed a number of major issues with undergraduates, regarding both discipline knowledge and core skills⁹.

The core disciplines that have a substantive skills deficit in biomedical sciences (many of which are at the heart of translational medicine or key to the commercialisation of research) are:

- Clinical pharmacology/experimental medicine
- Drug metabolism and ADME
- Pharmacokinetics, pharmacodynamics and modelling
- *In vivo* sciences and supporting animal technologies
- Chemical and process engineering
- Biopharmaceuticals
- Statistics
- Computational chemistry

The core skills required by the life sciences industry and currently in deficit relate to:

- Basic mathematical capability
- Practical skills
- Ability to apply scientific and mathematical knowledge

ABPI member companies reported an increasing concern over the level of practical skills of new recruits: a major concern for 59% and a concern or major concern for 89% of respondents.

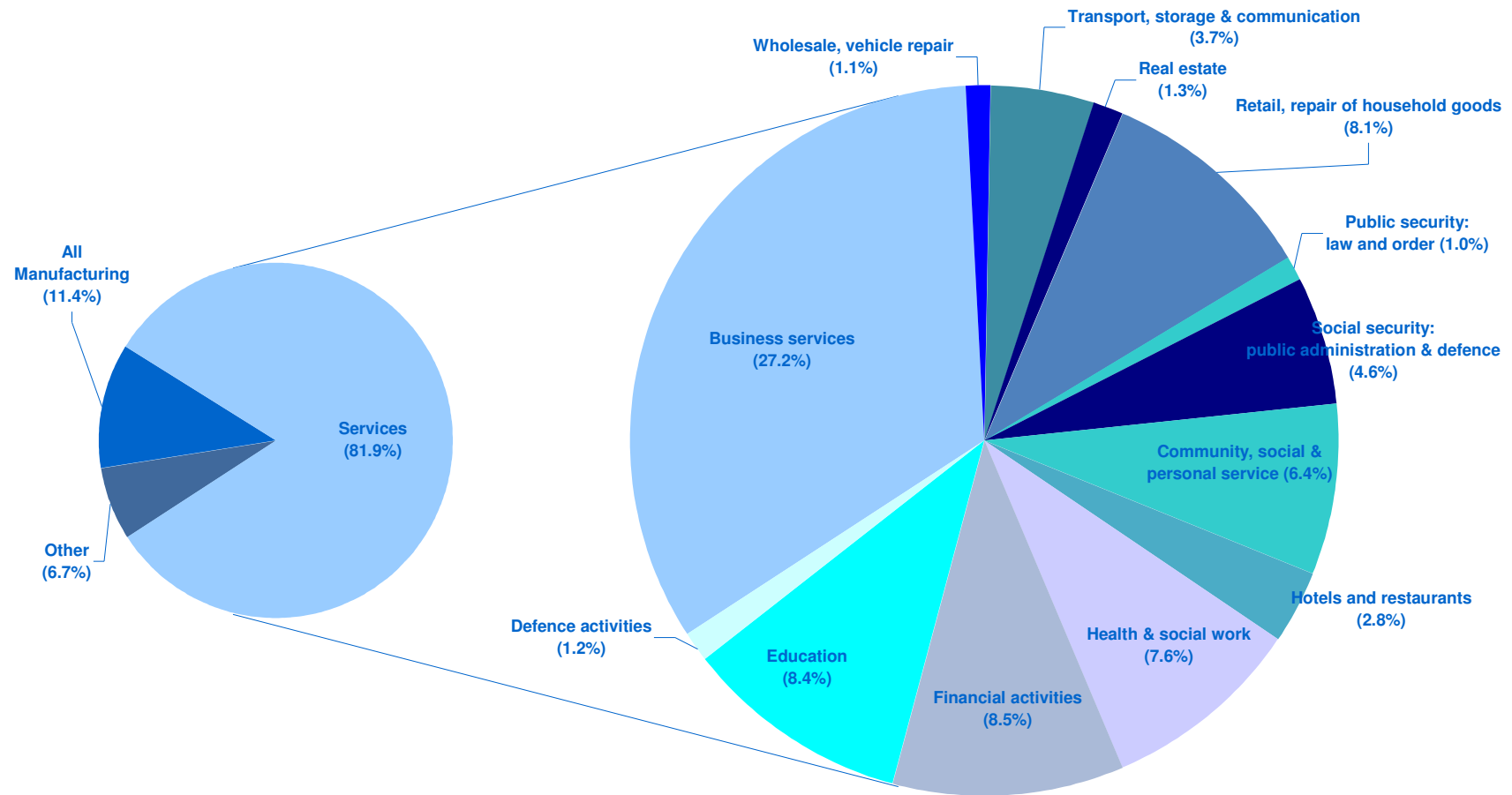


Figure 4.1: Destinations of STEM graduates (Source: 29)

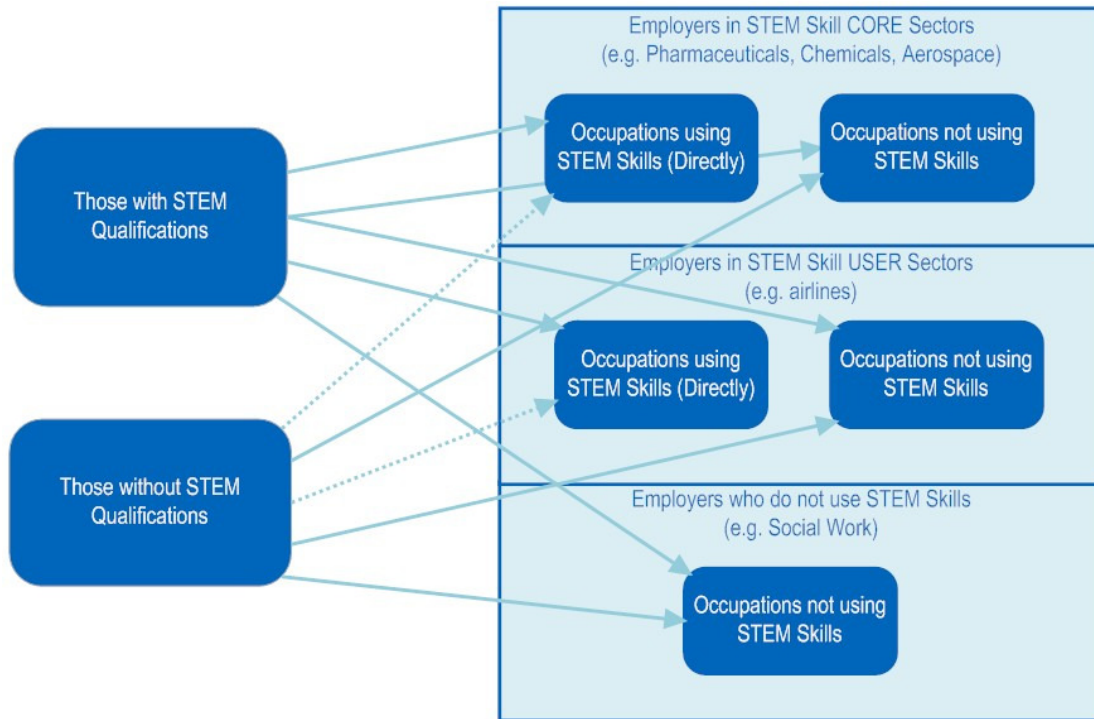
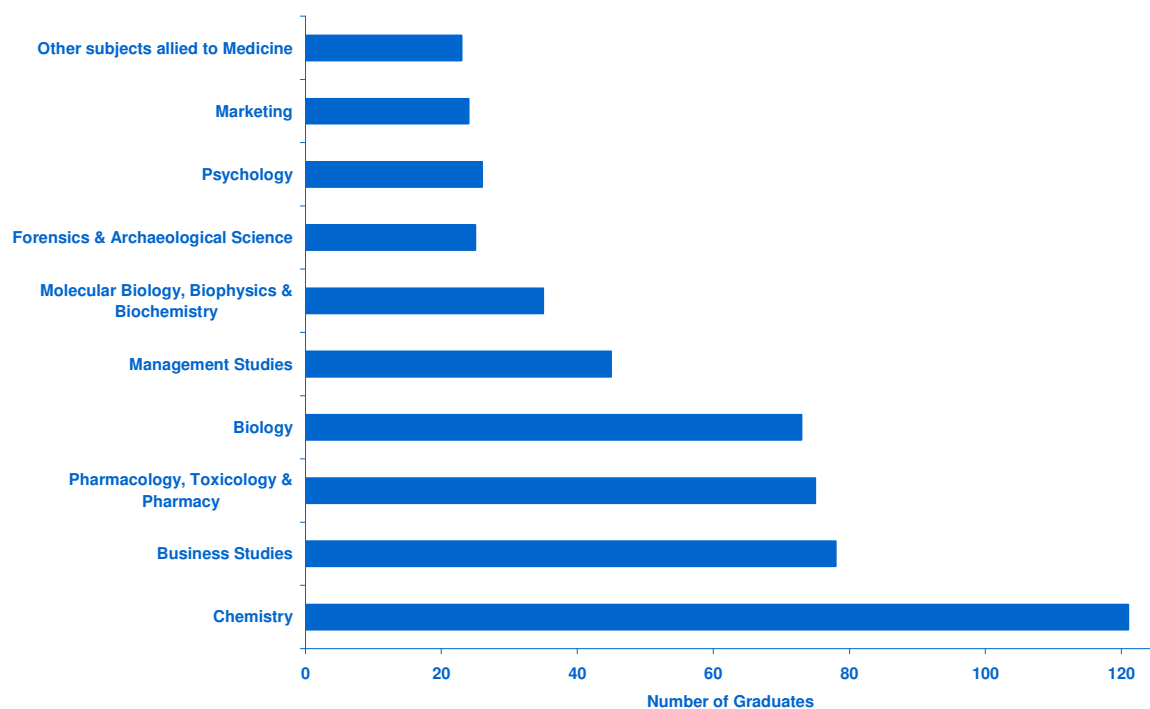
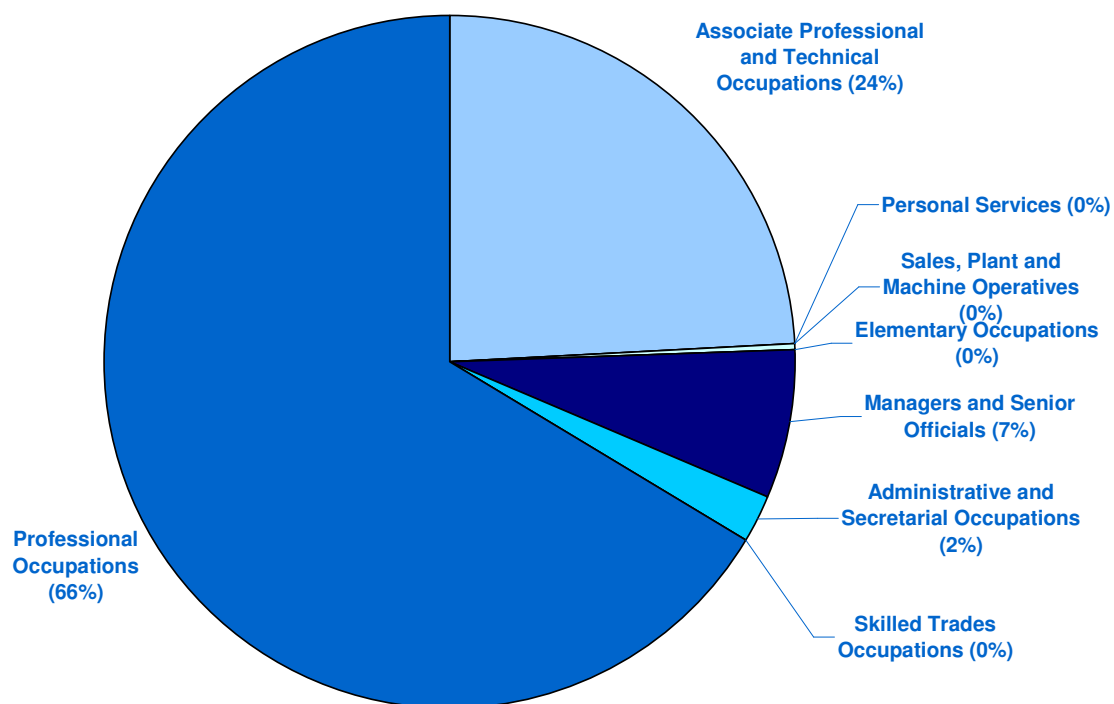


Figure 4.2: Destination of those with and without STEM Qualifications (Source: 30).



(a)



(b)

Figure 4.3 (a) Occupational Destination of STEM graduates entering employment in Pharma industry 07/08; (b) Top 10 subjects entering life sciences industry (Source: 31)

Subject	Total Number of Students 2007/8					Change 2002/3 to 2007/8				
	Total HE Students	Full-time graduate	Full-time undergraduate	Part-time graduates	Part-time undergraduates	Total HE Students	Full-time graduate	Full-time undergraduate	Part-time graduates	Part-time undergraduates
Medicine and Dentistry	61810	7670	43820	10160	160	12895	10475	2210	205	5
Subjects allied to medicine	287125	11690	143910	35165	96360	20710	12950	4400	7920	-4565
Pharmacology, toxicology and pharmacy	21615	2775	13715	3950	1175	5955	3475	1490	300	690
Medical technology	8335	380	5445	1780	730	1740	1740	185	-450	265
Biological sciences	161600	16650	111690	9940	23320	35740	19350	3910	-2625	15105
Broadly-based programmes within biological sciences	765	10	720	0	35	-260	-165	-55	-65	20
Biology	26360	3390	18405	950	3615	1950	1015	275	-1125	1785
Botany	620	335	195	25	65	-225	30	50	-105	-195
Zoology	3810	300	3390	30	90	-55	225	5	-145	-140
Genetics	2100	510	1480	75	30	-595	-310	-5	-260	-25
Microbiology	3375	655	2225	310	185	-820	-130	-290	-455	55
Sports science	32870	1060	29365	855	1590	15285	13610	535	145	995
Molecular biology, biophysics & biochemistry	10315	2120	7280	360	555	1035	595	585	-390	245
Psychology	72570	7150	44625	6580	14215	21790	8830	2515	-35	10480
Others in biological sciences	8815	1115	4005	760	2935	-2370	-4345	280	-185	1875
Veterinary sciences	4850	490	4080	225	55	1010	915	90	-15	15
Physical Sciences	82130	13900	52685	3890	11655	11090	5175	1875	-2445	6485
Broadly-based programmes in physical sciences	965	0	910	0	60	35	0	0	0	40
Chemistry	18815	4240	12515	310	1745	-200	890	-30	-1430	365
Materials science	620	340	255	20	0	185	30	185	-15	-20
Physics	14870	3225	10145	290	1210	2040	1100	630	-780	1090
Mathematical sciences	34120	3600	22770	1520	6225	7930	3300	755	-1220	5090
Broadly-based programmes within mathematical sciences	85	0	55	0	30	-450	5	0	0	-455
Mathematics	29620	2420	21045	935	5225	9500	4190	525	-45	4840
Operational research	855	355	415	80	5	40	-15	155	-55	-45
Statistics	3435	800	1215	495	930	-505	-465	240	-1010	740
Others in mathematical sciences	125	30	40	15	45	105	20	30	15	45
Computer science	95575	13425	55700	6520	19935	-38460	-29835	-975	-3450	-4195
Engineering & Technology	139435	23875	80425	11800	23335	7860	3570	3825	-4690	5150
Chemical, process & energy engineering	7715	1660	4405	1010	640	2130	1230	285	125	490
Biotechnology	1025	495	460	55	20	890	335	485	55	20
Economics	29850	5310	22155	725	1660	710	270	1060	-1350	735

Table 4.1: Students studying degrees germane to biomedical sciences, 2002/3 to 2007/8 absolutes (Source: 15)

Employers wish to see the following practical skills in graduates entering the Life Science Sector⁹

- Understanding of basic experimental design, observation, recording, and testing hypotheses.
- Ability to plan and conduct a scientific experiment with appropriate controls and analysis of data.
- Demonstration of good, safe laboratory practice, including an understanding of Good Laboratory Practice, standard operating procedures and the impact of health and safety in the laboratory environment (and environmental issues).
- Basic practical laboratory procedures (setting up equipment, use of pipettes, serial dilutions, basic chromatography and basic chemistry skills).
- Exposure to molecular biology procedures (such as tissue culture and collection, aseptic techniques).
- Experience of the handling of live organisms and dissection of organs.
- Ability to accurately observe and record data (including understanding of the importance of accuracy over speed).
- Recognition of the integrity of data gathered.
- Ability to bring aspects of an experiment together.
- Understanding of how errors arise (including use of error bars).
- Critical analysis of their results.
- Independent and confident interpretation and assessment of scientific experiments.
- Problem solving skills, for example independently solving difficulties encountered in the lab.
- Application of scientific and mathematical knowledge in designing experiments and interpreting results.
- Critical thinking skills and being able to dispute scientific procedures, data sets and other people's work.
- Basic report writing and accurate record keeping.
- Ability to develop a project plan and be able to use it as a communication tool
- Know how and when to use IT; including Word, Excel (use of spreadsheets for computer modelling), data capture devices, search engines (to effectively research scientific literature).
- Communication and interpersonal skills.
- Team working, collaboration and problem solving.
- Independent working.
- Data and text mining skills.

The Royal Society of Chemistry noted similar issues with generic and technical skills in 2007²². Their report noted that graduates also had difficulty with oral presentation skills, planning and design of experiments, skills with chemical instrumentation, analytical techniques, time management and organisation.

More recent research reported in 2010 by the Biopharma Skills Consortium reflected these concerns and attributed them in part to a changing higher education and business landscape³².

In recent years, the higher education environment has altered dramatically, with increasing numbers of students entering university, with a wider range of entrance qualifications, and particularly a lower level of mathematical skill. There has been a decreasing emphasis on technical training and the development of numeracy skills, and the move towards teaching undergraduates in modular form has led to learning becoming compartmentalised. The

universities are working hard to provide solutions within their power, but a large number of the biological sciences are unable to attract the supplementary Government funding that allows for greater provision of high-level laboratory-based courses.

The business landscape of the life sciences sector has also changed, increasing the complexity of the skills needed to work in this sector. The industry is working in new ways and has new working practices, including outsourcing within and outside of the UK. These changes have created a concomitant increase in skills and knowledge demands on new recruits and existing staff. Financial constraints arising from a declining drugs pipeline, patent expiries and other sector-wide factors have taken priority over investment in education. There have also been quick shifts of focus and fluctuations in demand relating to the number of graduates and postgraduate recruits and particular areas of expertise required at any given time.

With these changes, there has been a reduction in investment in educational development by industry, and a lack of sector-wide action to define and action such provision, and to create the economies of scale needed by universities and industry.

4.3 Improving Undergraduate Provision

In recent years, there has been an emphasis on defining action that will improve skills development and employer engagement in undergraduate provision. This work has been undertaken by the Office for Life Sciences in collaboration with universities, employers, professional bodies and a wide range of stakeholders.

Much of this work has focused on the professional accreditation of undergraduate courses through the Royal Society of Chemistry and the Society of Biology, with the aim of improving students' education and skills by ensuring that sufficient practical experience is embedded into degree programmes^{22,23}.

In the case of Chemistry courses, the high-cost laboratory courses are supported by enhanced funding arrangements and are usually delivered as a four-year integrated Masters programme. Placements are also commonplace, but relatively few students have an industrial placement as part of their BSc (15%) or MChem (35%) course, preferring instead to undertake a research project at their university²².

These types of course have less of a tradition in the Biological Sciences, but are now beginning to increase. Students may undertake a year in industry combined with a programme of work-based learning, often delivered through ongoing remote study through the university. This industrial year may or may not be assessed or carry credits and contributions towards the student's overall final degree classification. Where experience is credit bearing, not only the supply but also the quality and comparability of placements become a concern for academia, students and professional bodies.

The Society of Biology recently initiated a pilot programme in the discipline areas of biochemistry and *in vivo* sciences²³. Through this pilot, employer views have been considered in terms of practical and analytical skills, work experience and employability skills. The programme aims to drive up standards through the provision of accredited courses that deliver:

- Specific knowledge, understanding and skills for routes identified by the intended learning outcomes
- A sizeable research element, which provides the opportunity to develop skills in a range of research techniques and experience of planning and analysis of at least one substantial research project

- An expanded focus including both integrated Masters Programmes and BSc courses with sandwich placements in the degree accreditation programme
- Increased communication of programmes

Through this accreditation system, it is hoped that standards will be driven up, allowing employers to pre-select candidates able to function within the laboratory environment, easing the recruitment process.

Although this pilot focuses on biochemistry and *in vivo* sciences, the Society plans to embrace other disciplines in the scheme in the future.

However, these courses need to be resourced more appropriately to support practical skills delivery. Enhanced funding for such strategically important disciplines as chemistry, physics and engineering should be extended to include designated biological science courses.

4.4 The Need for Undergraduate Placements

The total number of sandwich course placements can be derived from HESA data. These usually occur as a placement year within a three-year Bachelors course, or a four-year integrated Masters; occasionally a placement year is taken in addition to a four-year taught course. These data are shown in table 4.2.

In 2008/09 there were 115,000 students on sandwich courses, of which just over 62,000 (54%) were in STEM areas, a 10% decline on a decade before, and more significant when compared with the substantial increase in undergraduate students studying at university¹⁷.

Life sciences employers do provide work experience, but the changing landscape in the sector has affected the numbers on offer: for example, the ABPI reports a dramatic decrease in undergraduate placement opportunities among its membership from 530 in 2007 to just 355 in 2009^{19,32}.

Reasons cited include site closures and restructuring, recession and related factors, and an increasing need to tap into the SME market to meet demand. Employers also feel that placements are costly, not only in the direct funding of placements but also in terms of the investment in the training and time required for students to adjust to workplace requirements.

Employers may also have difficulty offering work experience directly relevant to specific degree courses. Thus, while employers often seek to recruit graduates and postgraduates who have evidence of skills and experience, they are not always in a position to deliver the placements that might enable those skills to be developed.

New ways of working need to address how employers, large and small, can aid the delivery of skills, and how collaboration can increase the number of placements, ensuring a supply of highly skilled graduates³².

	Total number of sandwich placements	Percentage of all undergraduates	Percentage of full time undergraduates	Studying on three-year courses	Studying on four-year courses
Medicine and dentistry	0	0	0	66.2	45.2
Subjects allied to medicine	5730	2.4	3.8		
Biological sciences	7035	4.9	5.8	14.6	19.6
Veterinary sciences	0	0	0		
Agriculture and related courses	2385	15.3	21.4	9.0	12.3
Physical sciences	3995	5.9	7.0		
Mathematical sciences	1855	5.9	7.1	9.2	29.0
Computer sciences	14990	20.2	25.5		
Engineering and technology	16625	15.2	17.8	13.0	22.5
Architecture, building and planning	9800	19.9	28.3	21.2	34.9
Social studies	3515	2.2	2.9	28.7	17.1
Law	1555	2.2	2.7	16.0	7.1
Business and administrative studies	37380	17.2	21.6	14.6	37.1
Mass communications	1200	3.0	3.1	-	-
Languages	2785	2.4	3.4	-	-
Historical and philosophical studies	105	0.1	0.4	-	-
Creative arts and design	5690	3.9	4.0	21.2	20.6
Education	95	0.1	0.1	74.1	60.4
Combined	80	0.1	0.1	-	-
Total	115805	6.2	9.0	-	-

Table 4.2: Number and proportion of undergraduates on UK sandwich courses (source: HESA, 2009); Propensity to have undertaken one or more UK work placements as part of courses by subject, comparing those on three and four year courses (Futuretrack 2006 combined dataset: UK based final year students (weighted)). (Source: 17)

4.5 Engaging Students

There are also challenges remaining with the delivery of undergraduate placements and in ensuring that students are able and encouraged to participate. Methods to increase students' awareness of and participation in placements need to be addressed and clear messages delivered around the value of placements and work experience.

The benefits to students include the opportunity to engage in a year-long “interview and induction” in a two-way manner. The student can ensure that this is the career they want, while the employer can consider whether the student is a good match for their organisation. If this is the case, the benefits for students are clear in the context of improving employment opportunities. Placements are a key factor in aligning student aspirations with the reality of the graduate market, and also highlight the importance of considering work in companies across the life sciences sector, particularly SMEs and the wider supply chain. In a changing environment, greater interaction with these companies and less reliance on the large pharmaceutical companies will ensure greater recruitment and employment of graduates in this sector.

Barriers to student participation also need to be eased; these can include the time pressures of application, uncertainty in securing a placement, strong peer-group pressure to opt out, and difficulties in finding a placement close to the university or parents' home.

Moreover, the new HE funding system will bring heightened costs for students, including increased tuition fees and interest charges on the student loan during the sandwich year. Students have to face a tough choice of extending their student debt by undertaking a “year in industry”.

It is in the interests of students, employers and universities that barriers to increasing the number of students benefitting from sandwich placements are removed.

Universities are currently permitted to charge a fee of up to £4500 for sandwich years. A lower fee – a guideline fee of £1000 is suggested – could be less off-putting to potential participants concerned about accumulating debt. Financial barriers would also be reduced if the Student Loan Company were to suspend interest charges on any existing loan during the period of the placement.

It is difficult for students to assess the relative employment prospects for various degree programmes. The collation of data relating to graduate employment and salary just 6 months after graduation can lead to an unfair and inaccurate descriptor when students are faced with a choice of undergraduate courses that seem to meet sector need.

A better and fairer reflection of career pathway and employment would be gained through a longer-term look at career outcomes and consideration of the work experience opportunities within the various courses on offer. It is essential to demonstrate clearly to university applicants that participation in placements establishes the essential skills that will help them to secure a route into employment. This type of information should supplement the Key Information Sets (KIS) now being provided to prospective students.

This experience should also be recorded more formally in order that participating students can demonstrate their skills and employability more readily at the time of recruitment. The Higher Education Achievement Record (HEAR), now coming into wider use in universities, records information relating to the qualification and level of study, the individual modules studied, the form of assessment, marks awarded, and their relative weighting towards the final summary mark or grade. Critically it also includes information on other activities which provide academic credit, such as volunteering and work experience, and is both a formative and a summative document, evolving throughout the student's experience at university.

Use of the HEAR will allow students to give prospective employers more and better information on their skills, progress and attainment, and their work experience to date. It also has the potential to increase their self-awareness, a critical characteristic for graduate recruitment.

4.6 Engaging Universities

Some universities place considerable value on maintaining sandwich placements, and on the subsequent enhanced employment prospects that such an experience provides; this approach should be championed.

However, there are barriers to increasing placement opportunities and universities, companies and students must invest to overcome them.

Clearly the university has to invest to provide placement opportunities for students; developing and maintaining relationships with employers is time-consuming and is not cost-free. However, although creating new placement destinations requires significant upfront investment, good experiences can lead to repeat placements, at a lower cost, and to further collaboration in other areas of university activity, to the mutual benefit of universities and businesses.

In addition, feedback from academic staff strongly indicates that students who participate in a placement return to university highly motivated, more mature, and often attain a higher degree classification than predicted. Those students also find it easier to get a job in the sector.

In developing placements, universities need to create a two-way partnership with the employer, to address some key areas of concern, such as guaranteeing the availability of placements and reducing the administrative burden on all parties.

Intellectual property (IP) and confidentiality can be another barrier in areas of commercial interest. Students may not always be able to present their work in a manner readily acceptable for assessment and accreditation by the university. Such cases require greater flexibility around confidentiality and legal agreements appropriate to the circumstances, in order that placements can be taken forward.

Pre-placement training, particularly for research and development placements, also needs to be highlighted. Some universities, such as Bristol, deliver intensive training in practical skills at the start of the placement year. This good practice needs to be encouraged more widely, particularly where the employer aids the delivery of this training; a case study for GlaxoSmithKline Research and Development Chemistry Industrial Placement Programme Quality Mark is provided below. A system of recognition and reward for such employer participation should be championed.

Given the critical need in this sector for work experience embedded into courses, we need to sustain and further encourage work experience and the sandwich course structure as part of the undergraduate degree, aiding the delivery of student aspirations and industry expectations.

4.7 Engaging Employers

With an increasing number of universities seeking to develop links with employers, competition to secure placements with industry has increased dramatically. This activity has therefore become time consuming and costly to individual universities and to academic liaison employees within the industry environment.

Employers choosing to offer placement opportunities also have a wider range of students to choose from, and have correspondingly increased the rigour of their application processes in order to narrow a large potential field.

Other disincentives to employers are usually associated with the cost, time and effort required to deliver a placement, including supervision, set-up and monitoring of students' projects or work tasks, and making links with higher education institutions and students.

Companies new to placements often struggle with these tasks and would benefit from help to guide them through the process of devising and delivering a programme of learning and experience, particularly where it forms part of an assessed undergraduate year.

The upfront training and investment required for placements in the research environment makes many employers believe that only a longer-term placement (a minimum of six months) will enable real return on their investment. However, smaller employers in particular are not always able to financially resource a full year in industry, and prefer to offer shorter placements; the upfront training investment therefore becomes disproportionate to the return. Smaller employers are also less likely to take on multiple placement students at one time and cannot therefore benefit from economies of scale in this training.

This predicament can be off-putting to employers; new opportunities for working in partnership with the university and other employers should therefore be encouraged, to build more flexibility into the system and reduce individual burdens. Enhanced training prior to placement years, as discussed above, would also alleviate the situation and should be supported.

In addition, companies who receive students on full sandwich placement years should be able to obtain a tax credit or national insurance freeze proportionate to the salary costs of employing the student.

Despite these costs and barriers, placements can offer employers a relatively low-cost route for taking forward projects which would otherwise require staff resource from elsewhere in the company or not be undertaken at all. Employers can also benefit from the enthusiasm and fresh ideas which placement students can inject into a business and from the opportunity to assess the skills and abilities of the placement student prior to recruitment. Many employers also see placements as a way to develop broader relationships with universities.

4.8 Encouraging New ways of Working

There are emerging models of good working practice across the UK, where universities and industry work together to deliver placements across a consortium.

Consortia models can increase the number of placements available to students in a variety of environments: placements can be in the research laboratory, manufacturing or in roles supporting the business operation. Students may also work as a team to deliver solutions to a business, thus enhancing project-based learning and teamwork.

These models offer greater flexibility for employers who are unable to offer year-long placements, they maximise benefits and minimise risk of engagement, whilst improving meaningful and consistent commitment to working with academia. Through analysis of the work experience on offer, there is also improved articulation of future industry needs, through which academic institutions can learn and improve provision for future students.

Consortia models can also offer employers wider access to administrative and external funding support, becoming more cost effective for the university and the employer. A single point of contact between universities and industry also aids communication. These models are designed to aid SMEs in particular, and this innovative practice is welcomed.

4.9 Rewarding Best Practice

Placements for this sector need to be high in quality, and models of best practice need to be adopted throughout to ensure the delivery of skills relevant for the future. The National Council for Work Experience (NCWE) offers guidance on best practice in this area, and this needs to be championed across the sector³³.

By ensuring best practice, universities and employers are able to attract potential placement students more readily, and as such the experience for all partners is improved.

The NCWE also reviews and assesses placement provision, awarding the “Quality Mark” to employers and universities where high standards are met. This system showcases how industry and academia can work together to develop the workforce of the future. The case study provided by GlaxoSmithKline below shows clear benefits to all participants where best practice is rewarded³³.

Quality Mark for GlaxoSmithKline R&D Chemistry Industrial Placement Programme

The GlaxoSmithKline (GSK) Chemistry Industrial Placement programme is the cornerstone of maintaining the company's reputation with leading chemistry groups in the UK and Europe and a major component of the graduate chemistry recruitment strategy. In 2004, GSK UK R&D Chemistry received the Quality Mark certificate for the high standards attained in the programme and the role that programme has in developing the workforce. The Quality Mark was awarded by the National Council for Work Experience (NCWE) and it was the first time that a corporate organisation had been recognised in this way. Essentially GSK had to describe in detail the programme to this independent body and so a full review of all aspects of the programme was conducted including the recruitment and selection processes, how students are treated on site and what systems are in place for their development. The Quality Mark is now being used by the NCWE as a 'gold standard' and has set a new level for other organisations to reach. To date, 14 other organisations have been awarded a Quality Mark. GSK UK R&D Chemistry was re-accredited in 2007 and in 2010 by the NCWE.

Following receipt of the Quality Mark in 2004, GSK UK R&D Chemistry was also officially recognised by the French Chemical Society in 2005 and is regarded as a showcase for how industry and academia can work together to develop the workforce of the future by this organisation.

Quality Mark Benefits	
Students	
-	First class industry training & experience in chemistry
-	Demonstrable transferable skills
o	Communication
o	Working in teams
o	IT/Managing Information
o	Application of Number
o	Problem-solving
o	Improve own learning
-	Network of premier industry contacts
-	Can be captured in CV
Universities	
-	Attracts students
-	Address employability issues
Benefits to GSK	
-	Builds relationships with universities
-	Develops existing staff
-	Recruitment aid
-	Visible to senior GSK management
-	Increased networks
Wider Benefits	
As a consequence of attaining the Quality Mark, a number of unexpected benefits emerged for GSK including:	
-	An enabler to French Chemical Society accreditation
-	Ensured best practice was applied to all areas of GSK UK R&D Chemistry
-	GSK was invited by the former DfES to participate in a pioneering programme which was dedicated to accrediting work-based learning. This led to the introduction of the GSK Postgraduate Certificate in Professional Development which is offered to chemistry graduates. This in turn led to the development of a collaborative MPhil/PhD programme with the University of Strathclyde, which is also offered to our chemistry graduates
-	Extended networks e.g. involved in the UK/India Education & Research Initiative (UKIERI)

5. Internships in the Life Sciences Sector

In recent years, there has been an increased emphasis on the internship model particularly as the economic climate has limited employment in a wide range of sectors.

An *internship* is traditionally considered to be a sponsored trial by an employer of a potential employee (usually a student or graduate). It is commonly short term, and primarily benefits the employer, although the participant clearly gains from the ability to cite relevant experience in future job applications and potentially from being accepted for long-term employment by the company.

The 'sponsored' aspect seems to be diminishing, and a significant proportion of internships are now unpaid. Employers' policies vary in this regard, but unpaid internships are the topic of current political campaign.

In the UK the term 'internship' is increasingly but not exclusively used for graduate placements as opposed to those undertaken by students. For the purposes of this report:

- An undergraduate internship is taken to be a short period of professional experience during a degree programme or summer placement.
- A graduate internship is defined as a short period of post-graduation professional experience.

Other types of internship on offer at postgraduate level are addressed in section 6.

5.1 Undergraduate Internships

Although the terminology may have changed more recently, undergraduate internships have been offered by a wide range of industries through a number of schemes dedicated to summer vacation work experience.

One such programme that attracts significant investment from STEM-based companies is the STEP Programme, which many universities promote to their undergraduates³⁴. Through this programme, over 1500 placements are offered per year; a third of these are in STEM areas and a further third in business and marketing. Employers are required to provide an appropriate project for an undergraduate and to support the intern to develop their skills to carry out and complete this project in industry.

Schemes are also available for those undertaking a gap year prior to entering higher education, such as the EDT Year in Industry Initiative (YINI)³⁵. These schemes, offering year-long internships, are currently focused on the engineering and IT sectors, but the programme is now branching out to technical and scientific sectors.

A number of universities have also developed their own undergraduate internship schemes, sometimes integrated within degree programmes. These internships are recognised as a valuable asset in future employability, and such schemes are now being identified explicitly in the employability 'offer' of universities through the Key Information Sets (KIS) and other forms of information for university applicants.

One such programme is the Liverpool John Moores University's World of Work Programme³⁶.

Employability Skills at Liverpool John Moores University³⁶

Liverpool John Moores University's World of Work® (WoW) initiative aims to ensure that every student is equipped with the skills they need to successfully engage in the world of work, either because they possess skills which are highly valued by employers or because they are well equipped to set themselves up in their own business.

The programme, developed and delivered collaboratively with employers, identified the need for higher-level skills most valued by employers covering Self Awareness, Organisational Awareness and Making Things Happen. It also identified eight graduate transferable skills as being essential for employment: analysing and problem-solving, team-working and interpersonal skills, verbal communication, written communication, personal planning and organising, initiative, numerical reasoning, information literacy and IT skills.

All students are encouraged to develop these key skills within their subject and also at the purpose-built Graduate Development Centre.

These employability skills are developed and recognised through the WoW® Certificate which comprises a skills gap analysis, workshops and a filmed one-to-one interview with an employer and the "Ready for Work" Programme of group sessions, employer master classes and student profiles demonstrating skills attainment.

The programme also encompasses conventional careers advice and guidance.

Ideally, every full-time undergraduate student should have the opportunity to experience at least one structured, university-approved internship during their period of study.

A wide range of industries offer undergraduate internships and advertise them on the internet and through university careers offices. Such internships are often informally viewed as an opportunity to assess potential future employees.

These short-term internships provide a valuable means for undergraduates to gain relevant work experience when they either cannot or do not wish to undertake a full sandwich year in industry. Participation by companies and students should therefore be incentivised. For example, companies offering paid internships should be able to obtain a tax credit proportionate to the salary costs of employing the student.

Mechanisms are also needed to ensure that such opportunities remain open to all students; universities should therefore use internal funds – such as those set aside as part of their Access Agreements with the Office for Fair Access (OFFA) – to support eligible students in unpaid placements.

5.2 Graduate Internships

Recent years have seen a growth in graduate internships and these have a strong reputation for helping recent graduates into permanent employment. Some structured schemes have provided an ideal opportunity for universities to understand better employers' expectations of their graduate recruits and to explore the industry's recruitment tendencies, particularly with regard to level of qualification.

Much of this growth has been stimulated by Government funding, which has supported schemes to increase the number of supported internships and thereby to remove barriers to both companies and graduates³⁷. The trend towards unpaid graduate internships in many sectors is controversial in two respects: first in the context of social mobility, especially when the internship leads to employment;

second where there is no intention of the organisation employing the intern, rather recruiting sequential interns at no or marginal cost to fill a single vacancy.

One high-profile source of support from public funds has been a number of schemes initiated through the Higher Education Funding Council for England (HEFCE). The HEFCE-sponsored graduate internship scheme, for example, was based on a model of three months' paid work for an intern, with the costs split between the public purse and employer on a one-third / two-thirds basis. The scheme was fully subscribed by graduates.

In Spring 2010, some 8000 internships were available in industry, two-thirds of which were paid, and over 30,000 graduates had registered to undertake them. This scheme was vastly oversubscribed, but did attract employers with no history of graduate recruitment^{16,17}. Table 5.1 demonstrates the number of internships during 2009.

The HEFCE scheme had good outcomes for graduate participants: 46% of interns secured long-term employment following their internships. The scheme was also successful in encouraging participation by SMEs: 81% of the employers involved in the scheme were small businesses and the scheme helped demonstrate to them the added value that graduates can provide to their companies, whilst containing the risk of their initial investment to manageable proportions. For many of these companies, it was their first engagement with a university and an opportunity to create a lasting relationship.

In parallel, HEFCE monies funded a further 56 schemes to create internships for recent graduates through the Economic Challenge Investment Fund (ECIF), set up to support individuals and businesses in the recession. Many of these schemes focused on target sectors and SMEs, with the majority of universities using the funds to subsidise the cost of the internship to the employer. This initiative generated a further 8000 internships, mostly in SMEs that had not offered them before.

With this huge push and financial incentive there was a great increase in interest and uptake – nearly 30,000 - 35,000 graduate internships in total – at a time of recession.

However, as a result of post-recession cutbacks, HEFCE no longer provides funds explicitly for subsidising internships, as reflected in the number of vacancies advertised through the Graduate Talent Pool, which had dropped to 2000 at the time of writing. In effect, internship numbers overall have decreased significantly from 35,000 to around 10-15,000; unpaid vacancies are also on the rise.

The graduate internship programme was a highly valuable means of generating placement supply and uptake, and should be continued. However, recognising the constraints on the public purse, it is recommended that only companies entering into the graduate internship programme for the first time be supported by a one-off subsidy; repeat business should be funded by the companies and universities.

A recent study with over 100 employers explored employers' expectations when recruiting and training graduates³⁸. It identified the key areas where employers seek skills and attributes required to perform in graduate-level roles, from application through to three years in employment. These areas are detailed in table 5.2.

The key findings of this report provide useful guidance about the areas that graduate internship programmes need to consider:

- The majority of employers require graduates to perform to expectation by the end of the first year, but with many of these attributes being visible on appointment.
- Employers feel that technical skills do not need to be as highly developed as so-called 'soft' skills (e.g., listening skills, ability to integrate). The employer is prepared to wait (for up to a year only) for technical

skills to develop. However, in certain specialist employers, e.g., in science and engineering, employers do require a range of technical skills at appointment.

- Employers seek graduates who are able to present ideas clearly, both verbally and in writing. Indeed, the ability to demonstrate cultural and social awareness, on appointment, comes ahead of IT skills.
- Personal ethical qualities of honesty, integrity and trust are expected at appointment, ahead of any other skill or competence.

These preferences apply across all sectors and sizes of organisation; these are the areas with which graduates need to identify and that internships can help deliver. Some 700 respondents to a HEFCE survey identified the skills they had developed through these internship schemes^{16,17}. Of these, the top ten were:

1. Prioritisation
2. Problem-solving
3. Team working
4. Commercial awareness
5. Customer awareness
6. Influencing
7. Negotiating skills
8. Leadership
9. Management
10. Practical ICT

5.3 Internships in the STEM and Life Sciences Sectors

As shown in table 5.3, the numbers of internships on offer in the STEM sector are small when compared to other industry sectors with a tradition of internships¹⁷. However, a number of graduates from STEM subjects have undertaken internships with a wide range of employers under various schemes.

The evidence from these programmes shows clear differences in how the graduate intern is deployed compared with the sandwich student:

- A higher proportion of work placements for undergraduates may involve scientific and technical work than seems to be case for internships. The latter are often of shorter duration than an undergraduate placement and the time taken to get graduates trained for lab work can therefore be disproportionate to the actual length of the internship. Also, the industry tends to take on interns for less research-focused work, directing them instead to business functions where a scientific background is required.
- The training of the sandwich student is a key factor: employers are investing in longer-term preparation for science-related roles. With an intern, employers may seek to bring in and evaluate more business related skills.

The data further suggest that STEM interns are also attracted to other industry sectors. Indeed, there seem to have been few specifically science-based opportunities offered, but lack of specific degree requirements stated in internship particulars make a proper categorisation difficult.

However, a number of graduate internship programmes funded by HEFCE through the Economic Challenge Investment Fund (ECIF) targeted the bioscience industries and more informed messages can be determined from the evaluation of these schemes:

- The Reading-Surrey Biopharma Skills Internship Project³⁹
- Overcoming Recession: Bioscience Investment in Skills (ORBIS)⁴⁰

Sector	Graduate internship vacancies in the Graduate Talent Pool, during late 2009 and spring 2011, classified by career					Employers providing internships in HEFCE-funded schemes (sample response of c.450 employers)	
	Number of vacancies (Q4, 2009)	% of vacancies (Q4, 2009)	Number of Postings (Q4, 2009)	% of Postings (Q4,2009)	Number of Postings (2011)	Number of Employers	%
Advertising, marketing and PR	154	4	115	6	376	40	9
Arts, design and crafts	95	1	67	4	96	49	11
Charity and voluntary	1585	23	123	7	107	16	4
Construction & property management	109	1	81	4	44	38	8
Education, teaching & learning	981	14	221	12	68	39	8
Engineering	139	2	82	4	69	24	5
Finance & management consultancy	761	11	100	5	128	20	4
General management	76	1	49	3	113	-	-
Healthcare	58	1	39	2	37	13	3
Hospitality and events management	42	1	15	1	68	3	<1
Human resources & employment	92	1	32	2	81	18	4
Insurance, pensions & actuarial	13	<1	8	<1	31	-	-
IT (including economic & statistical services)	800	12	292	16	288	40	9
Legal services	18	<1	9	<1	39	7	<1
Leisure, sport & tourism	208	3	39	2	58	18	4
Logistics & transport	41	1	41	2	38	6	1
Manufacturing & processing	190	3	103	5	45	33	7
Natural resources & environment	20	<1	16	1	45	14	3
Public sector	625	9	97	5	36	6	1
Publishing, media & performance	263	4	141	8	145	42	9
Sales, retailing & buying	433	6	103	5	170	19	4
Scientific services	39	1	26	1	49	10	2
Total vacancies	6840	100	-	-	-	-	-
Total postings	-	-	1819	100	743	450	100

Table 5.1: Summary of internships on offer through the Graduate Talent Pool and HEFCE Internships programmes by sector (Source: 17).

Expectation	On Appointment (%)	At One Year (%)	At Three Years (%)	Expectation	On Appointment (%)	At One Year (%)	At Three Years (%)
Demonstrate honesty and integrity	98.1	0.9	0.9	Shares the goals and objectives of my organisation	61.7	35.5	2.8
Is someone I can trust	94.4	5.6	0.0	Can report progress to managers and colleagues	61.7	37.4	0.9
Is able to listen to others	93.5	6.5	0.0	Is able to learn about my product/service thoroughly and quickly	59.3	39.8	0.9
Is able to integrate quickly into a team or department	92.6	7.4	0.0	Is able to recognise the limits of their responsibilities	58.3	39.8	1.9
Is able to present ideas clearly, both verbally and in writing	86.1	11.1	2.8	Can take responsibility for a piece of work and see it through	57.4	41.7	0.9
Can assimilate information quickly	84.1	15.9	0.0	Is capable of working without close supervision	57.0	39.3	3.7
Works safely	83.2	15.9	0.9	Is willing to take on a range of tasks and achieve team goals	54.6	42.6	2.8
Demonstrates good time-management	82.2	17.8	0.0	Is capable of understanding the structure of the organisation	53.3	45.8	0.9
Can plan and manage their time	79.6	20.4	0.0	Is able to communicate ideas about the service/ business/product	51.9	47.2	0.9
Can demonstrate attention to detail and thoroughness	79.6	19.4	0.9	Can communicate appropriately and effectively with clients/other agencies	50.5	45.8	3.7
Has a mature attitude	79.2	17.9	2.8	Can represent my business well to others	48.1	44.4	7.4
Is willing to take responsibility for their work	78.3	19.8	1.9	Is able to work unsupervised	46.2	47.2	6.6
Is interesting in learning and development	78.3	20.8	0.9	Is capable of taking on a broad range of tasks	45.8	44.9	9.3
Can share ideas with others	77.8	22.2	0.0	Quickly gains an understanding of policy and procedure	45.8	54.2	0.00
Can demonstrate tact	76.9	20.4	2.8	Can break elements of a project/job down and plan accordingly	43.0	52.3	4.7
Demonstrates cultural/social awareness	75.7	20.4	3.9	Is able to reflect on own development and identify strengths and weaknesses	42.5	50.9	6.6
Has confidence in their own abilities	71.7	25.5	2.8	Is able to see how my business fits into the wider sector/market place	41.7	56.5	1.9
Is able to take initiative	71.3	25.9	2.8	Can identify the appropriate tools (physical/ virtual/ administrative)	40.6	53.8	5.7
Can be relied upon by other members of the team/department	67.3	31.8	0.9	Can negotiate with others	36.4	53.3	10.3
Is capable of learning new IT products and systems quickly	65.1	34.9	0.0	Can be asked to undertake independent research	29.9	59.8	10.3
Is willing to take on new challenges and responsibilities	64.5	34.6	0.9	Is capable of identifying some strengths and weaknesses of my business	21.5	69.2	9.3
Has relevant technical skills	63.6	29.0	7.5	Is able to identify areas of weakness and suggest strategies to change	17.6	66.7	15.7
Thinks critically about their work	63.6	34.6	1.9	Is able to identify areas for change or improvement	7.5	85.8	6.6

Figure 5.2: Employer expectations of graduate skills and competencies ranked by preference upon appointment, and after one and three years in post (Source: 37).

Sector of Internship	Number of interns			Comment
	STEM	Business / Social	Arts / Creative / Humanities	
Accountancy	1	14	1	
Advertising, marketing & PR	6	38	25	
Arts, craft & design	2	4	33	
Charity & Voluntary	3	8	8	
Construction, building & property	17	5	0	All STEM graduates were from architecture and construction
Education, teaching & learning	11	14	6	
Engineering (including energy)	18	5	1	Almost all STEM graduates were from engineering
Environment & agriculture	8	3	0	
Fashion	2	7	22	
Government & public sector	4	4	2	
IT	28	13	3	Most STEM graduates were from IT and computing
Manufacturing	3	7	1	
Media & publishing	3	12	25	
Science (including pharmaceuticals)	2	1	0	Science graduates
Tourism, leisure & sport	2	4	5	
Total	130	171	150	

Table 5.3: Distribution of interns in broad subject groupings, by employer sector (HEFCE internship scheme data) (Source:17)

5.3.1 The Reading-Surrey Biopharma Skills Internship Project

The universities of Reading and Surrey delivered an innovative programme carefully designed to serve a number of purposes, relating to the interns, the industry and the universities³⁹. These include:

- to raise awareness of and secure interest in certain areas of the biopharma sector among science graduates
- to give recent graduates the opportunity to gain employment, experience and postgraduate-level education, and to develop skills in areas of interest to the industry, at a time of high levels of graduate unemployment
- to support the retention and development of the skills base in the life sciences, whether in academia or industry
- to better understand the nature of graduate transitions to the industry and of the 'skills gap' therein
- to stimulate dialogue between industry and academia about education and training needs in new recruits
- to facilitate dialogue between industrial and academic staff where research interests were aligned.

The HEFCE ECIF funds supported 20 internships lasting 11 months and, later, a further 12 five-month internships. The length of the initial internships was determined in response to the industry's stated preference for longer placements but also to give interns some thorough work experience and to maximise the opportunity for learning and relationship-building between the universities and the companies. The length of the second round of internships was determined by the project end date, but also offered the Reading-Surrey team the chance to test the sector's appetite for shorter placements and the value of these to both company and intern.

Interns were employed by the University of Reading and seconded to companies across the South East region in the biopharma and related industrial sectors. Most of their learning took place in their companies, on the job, but their contracts specified that they could spend up to 20% of their time at the universities, furthering their education at postgraduate level. Longer-term interns also had access to a £500 training budget to support their academic or skills development through other means.

Interns were also allocated academic mentors in one or both universities, as a resource to draw on for supporting their further academic development, whether related to their current industrial placement or to their future academic or industrial career.

The scheme also funded four Industry Liaison and Internship Fellows to support both interns and host companies; the Fellows used their industry experience to support interns in their transition to employment and in their subsequent skills and career development, and to support companies in the integration and supervision of their interns. The Fellows also looked to make links between researchers in the companies and the universities to initiate and facilitate other types of collaboration around the intern's work.

Companies were selected on the basis of their proposals for interesting, graduate-level internships that would develop an intern's skills in an area of key interest to the industry itself. They were encouraged to offer not only projects suitable for chemistry and bioscience graduates, but also opportunities that would appeal to graduates from other STEM disciplines relevant to the sector, particularly mathematics and statistics.

The University of Reading oversaw the recruitment of interns, but the selection was made primarily by the companies, on the basis of applications and interviews held at company premises. Interns

received an initial induction at the universities, after which the host companies took the lead in delivering the internships, supported by the four Fellows, with the universities providing a series of training and skills development events.

Group training focused largely on 'soft' skills development, including effective communication at work, time management, presentation skills and networking. The training element of the internship programme culminated in two events delivered jointly by the two universities: a one-week CPD module that brought the emphasis back to the full drug discovery / development cycle, and a conference at which interns presented their projects to an industry and academic audience and reflected on their experience and development within the programme.

In combination, these events consolidated the interns' learning about the sector and about themselves prior to taking their next career or study moves. In addition to the opportunity to improve presentation skills and master the art of discussing confidential work in an open environment, the conference demonstrated to interns the breadth of biopharma specialisms and related career paths and conveyed the positive impact of the Reading-Surrey project on interns' personal and professional development.

Interns were also encouraged to keep a skills log, in order to increase their self-awareness in terms of skills development and training needs, to aid career planning, and to encourage a positive attitude towards and ownership of their continuing professional development.

The evaluation of this programme enabled a number of conclusions to be drawn.³⁹ Above all, the programme demonstrated the value of a structured, extended graduate internship programme, offering all parties a high-quality means of transaction for work experience.

The graduate internship offers a viable alternative or complement to an in-course placement as a means to gain valuable work experience. They are more flexible than undergraduate placements in terms of timing and length, and therefore easier for businesses to accommodate. In addition, as a graduate package, interns can also offer a fuller knowledge and skill set than those on an in-course placement. Moreover, neither the universities nor the companies had to consider formal learning outcomes and assessment requirements; rather, the interns were able to grow in terms of education and maturity, to take their own development into their own hands, to develop skills relevant to the industry, and to become more career focused.

As regards internship length, the longer internships remain a strong industry preference, as they allow employers to accrue greater benefits from initial training, supervision and project costs, whilst increasing the quality of the role on offer to the interns. However, an internship lasting five months is beneficial for the intern in terms of gaining skills and knowledge that will improve employment prospects; likewise, most companies felt that they received some return on the initial investment in training, with interns generally operating independently and adding value within three months.

In a sector which often recruits at PhD level, the employment outcomes for Bachelors and Masters graduates 'upskilled' through industrial experience of 5-11 months were good: at least 15 interns secured subsequent employment in either their host company or another organisation in or related to the sector.

5.3.2 Overcoming Recession: Bioscience Investment in Skills (ORBIS)

ORBIS provided a paid 26-week programme of work-based learning for 60 recent graduates and postgraduates, mentoring partnerships and a series of training days for interns and their line managers focused on sector specific skills gaps⁴⁰. The programme focused on employers in the Oxford, Cambridge and London areas, and was coordinated through the Royal Veterinary College (RVC) and its bio-incubator LBIC (London Bioscience Innovation Centre).

The programme was mainly supported by HEFCE ECIF funds, but participating companies were asked to contribute £1000 for each intern hosted, bringing total programme funding to approximately £1 million. This employer contribution was collected upfront to secure commitment from the companies engaged. Interns were paid a stipend of £220 per week.

As with the Reading-Surrey project, companies were selected on the basis of the quality of the project they offered, in terms of skills development and stimulation for the intern. The scheme attracted a range of companies (28 SMEs offered 39 projects, with 6 larger companies providing the rest of the total 60 projects).

The intern recruitment process was facilitated by the RVC: the RVC undertook initial CV screening before passing candidates for consideration by the companies. Potential interns were then interviewed by the host company, and in some cases, assessment centres were used.

Interns and companies were supported by the ORBIS training programme, delivered by professional trainers. Training comprised 12 experimental training days (6 of which were open to both the intern and their line manager). The training focused on skills gaps relating to business improvement techniques, interdisciplinary collaboration, complex project management and commercial awareness. On the advice of the host companies, the training was delivered by professional trainers rather than university academics.

During the internship, interns developed a range of skills, alongside general employability and commercial awareness, and benefited from the support of industry mentors in planning their career development and improving their application and interview practices.

Of the 24 interns responding post-programme, 11 had secured a permanent graduate level position or a contract extension with the host company, 8 had secured graduate level employment in the bioscience sector, and 2 had commenced a course of postgraduate study. Only three were unemployed or engaged with casual work. The majority of interns believed that the internship programme significantly boosted their employability.

It is not possible to quantify the economic activity that the companies saw from this intervention, but a simple return-on-investment calculation shows that this funding mechanism was only £2000 more expensive per intern than the cost of existing UK unemployment benefit for the same 26-week period.

[A range of case studies from the ORBIS programme are provided in Appendix 2, and demonstrate student and employer experiences.](#)

5.4 Recruiting Graduates or PhD Students: Findings from Internship Programmes

These two case studies highlight how graduate internship programmes may be used to consider the skills and aptitudes of graduates as a means to graduate recruitment and entry into the life sciences sector.

The sector has relied heavily on a plentiful supply of PhD students, with many employers and students themselves considering this as the route to employment in the life sciences sector, particularly in the research and development areas.

“Many employers continue to ‘resolve’ the perceived skills gap by appointing at PhD level, including to posts which do not require the higher level skills and specialist knowledge developed through doctoral study”⁸⁹.

These recruitment practices have therefore resulted in what might be termed the PhD ‘trap’, which has two facets. Firstly, industry recruits PhD-level graduates partly because it perceives them as

having higher levels of independence of thought and operation, greater capacity to synthesise and analyse, and more and better technical skills, and partly because there is such a healthy supply pool of PhDs that companies do not need to look below this group for new recruits.

However, employers may not be able to match PhDs' expectations by providing suitably stimulating work and promotional opportunities (due to a bottleneck of recruits at the same qualification level), resulting in dissatisfaction and attrition.

Moreover, graduates may not be attracted to a sector where a PhD is deemed essential for entry and/or progress; they may choose instead to pursue further study or careers in other sectors. Where companies occasionally recruit below PhD level, they can find good quality graduates, but these might not stay in the company/sector because they cannot progress without a PhD, even if they have developed a high skill level through employment.

From the outside, it looks as if the PhD graduate is recruited less for specialist knowledge and more for skill level, with the qualification being taken as a proxy for a basic set of skills that might equally be found in a bachelors or masters graduate who had received suitable education and training and gained appropriate experience.

Through internships, it is hoped that this trend will be reversed, and employers will revert to employing graduates from undergraduate or postgraduate taught programmes, with these graduates demonstrating the value of improved and different forms of pre-doctoral education.

5.5 Call to Action

As with undergraduate work experience, internships should also be further developed, uptake and outcomes recorded, and participation rewarded.

Best practice should also be followed, in line with that produced by the Gateways to the Professions Collaborative Forum: Common Best Practice Code for High Quality Internships⁴¹.

A nationwide, cost-effective and sustained internship programme for the life sciences sector should be developed, with employers, universities and students and graduates encouraged to participate collaboratively.

Real investment and support for internship placements should be provided.

Ideally, every full-time undergraduate student should have the opportunity to experience at least one structured, university-approved undergraduate internship during their period of study. Where such internships are paid, companies should be able to obtain a tax credit proportionate to the salary costs of employing the student.

Where internships are unpaid, universities should provide financial support to eligible students through funds set aside under their agreements with the Office for Fair Access (OFFA).

However, recognising the limits of public funding, one-off subsidies should be offered only to companies engaging in internships for the first time; repeat business should be funded by the company and the university.

6. Postgraduate and Postdoctoral Placements in the Life Sciences Sector

The UK life sciences sector relies on a three way partnership to drive forward innovation, education and skills development. Through this mechanism, strong partnerships and links in the sector have ensured that the UK is a key contributor to the global research and development. This is clearly demonstrated by the BIS R&D Scorecards^{13,14}. The key measures of the BIS R&D Scorecards are presented in section 2.3.

To some extent the figures presented relate to the scale of the companies in the pharmaceuticals sector, but they also reveal that on measures of R&D activity, such as the ratio of R&D expenditure to sales, pharmaceutical and biotechnology companies stand out. These companies are detailed in tables 6.1a and 6.1b.

UK Trade and Investment (UKTI) estimates that UK companies account for 40% of all products in the pipeline by European public companies, and goes on to say:

*“The country’s success in life sciences – with UK companies accounting for 45 % of new biotechnology drugs in late-stage clinical trials in Europe – is driven by its rich pool of talent and skills. Its world-class scientific institutions, impressive research base and track record in product development continue to attract and retain healthcare innovators.”*⁴²

Strategically, the evidence base suggests that the UK is well placed to capture future gains in the medical biosciences field, because:

- The UK has a regulatory and governance landscape which supports translation of cutting-edge scientific discoveries, for example building on advances in genetics and stem cell research;
- A strong R&D base in both companies and higher education; and
- A centralised healthcare system (the NHS).

In contrast to the pharmaceutical and biotechnology sector, R&D expenditure in the medical equipment sector is estimated to be around £150m^{13,14}.

The life sciences industry business landscape has changed in recent years, and as such so has the way this sector invests in research and development.

As the financial constraints increase with the decline of drugs pipeline, patent expiries and other sector-wide factors, there have been quick shifts in focus and fluctuation in demand for particular areas of expertise. The skills and knowledge demand on recruits and existing staff have also increased.

As these changes have taken place, the Government is working with employers and Higher Education to improve ways of working and is placing greater emphasis on collaboration⁴.

Company	R&D as a proportion of sales (%)	R&D (£m)	Growth in R&D over last year (%)	Sector
Life Sciences Companies with Highest Ratio of R&D Expenditure to Sales (2007)				
Solexa (now Illumina, Cambridge)*	1768	14.8	60.8	Healthcare equipment & services
Ask Therapeutics	1301	14.6	12.4	Pharmaceuticals & biotechnology
CeNeS Pharmaceuticals (now part of Paion, Germany)	1081	5.9	-19.6	Pharmaceuticals & biotechnology
Paradigm Therapeutics (not Takeda Cambridge; now part of Takeda Pharmaceutical, Japan)*	697	7.1	24.9	Pharmaceuticals & biotechnology
Lombard Medical Technologies	632	6.4	33.1	Healthcare equipment & services
MediGene*	591	4.3	-17.9	Pharmaceuticals & biotechnology
Celtic Pharma Development*	503	10.1	131.3	Pharmaceuticals & biotechnology
Sosei R&D*	460	13.2	27.9	Pharmaceuticals & biotechnology
Oxford Biomedica	307	22.1	13.4	Pharmaceuticals & biotechnology
Oametech	295	2.8	-50.9	Pharmaceuticals & biotechnology
Summit	277	8.4	186.2	Pharmaceuticals & biotechnology
Acambia	266	25.3	-31.6	Pharmaceuticals & biotechnology
Life Sciences Companies with Highest Ratio of R&D Expenditure to Sales (2009)				
Reliance GeneMedix*	960	5.2	17	Pharmaceuticals & biotechnology
Prosurgics	844	2.1	n/a	Pharmaceuticals & biotechnology
Alizyme	605	11.2	-64	Healthcare equipment & services
Ask Therapeutics	525	15.6	-5	Pharmaceuticals & biotechnology
Lipoxen	523	2.5	-32	Pharmaceuticals & biotechnology
Syntopix	453	0.9	-14	Pharmaceuticals & biotechnology
Phytopharm	373	3.2	104	Pharmaceuticals & biotechnology
Renovo	357	18.1	-3	Pharmaceuticals & biotechnology
Proximagen	298	2.8	22	Pharmaceuticals & biotechnology
Silence Therapeutics	294	5.1	-24	Pharmaceuticals & biotechnology
Osmetech	285	1.8	-32	Healthcare equipment & services

* Foreign owned firms

Table 6.1a: Companies with the highest ratio of R&D expenditure to sales (Source: 13, 14)

Company	Country	Rank	2010		Rank	2008	
			R&D (£m)	Growth in R&D over last year (%)		R&D (£m)	Growth in R&D over last year (%)
Pharmaceutical & Biotechnology Companies by R&D Expenditure							
Top Global Companies							
Roche	Switzerland	2	5688	9	8	3680	25.9
Pfizer	USA	5	4802	-2	3	4064	6.4
Novartis	Switzerland	6	4581	2	14	3222	21.1
Johnson & Johnson	USA	8	4326	-8	6	3858	7.8
Sanofi-Aventis	France	9	4060	0	11	3351	3.6
GlaxoSmithKline	UK	15	3629	10	13	3246	-6.1
Merck	USA	16	3619	22	23	2453	2.1
Takeda Pharmaceutical	Japan	25	3014	64	-	-	-
AstraZeneca	UK	-	2746	-12.0	19	2533	29.8
Top UK Companies							
GlaxoSmithKline	UK	1	3629	9.5	1	3246	-6.1
AstraZeneca	UK	2	2746	-12.0	2	2533	29.8
Shire	UK	11	347	16.2	12	261	71.7
Pfizer	USA	12	326	3.0	13	258	-30.2
Roche Products	Switzerland	19	208	15.0	19	163	14.9
Eisai Europe	Japan	25	151	42.0			

Table 6.1b: Life Sciences Companies by R&D expenditure (Source: 13, 14)

6.1 The Role of UK Higher Education in Research and Development

In the UK, universities are established as global leaders in research and development. They drive forward innovation through a number of routes, including postgraduate education, research council funding and collaborative investment.

In recent years, greater emphasis has been placed on taking forward innovation through collaboration and investment in R&D through industry and academic partnerships.

Collaborative investment is supported through a variety of funding channels, including Teaching Grants, Higher Education Innovation Funds (HEIF), through the UK Research Councils (RCUK), and through the Technology Strategy Board (TSB). As such, universities are measured on their employer engagement and research activities through the Higher Education Business Interaction and Collaboration Survey (HEBCIS) and through the “Research Excellence Framework” (REF). These assess university performance in areas such as the delivery of research programmes and associated research papers (and the number of citations they receive), intellectual property, patents, licensing, and knowledge transfer partnerships, to name but a few measures.

Through these partnerships, greater awareness of the future skills pipeline through studentships and people exchange mechanisms has also developed. The need for greater career awareness and guidance has also been stated. This is not limited to postgraduate students but expands through to postdoctoral researchers.

6.1.1 Postgraduate Education

Postgraduate education forms a considerable part of the UK Higher Education provision and consists of taught postgraduate programmes and research studentships. Perhaps unsurprisingly students’ main motivation for undertaking postgraduate study is to improve their employment prospects⁴³.

A comprehensive overview of the postgraduate landscape was recently undertaken in the BIS review “One Step Beyond: Making the most of postgraduate skills”⁴⁴. This report highlighted the lack of information on employer demand for postgraduate researchers’ skills, and called for more activity from higher education funding bodies and the research councils in this area.

The report did however state that the value and impact of postgraduate education to the Government in terms of delivering higher level skills were key to attracting new business and driving a high performing economy^{44,45}.

Postgraduate education equips students and researchers with a range of skills, and enhanced knowledge valued by employers⁴⁶. In addition to subject knowledge, postgraduate study can nurture self-motivation, resilience and understanding, though employers may be unaware of the breadth of what a postgraduate can bring⁴⁷. The requirement for specific management high level skills, and managers able to operate at corporate level, is seen as a high priority⁴⁸.

There is also evidence that many PhD graduates are employed in sectors that do not have direct engagement in their research topics. Research by the UK Grad Programme (now Vitae) found that in 2005, among physical sciences and engineering PhD graduates, 18.9% found employment after graduation in finance, business and IT compared to 22.8% in manufacturing⁴⁹.

Figure 6.1 demonstrates the range of career pathways open to researchers. However, there remains a distinct disconnect between the aspirations of research students and the reality of their future career pathways⁵⁰.

The 2009 Postgraduate Research Experience Survey (PRES) 44% of respondents were planning an academic career in HE (research and teaching, or teaching alone) and 14% a research career in HE⁵¹. Further analysis by Vitae⁵² of the longitudinal DHLE survey shows that 3.5 years after completion, only 23% were employed as academic staff.

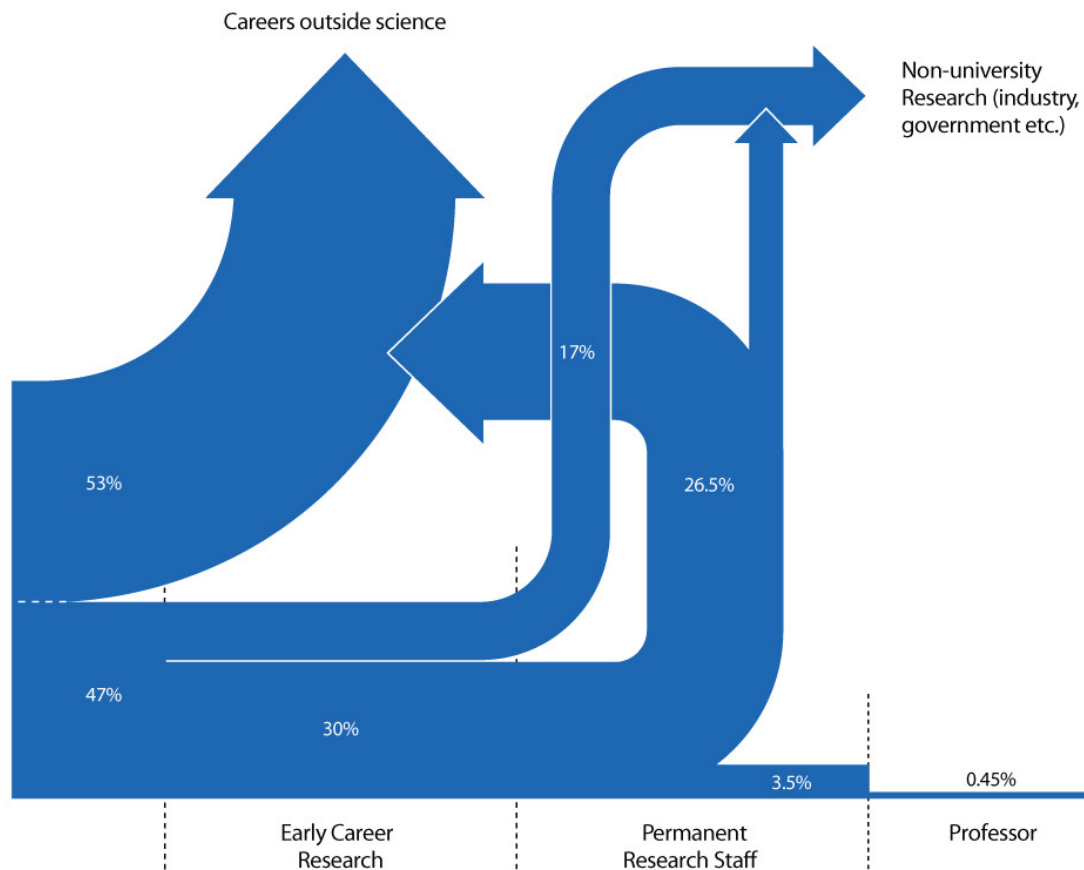


Figure 6.1: Careers of postgraduate researchers (Source: 50)

It is critically important that the UK benefits from this highly qualified group of people by supporting their wider skills development as part of their education and research career pathway.

Progress has been made in this area and a number of schemes to encourage greater considerations towards employability, entrepreneurship training and the engagement of employers in postgraduate and postdoctoral research have been undertaken.

In the life sciences sector, many postgraduate students and researchers funded by the Research Councils are able to access a range of schemes aimed at delivering greater employability and career awareness. Examples include:

- The EPSRC entrepreneurship training fund (£1.4M in 2007 rising to £2.9M to 54 organisations in 2009)
- The Biotechnology Young Entrepreneurs Scheme (YES): an annual business plan competition which has been running for 15 years with some success. It is also a model that is being adopted on a wider basis^{54,55}.

These schemes are in place to address the skills imbalance between the research skills of doctoral students and academic researchers who do not take up a position in academe and the enterprise skills required by business. As with the issues relating to undergraduate students, there is also a need to provide experience with a working environment outside academe through placements and internships. A number of recent changes have occurred in the area of work experience, and are discussed further below.

6.2 The Role of UK Research Councils

There are a number of Research Councils that relate to the UK Life Sciences sector:

- Biotechnology and Biological Science Research Council (BBSRC)
- Engineering and Physical Sciences Research Council (EPSRC)
- Medical Research Council (MRC)
- Natural Environment Research Council (NERC)

These Research Councils are responsible for the interaction with and investment from the life sciences industry with higher education partners.

As with the case of undergraduates and interns, work experience for postgraduate students and researchers is critical:

Work experience contextualises research through practical delivery of skills, often enhancing academic progress, and ultimately employability. Employers also benefit from a period of time to assess the performance of potential future employees, and in the case of research staff, gain fresh insights into cutting edge research and development and knowledge transfer activities.

The range of work experience for researchers includes:

- Collaborative doctoral programmes which are at least partly employer-hosted, including CASE awards, industrial and engineering doctorates
- Schemes for work experience placements, internships and secondments that are funded by the Research Councils
- Individual internships and fellowships funded by employers and external organisations
- Consultancy and employer-hosted projects, including Knowledge Transfer Partnerships.

In terms of placement opportunities, table 6.2 shows the schemes and estimated figures available across all UK Research Councils²⁶.

Funding for secondments and people exchange is available from a variety of sources, for example the Research Councils, the Royal Society and Royal Academy of Engineering industry fellowships. These initiatives do not provide comprehensive coverage across the research spectrum as yet; however, the Research Councils relating to the life sciences sector have committed to funding a significant drive to expanding these initiatives further, delivering funding for people movements to enhance the researcher experience and offer wider career development at all career stages. These schemes are presented in table 6.3.

The interaction between universities and business is complex, and gaining a true measure across all activity is beyond the scope of this work: many industry partners fully fund and support researchers outside the scope of the Research Council.

Collaborative Doctoral Awards	
CASE type awards/studentships	c. 700 (based on Research Council funding)
Engineering/Industrial Doctorates	<100 (doctoral researcher survey data)
Internships, secondments and fellowships	
Research council and public funded	< 200 (counts of opportunities)
Commercial UK internships	< 200 (counts of employer vacancies)
Within generic graduate schemes	< 50 (graduate scheme survey data)
Royal Society industry fellowships	< 10 (count of annual opportunities)
Professional internships for PhDs	c. 220 (planned BBSRC Doctoral training)
Hosted projects and consultancy	
Shorter Knowledge Transfer Partnerships (KTPs)	< 100 (TSB estimate)
Classic KTPs by PhDs/Researchers	< 100 (estimate from TSB opinion)
Individual consulting projects	Unknown
“Known” total estimate	c. 1500 per year

Table 6.2: Summary of placement opportunities and schemes with estimated figures available across all UK Research Councils (Source: 17)

6.3 Collaboration between Industry and Higher Education in the Life Sciences Sector

Collaboration between industry and higher education in the UK is common place, and is actively used to drive forward innovation, education and skills development.

The ABPI undertakes a bi-annual survey of industry and academic links in the life sciences sector, and these reports detail the areas where industry invests and collaborated with universities.

In 2009, the ABPI Industry/Academic Links survey noted a 10% increase in the number of postgraduate studentships available, but a 6% drop in those supported by industry since 2003. Imperial College London, Manchester, Oxford and Cambridge universities were offering over a third of these placements. Many of these PhDs are supported through industrial CASE awards, as shown in figure 6.2¹⁹.

The number of reported postdoctoral research collaborations also increased by 17% over the prior two years: there were a total of 384 collaborations with 127 academic organisations. Manchester, Imperial College London and Cambridge topped the list for this activity with over a quarter of these collaborations. During 2007-2009, over half of the reporting companies did not support the costs of postdoctoral positions, but preferred to support shorter term research. It was suggested that full economic costing is a barrier to collaboration in this case¹⁹.

Although this may have been a perceived barrier in 2009, the report noted a shift towards open collaboration between academia and industry as evidenced by a number of recent collaborative opportunities and initiatives. These were identified as:

- The University of Dundee Division of Signal Transduction Therapy
- The Medical Research Council Centre for Drug Safety Science based at the University of Liverpool
- The Engineering and Physical Science Research Council Co-funded Chemistry Studentships scheme with Astra Zeneca, GlaxoSmithKline and Pfizer.

In 2011, the subsequent ABPI reported further new academic partnerships, including²⁷:

- The MRC-ABPI Immunity and Inflammation Consortia
- The Manchester Inflammation Centre, funded by GSK and AstraZeneca
- The MRC/AstraZeneca Compound Library
- A number of “Discovery Partnerships with Academia” agreements between GSK and a range of academic institutions.

There remains a core group of research intensive universities that understand the benefit and value of training the future researchers in the life sciences industry. These are shown in figure 6.3.

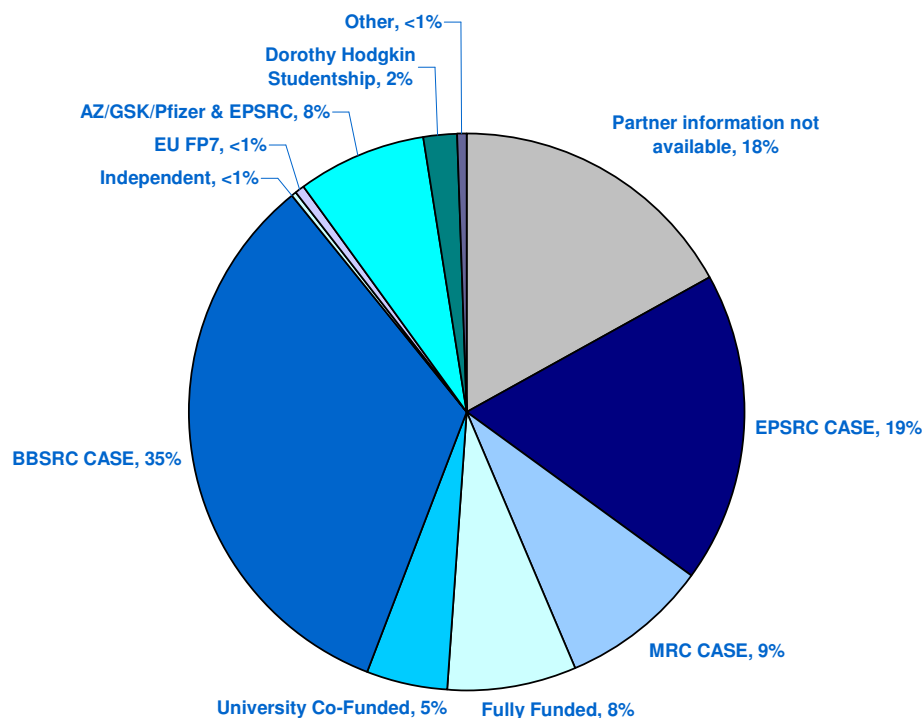


Figure 6.2: Funding methods for CASE Studentships in the Pharmaceuticals Industry sector, 2009 (Source: 19)

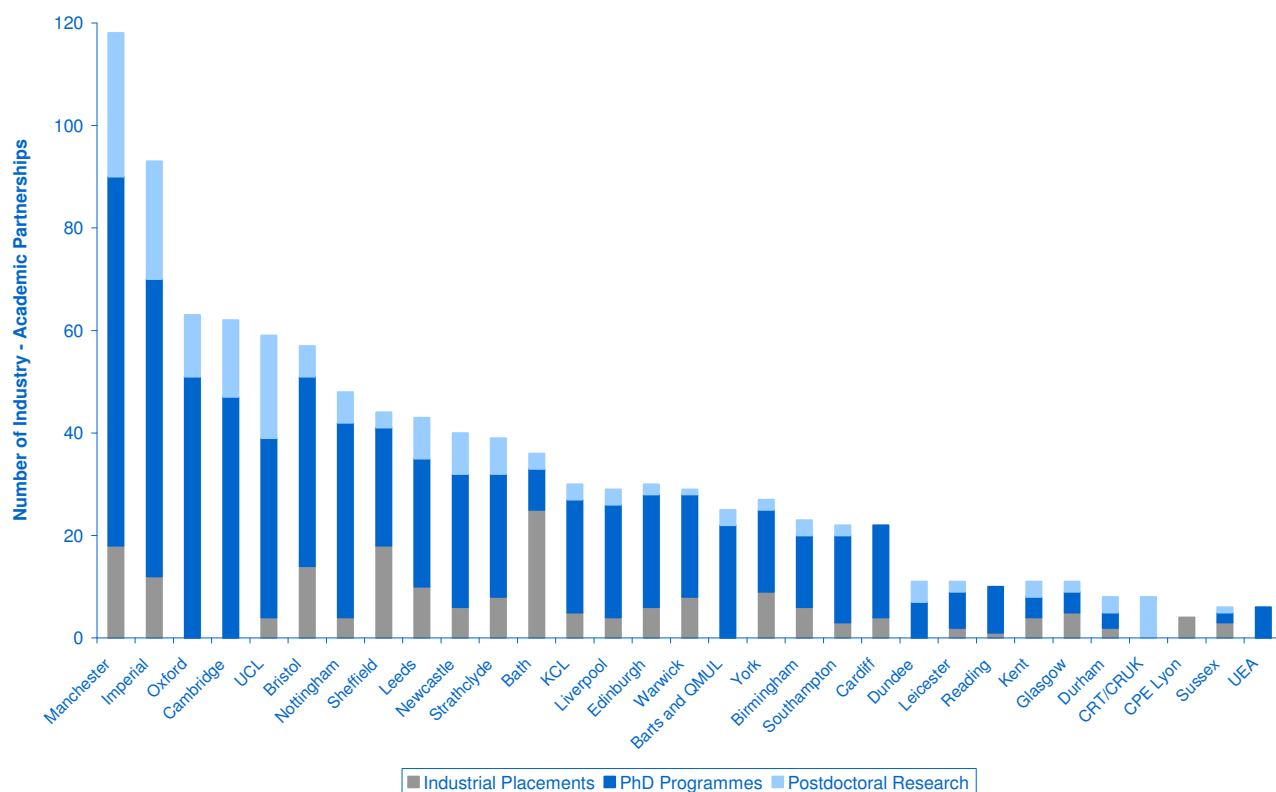


Figure 6.3: Overview of industry-academic partnerships (Source: 27)

6.4 Postgraduate Research Programmes in the Life Sciences Sector

There has been a range of developments in the types of postgraduate and PhD programmes on offer in the UK in the last 20 years, primarily focused on increasing the development of research and transferable skills. The UK Research Councils have also supported the development of skills training programmes for all PhD students and postdoctoral researchers and a 2010 RCUK review found the progress in this area had drawn international attention⁵⁵.

Although some sectors, particularly those in research-intensive, high technology areas, recruit PhD graduates for specific skills, employers also recruit postgraduates for wider attributes including analytical thinking and problem solving skills⁵⁶. In a 2010 survey of employers there were still reservations that PhDs find it difficult to adapt to non-academic environments, that they were not work-wise, and that postgraduate qualifications were not a guarantee of leadership potential.

Research Councils are now focusing on priority research areas and increasing the resource per individual student, including an extension of studentships to four years as standard. This will result in a reduction in the number of Research Council funded PhD students, but indicates a clear support for “quality over quantity”. The BBSRC and MRC are also collaborating with the British Pharmacological Society to provide additional ‘top-up’ funding to BBSRC- and MRC-funded studentships to support research training in integrative mammalian biology.

In addition, there is greater emphasis on collaborative research, industry engagement and people movement.

6.4.1 Knowledge Transfer Partnerships (KTPs)

The well-known and established Knowledge Transfer Partnerships (KTP) scheme places recent graduates with companies under joint academic and company supervision to undertake a research project, with the goal of improving the competitiveness of the company. Now managed and co-funded by the TSB but running for over 30 years, the benefits of these partnerships are well established⁵⁷. KTP is an intensive intervention with a highly structured management; this ensures that it is suitable for businesses with low absorptive capacity. Its client businesses are predominantly SMEs.

The KTP programme is highly successful but is not prominent in the priority list for our largest research intensive universities, possibly because its associates are normally graduates rather than postdoctoral staff. Appointing postdoctoral staff to these programmes may require the salary cap for associates to be increased, with the consequence of a lower number of schemes, unless the budget were increased.

The KTP programme has a track record of successful knowledge exchange between universities and academia, deploying graduates to support innovative companies, and is commended for that performance. The introduction of a postdoctoral level of input should only be undertaken where the skills associated with that level are required.

Building on proven success, the expansion of this programme, funded by the TSB, should be challenged in order to meet the needs of business. Mechanisms to facilitate networking between KTP associates as part of a broader agenda to unify the people exchange programme should also be encouraged.

Where the KTP is highly technical and requires postdoctoral expertise, the current financial cap on salaries for KTP awards should be raised in order to expand the involvement of these staff.

Research Council	Career Stage					
	Undergraduate	Doctoral	Early Career Researcher	Established Researcher	Group Leader	Open to All Career Stages
BBSRC	Research Experience Placements (100)	- Industrial CASE studentships (90) - Industrial CASE Partnership studentships (75) - KTPs (5-10) - Policy Placements (14) - Professional Internships for PhD students (PIPS from 2012) (220)	Industry Interchange Programme* (5-10)	- Industry Fellowships Scheme (Royal Society) (2-3) - Industry Interchange Programme* (5-10)	- Industry Fellowships Scheme (Royal Society) (2-3) - Industry Interchange Programme* (5-10)	Industrial Impact Fellowship* (2-3)
* Note: Industry Interchange Programme and Industrial Impact Fellowship schemes will close in 2012; they will be replaced by the new Flexible Interchange Programme, to be launched 2012.						
EPSRC	Universities can award up to 15 vacation bursaries per year funded through doctoral training grants (DTGs)	- Industrial CASE studentships (250) - Engineering Doctorate - Collaborative Training Accounts - Industrial Doctorate Centres - KTPs - POST Placements - CASE Conversion target built into Doctoral Training Grants	- Industry Fellowships Scheme (Royal Society) (6) - Knowledge Transfer Secondments (KTS) - Ad-hoc programme related policy placements	- Industry Fellowships Scheme (Royal Society) (6) - Knowledge Transfer Secondments (KTS) - Ad-hoc programme related policy placements	- Transfer Secondments (KTS) - Ad-hoc programme related policy placements	Knowledge Transfer Accounts (KTAs)
MRC		- Industrial CASE studentships (35) - Academy of Medical Sciences/ MRC Policy Placements (4) - BA Media Fellowships (9-10) - MRC Industry Collaborative Clinical Training Fellowship Programmes (targeted to skills gaps e.g. clinical pharmacology)	- People Exchange Programme (2-5) - KTPs - MRC Fellowship Partnership Awards - MRC Industry Collaborative Agreement (MICA) Fellowships	- People Exchange Programme (2-5) - MRC Fellowship Partnership Awards - MRC Industry Collaborative Agreement (MICA) Fellowships	- People Exchange Programme (2-5) - MRC Fellowship Partnership Awards - MRC Industry Collaborative Agreement (MICA) Fellowships	
NERC	Research Experience Placements (30)	- CASE studentships (37) - KTPs (8-12) - Secondments for NERC funded PhD students (extension of POST) (9)	- Industry Fellowship Schemes (2) - Policy Placement Scheme (4)	- Industry Fellowship Schemes (2) - Policy Placement Scheme (4)		Policy Placement Scheme (Works Shadowing) (up to 10)

Table 6.3: Existing Research Council People Movement Mechanisms (prepared by Research Councils UK for this report)

Case Studies: Shorter Industrial Mathematics Knowledge Transfer Partnerships, co-funded by EPSRC

Mathematical Modelling of an Ultrasound Sensor for Bioprocesses

Company: Bioinovel
University: Strathclyde
Internship Length: 6 months

Bioprocesses such as microbial fermentation and cell culture are fundamental for the production of a whole host of products ranging from pharmaceuticals, specialty chemicals, food ingredients and bio-fuels. At present, these processes operate in a sub-optimal fashion because of the lack of available monitoring, and optimisation technologies which could “control” the biological system, and lead to maximised yields and product quality.

Bioinovel is a new biotechnology venture developing novel in-line process sensors and associated bio/chemo-informatics and control software for bio-processing, agro-food processing and specialty chemicals processing. Its vision is to revolutionise the way that these industries develop, monitor and control their production processes.

This project contributed to the ongoing development of Bioinovel's ultrasound probe technology which aims to significantly increase the capacity and productivity of these industrial sectors by introducing effective real-time process performance monitoring and optimised control. This technology is being developed using a multi-disciplinary approach that combines mathematical modelling with ultrasound engineering, chemistry, biology and software engineering.

The focus of this project was to further develop the acoustic component of the mathematical modelling associated with this technology.

Underarm Malodour Modelling

Company: Unilever
University: Nottingham
Internship Length: 5 months

The internship project encompassed the construction of complex mathematical algorithms to aid in the development of an in silico kinetic model of axillary (underarm) malodour. Specifically, the student will be asked to address two significant deficiencies in Unilever's current prototype model. The model contains objective data on the concentration of each odour molecule that is detectable by the human nose as malodorous. However, the project aimed to build an algorithm to interconvert this data with subjective malodour scores, as determined by expert underarm sniff-assessors.

There were three distinct areas of investigation:

- *Error Analysis*
- *Bioinformatics*
- *Systems biology*

6.4.2 CASE Awards

The most common form of postgraduate research PhD undertaken in collaboration with industry is the CASE (Collaborative Awards in Science and Engineering) Studentship. A number of Research Councils provide these awards, and the aims, benefits, programme expectations and eligibility criteria are summarised below.

BBSRC / EPSRC / MRC Vision of CASE Studentships

CASE awards provide PhD students with a first-rate, challenging research training experience, within the context of a mutually beneficial research collaboration between academic and partner organisations e.g. industry and policy making bodies.

There are a number of benefits associated with these awards:

Benefits to the student – CASE provides outstanding students access to training, facilities and expertise not available in an academic setting alone. Students benefit from a diversity of experimental approaches with an applied/translational dimension.

Students have an opportunity to develop a range of valuable skills and significantly enhance their future employability; many will become research leaders of the future.

Benefits to the academic / partner organisations - CASE studentships encourage productive engagement between partners who benefit from a motivated, high-quality PhD student undertaking cutting-edge research relevant to the organisations' priorities and objectives. CASE provides opportunities to explore novel research collaborations and strengthen current partnerships.

Defining an excellent CASE Studentship:

High-quality project – A challenging, feasible and realistically achievable PhD project which stimulates excellent hypothesis-driven research. Through a truly collaborative approach, it provides tangible benefits to all partners.

High-quality training environment – Through access to distinctive but complementary environments, partners provide a stimulating framework for research training in the proposed field. Joint supervision gives a unique and broadening perspective on the impact of collaborative research.

High-quality student experience – An enriched integrated training experience allows the student to acquire novel skills and expertise. The student gains a wider understanding of, for example, applied research or policy development that will enhance their future career prospects.

BBSRC/ EPSRC / MRC Non-Academic Partner Eligibility

UK-based organisations can be considered as the non-academic partner if they can provide students with distinctive research training and experience not available in an academic setting. Organisations eligible for Research Council funding cannot act as a non-academic partner. Where the non-academic partner is a company, it must have an established UK-based research and/or commercial production capability. In exceptional cases, organisations based overseas may be eligible, but only where they can provide the student with an opportunity to gain skills not currently available in the UK.

Further details on these schemes are provided in appendix 3.

A large number of CASE studentships offer wider ranging benefits and these can be seen in the case studies provided by the Medical Research Council in Appendix 4.⁵⁹

Case Study: Accessing resources⁵⁹

Emily Davies is approaching the end of her PhD studying the physiology of pain at the University of Bristol. The PhD was funded through an MRC Industry CASE Award, during which Emily spent eight months on a placement at GlaxoSmithKline.

“The time I spent working in industry has highlighted the benefits of industrial and academic collaborations, and I will certainly aim to make new collaborations with industry in my new postdoctoral role.”

“The industry collaboration provided me with additional intellectual input, experimental support in terms of equipment and funding, and establishing contacts within the field that have furthered my career.”

Emily Davies
MRC PhD student
University of Bristol/GlaxoSmithKline

There is, however, concern around the need for CASE students to spend at least three months of their studentship on a placement with the industry partner. In an evaluation of BBSRC studentships undertaken in March 2011, only 38% of Year 4 CASE students reported that they had participated in an industry placement⁶⁰.

A number of reasons why a placement had not been provided were provided. These included:

- the industry partner went into administration or experienced financial difficulties
- the industry partner's priorities changed (e.g. because of restructuring or new data)
- the industry partner was not interested in providing a placement (e.g. because the student project had no commercial value to them)
- the industry partner did not respond to contact from the student or supervisors
- the industry supervisor left the company
- current instabilities in particular sectors are affecting industry's ability to support placements
- health issues (student or supervisor).

However, a high proportion of students (82%) stated that the overall training experience provided by their placement was important or very important to their skills development. CASE placements improved students' perceptions of industry careers: 66% of CASE students who participated in an industry placement stated that this had made them more likely (51%) or much more likely (15%) to consider a career in the bioscience industry.

The role of a placement in providing a further high-quality training experience is vital; it would be better for students not to participate in a CASE placement than participate in a poor-quality placement. A full evaluation of BBSRC CASE studentships is currently taking place and a report of this evaluation will be published in summer 2012.

6.4.3 The Industrial Doctorate

The Engineering Doctorate, or EngD, has become established since its development by EPSRC in 1992⁶¹. The EngD was designed to provide postgraduate engineers with an intensive, broadly based, research programme incorporating a taught component, relevant to the needs of and undertaken through sponsorship with industry. These programmes equip their graduates for “powerful, creative leadership roles”, and recently the concept has been extended outside engineering and thus has been re-branded as “industrial doctorate”. Other professional doctorates have also been developed by universities⁶².

Integrated programmes, or “New Route PhDs”, through which students undertake structured training in research methods and transferrable skills as part of an initial taught programme, have also been gaining popularity in the last 10 years. Both “New route PhDs” and professional doctorates employ “1+3” models, with an integrated taught masters degree, leading to a 4-year course.

BBSRC has developed Advanced Training Partnerships which support the development and delivery of research training in the agri-food sector, through collaboration between public and private sectors. Through the ATPs, employees within the sector will partake in postgraduate-level CPD, part-time masters and professional doctorates in agri-food, where the four partnerships are developing a new DAgrIFood qualification. This model may be broadened to support other sectors⁶³.

6.5 Doctoral Training Centres and Partnerships

The EPSRC has made a £300M investment in specialist Doctoral Training Centres, currently funding over 75 centres, including EngD and industrial doctorate centres. A distinctive feature of these centres is the sustainably-sized cohort of students training together, with emphasis on team working and problem solving. Cohort working was noted in the EPSRC delivery plan 2011-2015 as a factor that puts these students in high demand by business and industry⁶⁴.

Case study: GSK – University of Strathclyde

From 2012, Glaxo Smith Kline, in collaboration with the University of Strathclyde will provide a novel approach to postgraduate chemistry training. The programme provides 12 chemistry graduates an opportunity to work towards a PhD through novel research conducted on GSK projects whilst being Strathclyde students. 8 will be funded by GSK, spending the majority of their 3½-year studentship at GSK, the remaining 4 by GSK/EPSRC CASE (Engineering and Physical Sciences Research Council’s Collaborative Awards in Science and Engineering) and spend the majority of their studentship at Strathclyde. All students will have an academic and an industrial supervisor. This new doctoral programme provides a cadre of chemists working towards a PhD, and benefiting from both industry and academic experiences and influences and they will benefit from being alongside the GSK chemists who are also studying for an MPhil/PhD.

Case Study: EngD Biopharmaceutical Process Development – Newcastle University

From 2012, Newcastle University will provide 12 EngD programmes through novel research in biopharmaceutical processes development. Students will spend 3½-years of their studentship on industrial placement, allowing them to build on existing skills with the latest scientific and engineering techniques and management skills to enable them to work at the interface between disciplines. Students will undergo a range of academic modules, professional and technical skills training and a Bio Apprentice where a team of students are set challenges to find a real-life business solution. A range of companies are engaged with this programme, including GSK, Croda, Astra Zeneca, Unilver, Perceptive Engineering and Alcyomics ABB.

Case Study: MRC Liverpool-Manchester Doctoral Training Programme in Clinical Pharmacology and Therapeutics

The BIS Strategy for UK Life Sciences highlighted this innovative programme, launched as part of the Office for Life Sciences Blueprint. The programme is built around a cohort of clinician PhD’s who benefit from placements at a number of partner organisations (including AstraZeneca, GSK and smaller companies such as ICON). This is an excellent example of how academia, industry and the NHS can work together to provide outstanding opportunities to develop the research leaders of the future, with the skills needed to underpin development of safe and effective innovative treatments and a successful UK life sciences industry.

Investment of over £67M by the BBSRC was announced in late January 2012. The investment will support 14 Doctoral Training Partnerships (DTPs) across the UK as well as a number of industrial CASE awards⁶⁶.

Over the next three years, DTPs will support 660 PhD studentships from October 2012, encourage partnership with other funders, including industry, and develop a new programme of Professional Internships for PhD Students.

The BBSRC also works closely in collaboration with key industrial partners through its Industrial CASE Partnership awards, which provide block funding of studentships for major industrial partners.

6.6 Professional Internships for PhD Students (PIPS)

Under the BBSRC's Professional Internships for PhD Students (PIPS) scheme, all PhD students funded through the Doctoral Training Partnerships competition are required to take a three month internship that is not of direct relevance to their PhD project (making it distinctive from CASE, where the industrial placement is an integral part of their PhD)⁶⁷. The placement can be in any area but clearly many will choose to experience working in industry, either on a research or non-research related project.

In developing the scheme, there have been a number of consultations with potential students, supervisors and managers. In general, the PIPS scheme has been welcomed by the bioscience community. The benefits of this scheme are demonstrated in figure 6.4. The main points of concern were as follows:

- **Supervisors** were seen as being a major barrier to the uptake of PIPS, where students were concerned about "being allowed out of the lab" and some supervisors struggled to see the broader benefits in taking an internship, to the student and their research. For this reason, PIPS will be mandatory for PhD students funded by a DTP award. Exceptions are made for CASE studentships, although PIPS are encouraged for these students too.
- **Availability of placements** – there has been some concern that there will not be enough host organisations able to take interns. Given the breadth of the scheme (policy, media, teaching, industry, etc) the BBSRC sees this as unlikely, but will be monitoring this closely in the first couple of years of the scheme's operation.

Where industrial sector engagement is integral to the PhD programme, there has been positive feedback from employers in that sector.

EngD programmes in particular are valued by employers; in these programmes, students spend 75% of their time working on a project of relevant to their sponsor company, often also undertaking placements on their site.

Universities and employers should be invited to consider providing internships to PhD students to aid the development of skills. All full time PhD students should have an opportunity to experience at least one 8-12 week internship during their period of study and should be encouraged to attend a short intensive enterprise skills programme alongside research students from other departments of the university. Universities should increase support for postgraduate students seeking to set up their own businesses.

Doctoral Training / Industrial Doctorate Centre	University
Virtual Environments, Imaging and Visualisation	University College London
Bioprocess Engineering Leadership	University College London
Molecular Modelling and Materials Science	University College London
Maths and Physics in the Life Sciences and Experimental Biology	University College London
Chemical Biology	Imperial College London
Sustainable Chemical Technologies	University of Bath
Bristol Chemical Synthesis Doctoral Training Centre	University of Bristol
Systems Approach to Biomedical Science	University of Oxford
Bio-nanotechnology, medical Imaging and Bioinformatics	University of Oxford
Systems Biology	University of Oxford
Systems Biology	University of Warwick
Molecular Organisation and Assembly in Cells (MOAC)	University of Warwick
Regenerative Medicine	Universities of Loughborough, Nottingham and Keele
Targeted Therapeutics	University of Nottingham
Physical Sciences of Imaging for the Biomedical Sciences	University of Birmingham
Systems Biology	University of Manchester
Tissue Engineering and Regenerative Medicine	Universities of Leeds, Sheffield and York
Physical Methods and Life Sciences: Molecules to Cells	Universities of Leeds and Sheffield
Biopharmaceutical Process Development	Newcastle University
Medical Devices and Related Materials	University of Strathclyde, Glasgow
Neuroinformatics	University of Edinburgh
Proteomic Technologies	Universities of Glasgow, Edinburgh and Dundee

Table 6.4: Summary of Doctoral Training Centres and Programmes (Sources: 64-66)

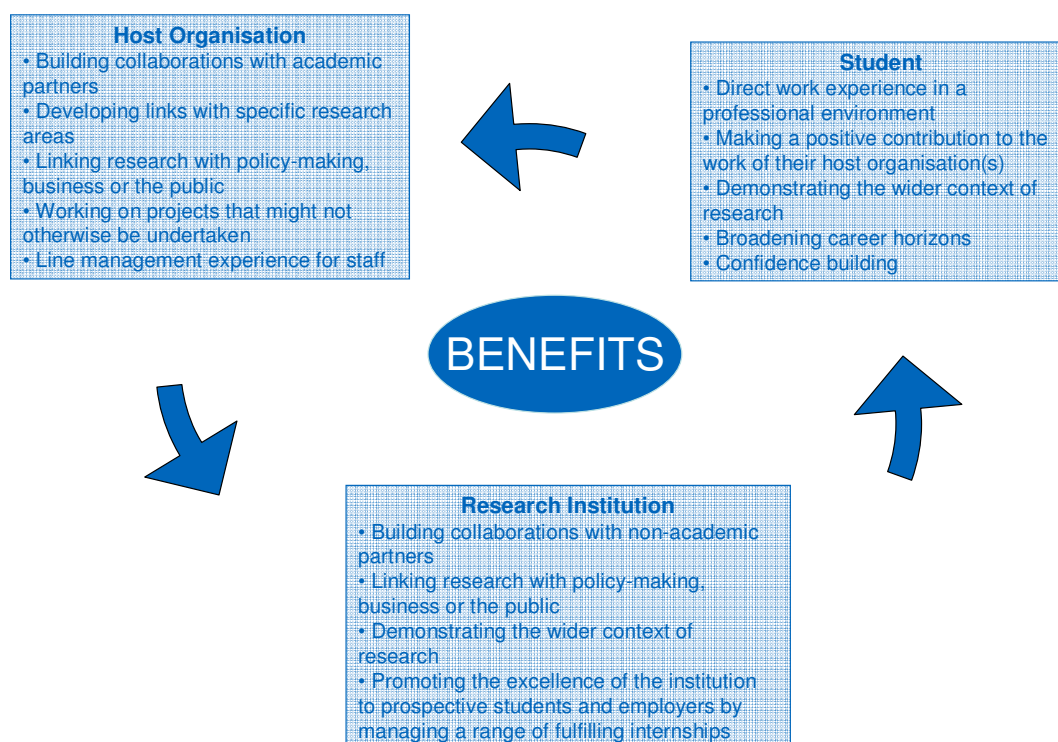


Figure 6.4: Benefits of PIPS (Source: 67)

6.7 Postdoctoral Exchange in the Life Sciences Sector

Postdoctoral secondments are recognised as one of the best ways to achieve knowledge exchange while strengthening university-business links¹⁸. However, experience of secondments amongst postdoctoral researchers is low (5%) and academics' competing commitments limit their availability to undertake such placements⁶⁸.

Time allocation amongst academic research staff is a common problem; the issue is not one of time constraint, it is one of time and goal prioritisation. Set in the context of career development and the rapidly developing world of business collaboration, such secondments should be promoted and encouraged.

The situation of postdoctoral research staff merits further consideration. Many researchers experience a series of short term contracts, dependent upon research grants. In the context of good practice and in maintaining real-time connectivity with the business world, it would be beneficial if these employees were offered a secondment with an employer in a relevant field of activity, and also benefited from additional support in terms of enterprise education to add those skills to their portfolio.

A wide range of grants are available from a number of sources, including professional bodies, charitable trusts and the Research Councils and are usually referred to as Industry Interchange Programmes and Industrial Fellowships. Grants are available across the career stages: early career researchers through to established researchers, academics and clinicians.

6.7.1 BBSRC Flexible Interchange Programme

A new Flexible Interchange Programme (FLIP) is being developed through consolidation of existing schemes, e.g. BBSRC's Industry Interchange Programme, Industrial Impact Fellowship, Research Development Fellowship, Institute Development Fellowships, and Discipline Hopping Awards⁶⁹.

FLIP will provide opportunities to enhance the genuine two-way flow of ideas, people and skills through individuals moving between different disciplines and sectors at all stages in their career beyond the PhD (or equivalent).

The scheme will allow for academia-industry exchanges, as well as movement between Research Organisations, government, business and/or policy-making organisations, or support those wishing to embark on new directions in their research. It is anticipated that the first awards will be made late 2012.

6.7.2 MRC Industry Fellowships Scheme and Partnership Awards

The MRC has also launched a suite of new opportunities to encourage MRC fellows to spend time and develop partnerships with industry⁵⁹. From January 2012, existing and new MRC fellows will be able to add a component of industry collaboration to their fellowship and access individual advice on partnering with industry from an expert panel.

The MRC plays a leading role in training the nation's future research leaders across a range of biomedical, clinical and health disciplines. At any one time the MRC supports around 1,900 PhD students and 200 postdoctoral fellows. This talent pool offers a valuable intellectual and practical resource for UK industry.

As part of its commitment to engage with a wide range of life sciences industries to drive mutually beneficial research partnerships, the MRC is now offering new ways for MRC research fellows to enhance their research and careers.

By supporting fellows flexibly in a variety of ways, the MRC will be helping to create a new cadre of leading researchers, comfortable working in the ambitious and open academia-industry partnerships that will deliver high impact science for the future.

Partnership Awards are a new award open to existing MRC fellows wishing to access extra funding to collaborate with industry:

- A Partnership Award is flexible both in terms of funds, duration, type of project and level of industry contribution.
- Applicants are expected to be at least half-way through their fellowship.
- Partnerships can take a variety of forms, not only a conventional 'research project'.

New fellowship applicants can incorporate industry collaboration into their research proposals, applying through the MRC's various fellowship schemes and attaching an MRC Industry Collaboration Agreement (MICA) form.

Case Study: Shared Expertise⁵⁹

Dr Ian Douglas is an MRC methodology research fellow at the London School of Hygiene and Tropical Medicine. He works one day a week with pharmaceutical companies such as GlaxoSmithKline, Gilead and Takeda, investigating drug safety using patient data.

*“[Working with industry] means I can work collaboratively with non-academic experts in the field, **so we all benefit from shared expertise** and hopefully improve the way we look at drug safety problems.*

“I’d recommend that fellows work with industry if both sides are likely to benefit — having a rounded experience of the field you work in is generally going to be a good thing. My work with industry complements, strengthens and draws on my fellowship work.”

Ian Douglas
MRC fellow
London School of Hygiene and Tropical Medicine

All full-time postdoctoral research staff should have the opportunity to benefit from 8-12 weeks of work experience outside academe every three years during their contract. They should receive career guidance from the university’s professional staff each year of their employment as an integral part of their appraisal and be encouraged to attend a short intensive enterprise skills programme alongside postdoctoral staff from other departments of the university.

6.8 Collaboration, Open Innovation, Intellectual Property and Networking

The ABPI Industry/Academic Links survey 2009 states that full economic costing is a barrier to collaboration¹⁹. Although this may have been a perceived barrier in 2009, in the subsequent 3 years, there has been a definitive shift towards collaboration and open collaboration between academia and industry as evidenced by a number of recent collaborative opportunities and initiatives.

An example is the MRC/AstraZeneca Mechanisms of Disease call – a unique open innovation collaboration where academic researchers will have unprecedented access to 22 high-quality AstraZeneca clinical and pre-clinical compounds.

It is important to put the Intellectual Property (IP) issue in context, particularly when industry and academia are embarking on open innovation. In revenue terms, university income from joint research with industry and the third sector (£1.7bn including governmental co-funding) greatly exceeds that generated from traditional linear technology transfer providing IP income (£84M)⁷⁰.

Further, there is growing evidence that businesses value collaborative relationships with HEIs above linear university IP transactions in their innovation processes⁷².

Interaction between universities and companies is an ever-changing market as businesses seek to be leaders in their particular fields and researchers seek to ensure that the potential of their work is realised.

The increasing adoption of open innovation models demands that even greater attention is paid to networking between research academics and business. Structured opportunities to network are taking a heightened importance. Whilst collaborations in the past were often the result of *ad hoc* connections and personal relationships, the importance of individuals with “boundary scanning” capabilities – identifying early stage technology developments or technologies used in other

industries – has been recognised by both universities and businesses, and need to be accommodated within a networking system^{72,73}.

This emergence of industry boundary-scanning positions (sometimes known as technology catchers or scouts) provides opportunities for additional models for proactive networking, both for companies seeking technology-related innovation through university research and for researchers seeking companies that could use their research and/or innovation to enhance their performance. Such “smart” networking is possible using the expertise and knowledge base of the TSB.

Case Study: Network building⁵⁹

Dr Matt Jones is an MRC senior non-clinical fellow at the University of Bristol. His research into neuronal networks and control of cognitive behaviour is underpinned by a number of productive industrial collaborations with Eli Lilly & Co, Janssen, GlaxoSmithKline, Pfizer and others.

*“I’ve always collaborated with industry. Ultimately, if you want to have a positive impact on patients, then you need industry’s support ... common scientific interests and goals mean **I’ve always found industrial collaborations invigorating.**”*

Dr Matt Jones
MRC fellow
University of Bristol

The TSB should work with universities, research funders and business to establish a boundary-scanning capability with intelligent brokering to facilitate innovation. This could include open innovation projects exposing existing research information on challenge areas, providing a valuable resource for business. When established, this facility should have the capability to reciprocate its service, linking companies in relevant sectors to universities seeking collaboration to develop applications for its research.

7. Globalisation and International Placements

As the life sciences industry competes on a global scale, we need to highlight the importance of the knowledge and skills required to work in this environment and increase opportunities for students and researchers to develop them.

The Government is driving forward policy to make Britain ‘the best place in the world to do science’⁷³. This ambition clearly sets the UK life sciences sector in the wider global context. As noted in section 6, the UK is strategically well placed to capture future gains in the medical biosciences field, through a combination of a conducive regulatory and governance landscape, a strong research base in academia (including four of the world’s top ten universities) and a national health service unlike any other.

However, these strengths alone will not secure a competitive future in the global market unless collaboration is encouraged across industry, universities and the NHS. Through such collaboration, high-tech opportunities can be realised whilst supporting jobs and boosting economic growth, with the aim of making the UK the preferred location for scientific R&D.

In a fast-paced and highly competitive and changing industry, policy is being developed to ensure our tradition for research and development is consolidated, and good working practice embedded to ensure the UK stays ahead.

International mobility among students and researchers, and improved cultural awareness, is an essential part of this picture; the greater supply and uptake of international placements should therefore be strongly promoted and facilitated.

7.1 Global Industry Performance

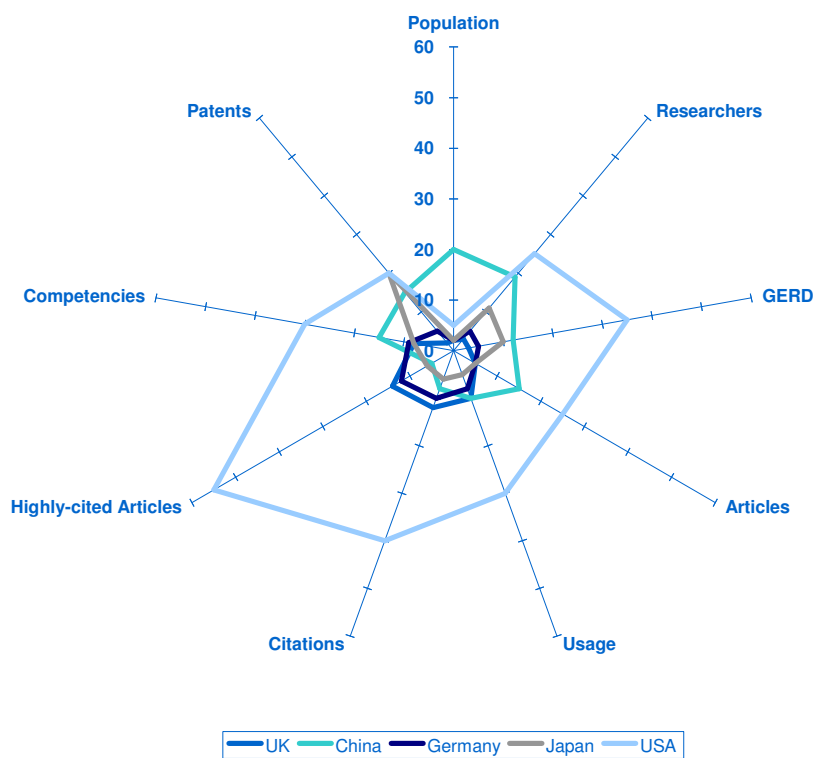
Analysis of the UK’s performance relative to other key countries reveals some notable trends relevant to the skills question, as demonstrated in a report prepared for the Department of Business, Innovation and Skills in 2011⁷⁴.

As shown in figures 7.1 and 7.2, the UK’s outputs in terms of researchers, articles, citations, patents and competencies may seem low by comparison with other research intensive countries, including China, Germany, Japan and, in particular, the US, which dominates these areas. The UK performs better when this data is presented in terms of total gross expenditure on research and development (GERD), particularly in terms of researchers and their competencies, and the number of articles produced and cited. On the other hand, it falls below many of the other countries when patents are explored more closely: Japan outperforms in this particular area.

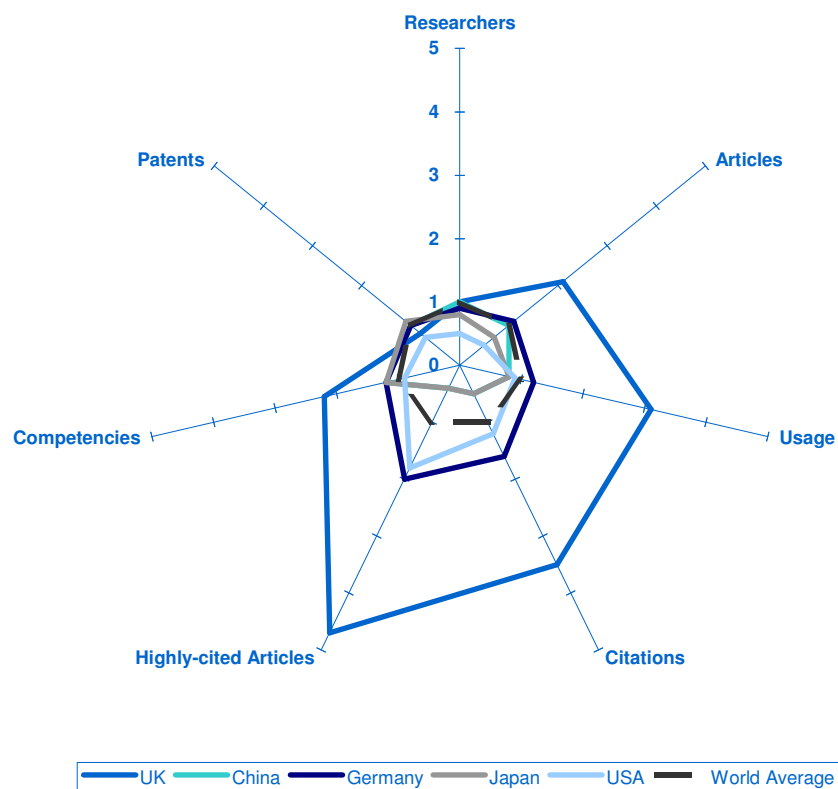
In terms of international investment in research and development, the UK has shown steady intensity over recent years. However, while the UK’s investment activity is in the mid range, much greater increases in intensity are evident in the US and China. Japan (which had had the highest level of activity since 2006) has seen a sharp decline over the past twelve months, although this is likely to be an anomalous dip due to the effect of recent natural disasters, undermining research activity during that period.

A number of investment mechanisms make up the total gross expenditure on research and development (GERD), including investment by Government, business and higher education; these are illustrated in figure 7.3.

Greater in-depth analysis of the funding mechanisms supporting research and development in the UK show that there is relatively even performance and funding in business enterprise and Government funding, as illustrated in figure 7.4.



(a)



(b)

Figure 7.1 Radar charts of key input and output indicators for the UK and key comparators across countries: (a) Output and (b) Output per GERD (Source: 74)

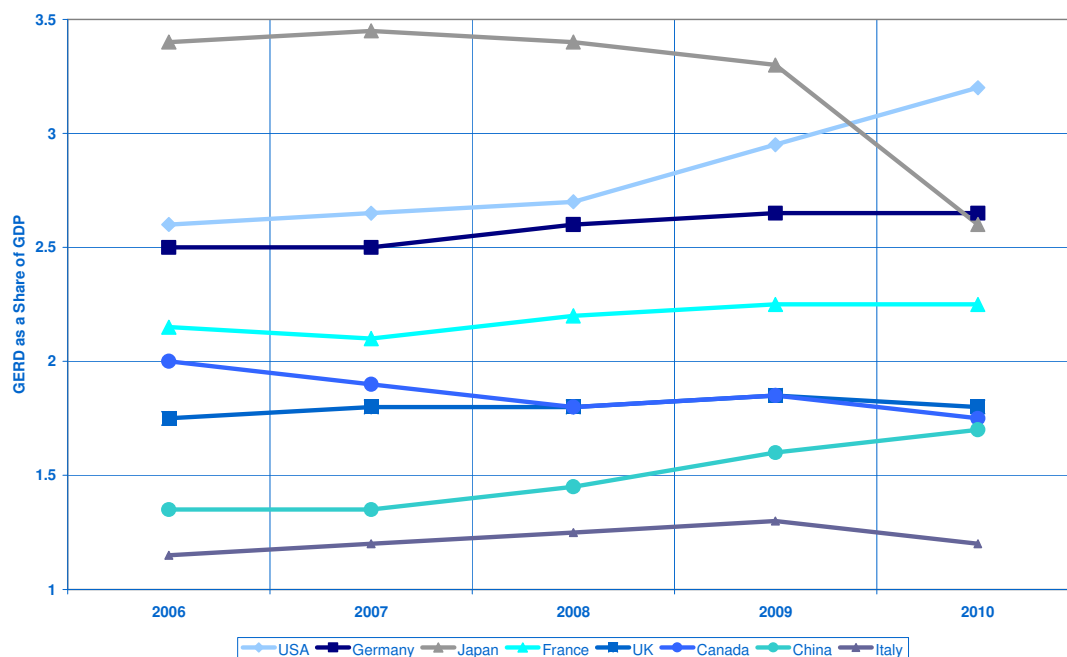


Figure 7.2: R&D intensity (GERD as a share of GDP) for UK and comparators, 2006-2010 (Source: 74)

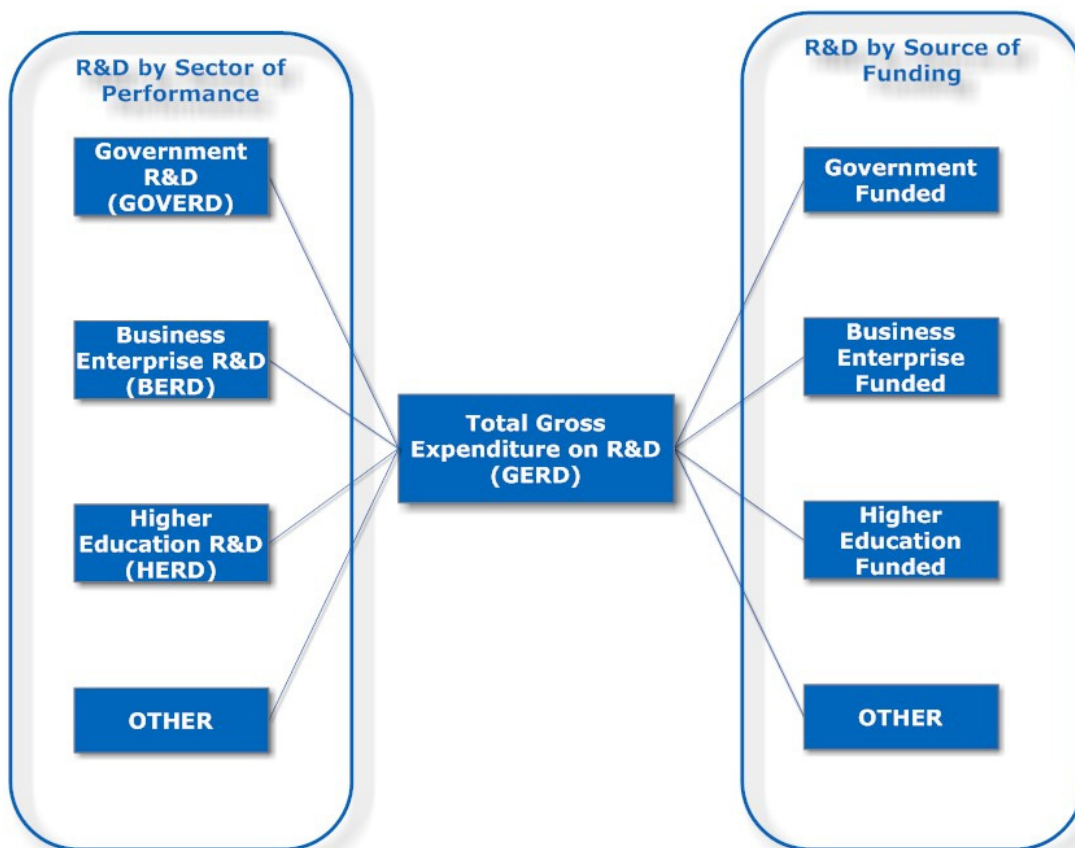


Figure 7.3: The distinction between performing and funding sector in establishing the composition of GERD. (Source: 74)

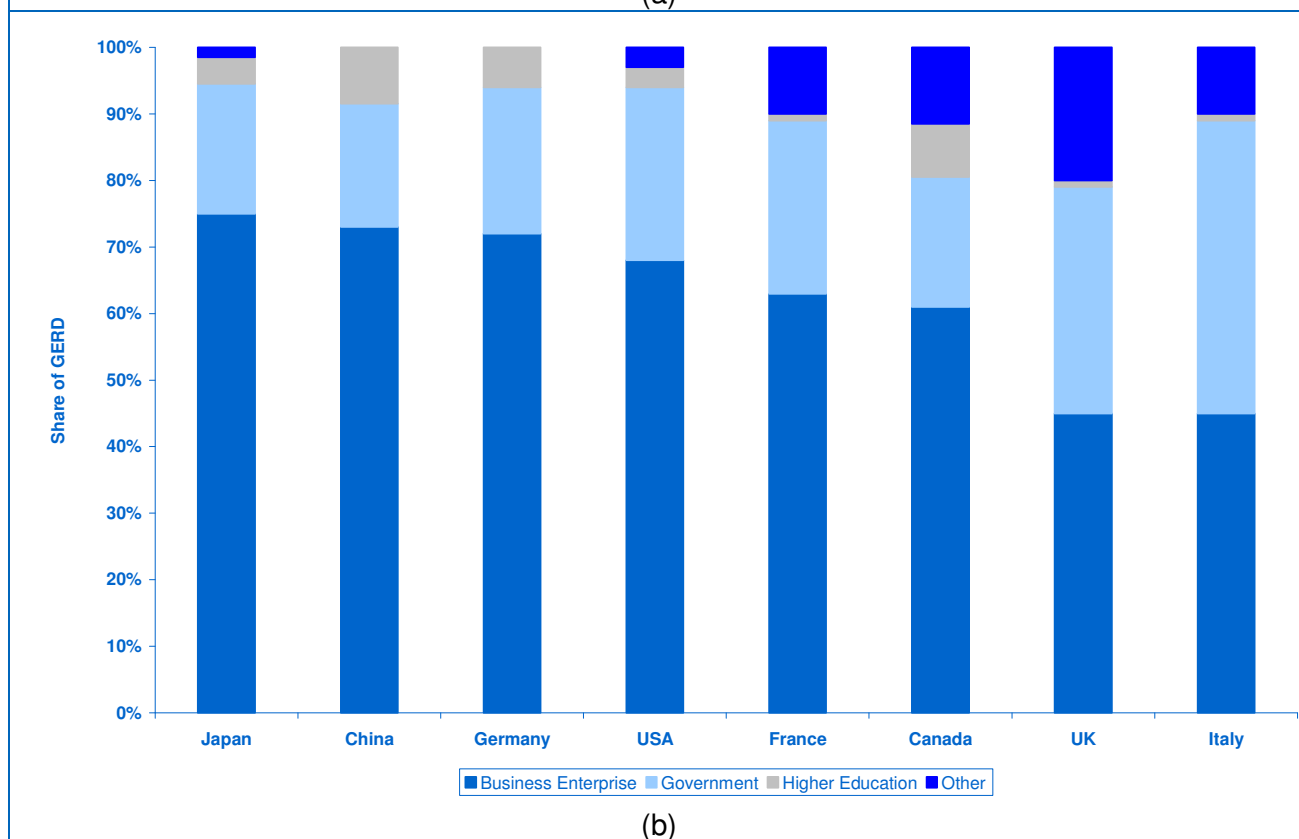
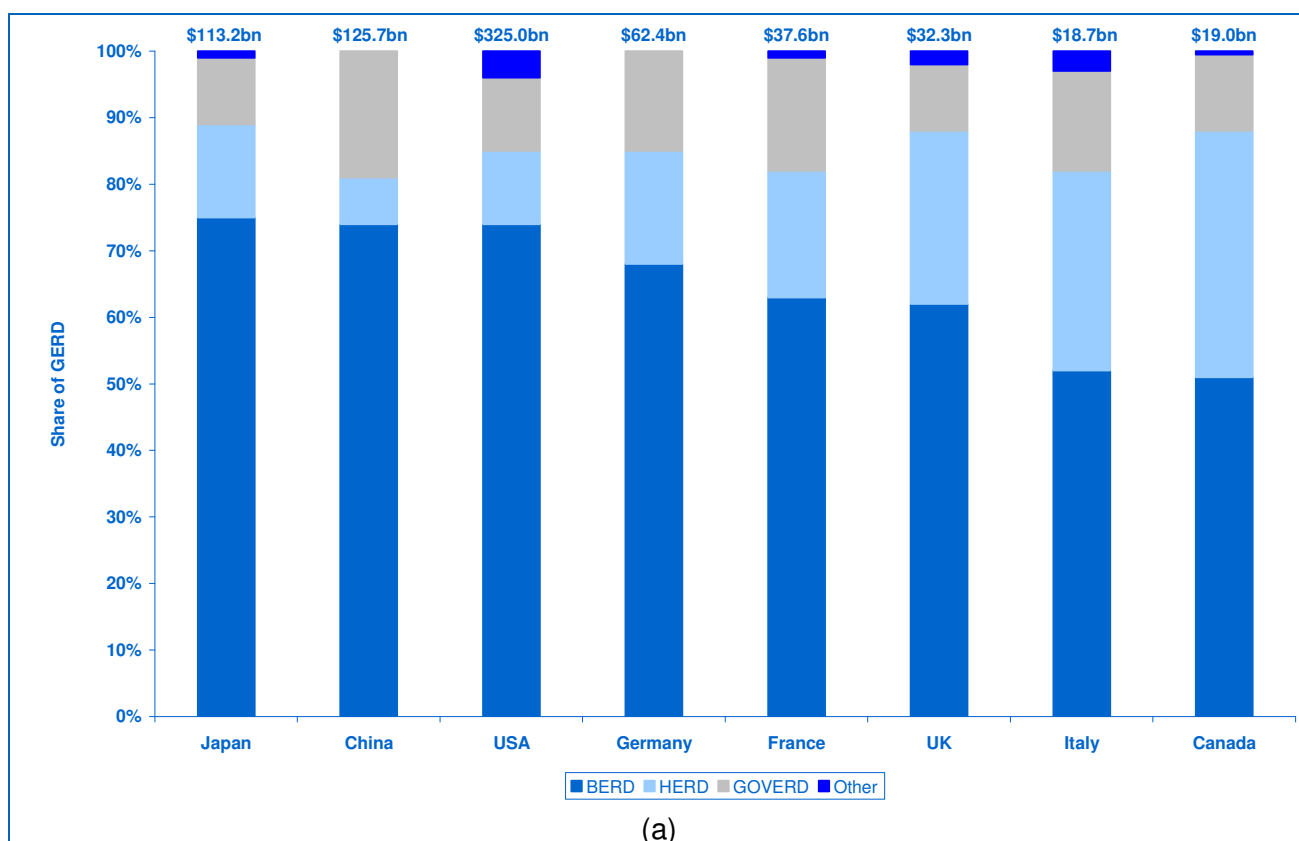


Figure 7.4: (a) R&D by sector of performance for UK and comparators and (b) R&D by source of funds for UK and comparators (Source: 74)

In the UK, sector performance approximates to:

- 60% business enterprise research and development (BERD)
- 30% higher education research and development (HERD)
- and a further 10% Government-funded research and development (GOVERD) and other.

Japan, China, the US and Germany all provide better business sector performance than the UK.

In terms of *sources* of research and development investment, the UK is resourced by:

- 45% business funding
- 30% Government funding
- 2% higher education funding
- 23% other funding sources.

Again, business investment in R&D is higher in Japan, China, Germany and the US than in the UK, which also falls behind France and Canada on this measure. Government funding is relatively even across the other nations, but it is a larger proportion in the UK, Italy and France, with the US following closely.

Of particular interest here, however, is the very small proportion of higher education investment seen in the UK compared with other countries. Canada and China are by far the largest investors on this measure, suggesting that UK universities are less commercially aware, or dependent, than some of their overseas counterparts.

These factors, while not unique to the life sciences industry, affect the business of research and development within it. As a result, the industry seeks ways to maximise on outputs while capitalising on the availability of funding to support their research and development aims.

A report from the ABPI in 2009 showed a large increase in collaborations outside the UK¹⁹. For example, in 2007 only 10% of all postdoctoral research was reported as being in conjunction with institutions overseas; this proportion rose to 25% in 2009, with the majority of research collaborations being within the USA. However, the subsequent ABPI report produced in 2012 shows a stabilisation of overseas collaboration and investment at 20%²⁷.

The pharmaceutical industry, as a global enterprise, will invest where environments are most conducive, including with regard to skills and knowledge availability. As a result, there have been multimillion dollar industry spends in the US, which claims a higher proportion of top 20 global universities than any other country. The Harvard Stem Cell and Immune Disease institutes are prominent examples.

Economic factors also important, and the increased cost of undertaking research within the UK has steered business investment to other countries, particularly in the east. Price Waterhouse Coopers (PWC) reports a number of companies investing in China, Singapore, Indonesia and India, as follows⁴²:

- Wyeth has operations in Beijing, China
- Roche operates in Shanghai, China
- Novartis is building facilities and working with universities and hospitals in Suzhou, Shanghai
- AZ and GSK are also considering bases in China
- Eli Lilly, Novartis and GSK have research centres in Singapore
- Novartis undertakes clinical research in Indonesia
- AZ has a R&D facility in Bangalore, India
- GSK undertakes global drug development with Tata Consultancy Services (software development) in Mumbai.

At present, these international investments are small when compared to expenditure on R&D in the West. Access to basic research is critical for growth in this sector and the West therefore remains the preferred location for investment. However, the West can only retain its current status if it maintains skills levels in its graduates and industry employees.

The UK therefore needs to produce graduates appropriately skilled not only for scientific work in this sector, but also for operating within or with such countries, as their share of R&D and manufacturing activity develops.

7.2 Global University Performance

The UKCES report on strategic skills needs in the biomedical sector ranks a number of universities in terms of global performance, as shown in table 7.1. Oxford and Cambridge are positioned 2nd and 3rd respectively; with Imperial College London appearing in 17th place. The University of Manchester is a key collaborator in the life sciences area, but does not as yet appear in the top 20¹⁵. As noted above, the table is dominated by US institutions, but it also features four Asian universities. Times Higher Education has more recently updated this evidence, and the trends in global performance are presented in table 7.1⁷⁵.

A further reflection of the shifting picture of global research activity can be seen in the statistics for published journal articles. Between 1988 and 2003, the number of articles rose from 466,000 to 699,000. The US share fell from 38% to 30% over this period; the EU share rose from 28.9% to 31.5%; China's output rose by a huge 530% and that of the Asia-8 (South Korea, India, Indonesia, Malaysia, the Philippines, Singapore, Taiwan and Thailand) by 235%, boosting their combined share of the world total from less than 4% in 1988 to 10% in 2003.

Western universities have also come under increasing pressure to commercialise the findings from their scientific research, increasing the cost of access to basic research for industry. Between 2000 and 2004, there was a 70% increase in the number of patents filed by US research institutions. In British universities, there was a three-fold increase in the number of licences and options executed, and a two-fold increase in gross income generated from Intellectual Property (IP).

This generic trend is also evident in the biotechnology sector: between 2000 and 2005, the average cost of an early stage compound increased by a factor of eight. Many biotech companies are securing more favourable rights, in the forms of co-promotion arrangements or other options, suggesting that they are keen to make the transition from pure R&D to commercialisation; they will therefore be looking beyond their traditional R&D skills set towards a wider portfolio of business-related skills.

The UK Government need to consider ways in which business investment in university research and education can be maximised, ensuring greater collaboration is achieved, and the UK becomes a global attractor to industry investment.

Rank	2009 - 2010		2010 - 2011		2011 - 2012	
	School Name	Country	School Name	Country	School Name	Country
1	Harvard University	United States	Massachusetts Institute of Technology (MIT)	United States	Harvard University	United States
2	University of Cambridge	England	Harvard University	United States	Massachusetts Institute of Technology (MIT)	United States
3	University of Oxford	England	Stanford University	United States	University of Cambridge	England
4	University of California, Los Angeles (UCLA)	United States	University of Oxford	England	University of Oxford	England
5	University of California, Berkeley	United States	Yale University	United States	Stanford University	United States
6	John Hopkins University	United States	University of Cambridge	England	University of California, Berkeley	United States
7	University of Tokyo	Japan	University of California, Berkeley	United States	Yale University	United States
8	Massachusetts Institute of Technology (MIT)	United States	John Hopkins University	United States	Princeton University	United States
9	Yale University	United States	Imperial College London	England	Imperial College London	England
10	McGill University	Canada	Princeton University	United States	University of California, Los Angeles (UCLA)	United States
11	University of Toronto	Canada	University College London	England	University College London	England
12	University of California, San Diego	United States	University of California, Los Angeles (UCLA)	United States	University of Chicago	United States
13	University of Melbourne	Australia	Duke University	United States	University of Washington	United States
14	Kyoto University	Japan	University of California, San Diego	United States	Cornell University	United States
15	University of Sydney	Australia	University of Washington	United States	University of British Columbia	Canada
16	University of British Columbia	Canada	University of Michigan	United States	University of California, San Diego	United States
17	Imperial College London	England	Cornell University	United States	Wageningen University and Research Centre	Netherlands
18	University of California, Los Angeles (UCLA)	United States	Columbia University	United States	University of California, Davis	United States
19	Peking University	China	University of British Columbia	Canada	University of Michigan	United States
20	National University of Singapore (NUS)	Singapore	University of Toronto	Canada	University of Wisconsin - Madison	United States

Table 7.1: Top 20 Life Sciences Universities (for years 2009, 2010, 2011) (Sources: 15, 75)

7.3 International PhD Measures

A report from PWC indicates that the number of doctorates awarded in natural sciences and engineering has leveled off or declined in the US, UK and Germany since the late 1990s⁴². Conversely, awards have been rising steadily in Asia. The US still leads the way, accounting for 22.5% of the 50,644 doctorates awarded in physical and biological sciences in 2002. The EU accounted for 37.2% and Asia for 18%. Over the same period, overseas students earned 32.3% of doctoral degrees in physical and biological sciences awarded in the US, 28.5% of those in the UK and 15.7% of those in Germany. Many of these foreign students then returned home to their country of origin upon graduation.

The UK life sciences sector is seeking to recruit experienced graduates and postgraduates, and is increasingly seeking these from overseas, as demonstrated in table 7.2.

There may be various reasons for this recruitment trend, but it suggests that employers find a higher level of appropriate skills in postgraduates from universities outside the UK. The Society of Biology reports some concern that the training that postgraduate students receive in the UK compares unfavourably with research training abroad, where postgraduate training typically takes longer²³. Anecdotal evidence suggests that UK postgraduate students lose out on postdoctoral research positions to overseas applicants due to this relatively short research training.

There are also concerns that the increasing formalities required of postgraduate students, such as upgrades and appraisals, further decreases the time that students spend in the lab.

There is a clear need both to improve the skills levels of UK graduates and postgraduates, and to prepare future life sciences employees for a global market, increasing their mobility and experience in this area⁷⁴. This is shown in figure 7.5.

7.4 Increasing Global Placements

In the context of globalisation of markets, multicultural awareness features strongly in employers' requirements. A survey by the Association of Graduate Recruiters placed a premium on the possession of 'cultural sensitivity', with 75% of multinational companies valuing international study or work experience as an important way of developing employability skills^{76,77}.

Foreign language skills, whilst desirable, are not the principal attraction of such experience to employers; neither is it valued by multinationals alone. Rather, it is seen as an excellent way of developing wider employability competencies such as the ability to adapt to changing situations, understanding cultural difference in the workplace and gaining new knowledge from different experiences.

Research has also shown that one of the key attributes developed by students participating in the European Union's ERASMUS study abroad scheme, and recognised by all stakeholders (students, academics and employers), is an increased level of 'maturity and personal development'⁷⁸.

Likewise, in research by the Institute of Directors⁷⁹, the ability to work collaboratively with teams of people from a range of backgrounds and countries received the highest mean rating from employers, at 8.2 out of 10, far above multilingualism at 1.7 in a ranking of global competencies.

However, despite being the second highest receiver of international students, the UK is ranked 34th worldwide for external mobility. This lack of movement from the UK to other countries is further evidenced by low levels of participation among UK domiciled students in ERASMUS placements overseas: British participation levels are less than half those of France and Germany⁸¹. Nonetheless, research funded by the British Council suggests that UK students have

a strong awareness of the wider world and would describe themselves as having an international outlook, although they do not necessarily recognise the employability benefits of that outlook.⁶⁰

The ERASMUS data further shows that the uptake of these placements is predominantly by language and creative arts and design students. In 2009, for example, no science-based students were reported to have undertaken ERASMUS programmes, as clearly shown in table 7.3¹⁷.

While an increase in uptake of ERASMUS placements by STEM students would be welcome, it will provide only a partial solution: programmes that provide placements beyond Europe are needed to truly address the needs of the life sciences sector. The British Council has a key role to play in the search for solutions to this challenge.

In tandem with moves to increase the supply of STEM-related international placements, we need to help UK students to recognise the importance of the skills acquired through such experience and encourage more of them to study or to take an internship/placement outside the UK.

	Number Recruited	Relevant Experience	Overseas Graduates
School Leavers	151	-	-
Apprentices/Advanced Apprentices	34	-	-
People whose highest qualification is a BSc	355	65%	19%
People whose highest qualification is a MSc	127	86%	30%
People whose highest qualification is a MSci	16	94%	19%
People whose highest qualification is a MChem	17	82%	29%
PhD Graduates	274	75%	31%

Table 7.2: Number of staff recruited with each qualification type in the last 12 months and number of those recruited with relevant work experience or from overseas, or overseas graduates (Source:11,12)

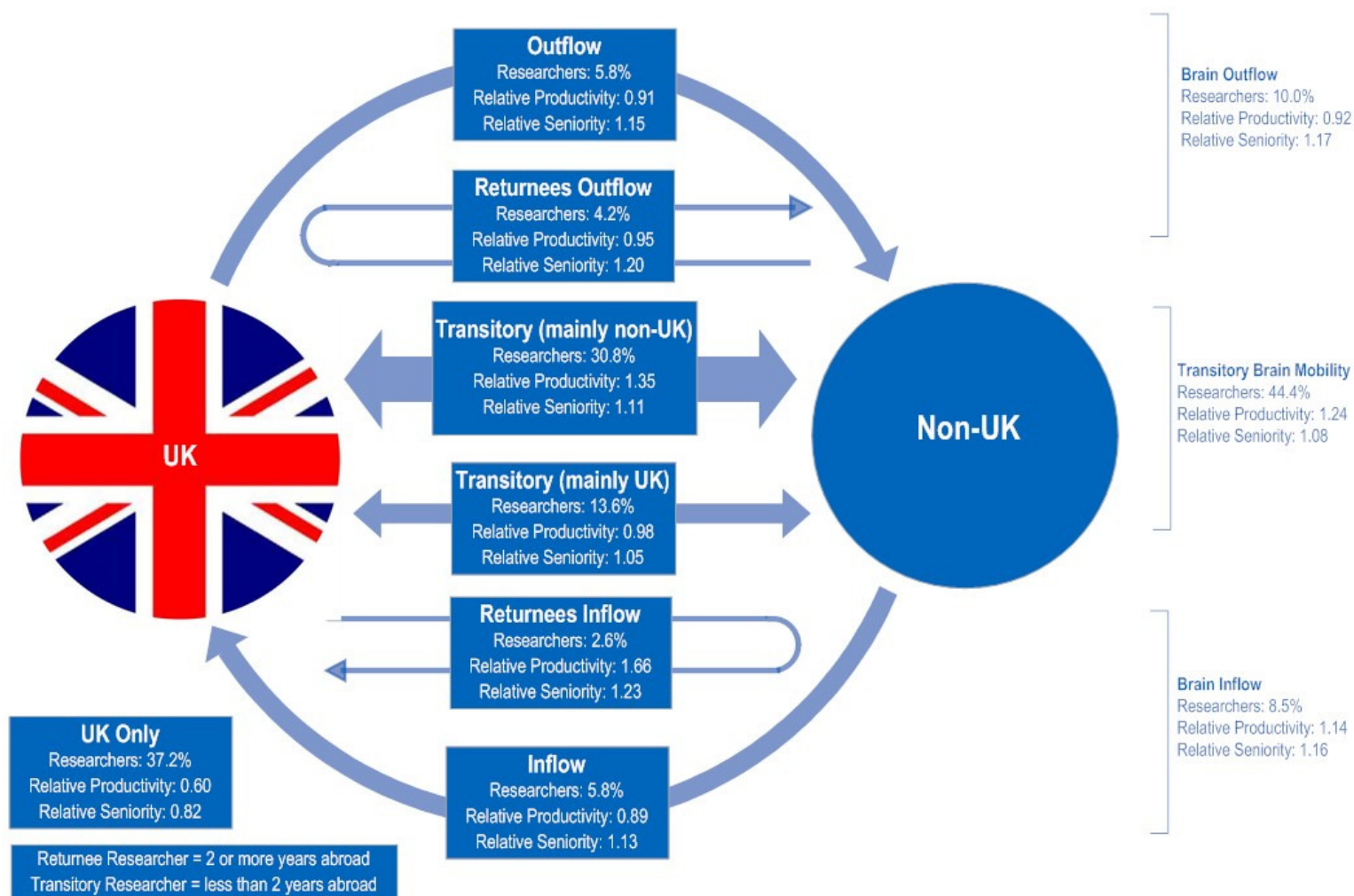


Figure 7.5: International mobility of UK researchers, 1996-2010 (Source: 74)

Subject area of study	Employment outcome six months after qualifying	Sandwich year	ERASMUS Year	No Placement	Total
Biological Sciences	Employment only	54%		57%	57%
	Work and further study	10%		9%	9%
	Unemployed/ Further Study Only	36%		34%	34%
Biological Sciences Total		960		19155	20390
Physical Sciences	Employment only	49%		49%	48%
	Work and further study	6%		6%	6%
	Unemployed/ Further Study Only	45%		45%	45%
Physical Sciences Total		625		8475	9465
Computer Sciences	Employment only	75%		57%	62%
	Work and further study	5%		6%	6%
	Unemployed/ Further Study Only	20%		37%	32%
Computer Sciences Total		1990		5645	7740
Engineering and Technology	Employment only	71%		58%	60%
	Work and further study	7%		6%	6%
	Unemployed/ Further Study Only	22%		37%	34%
Engineering and Technology Total		1880		8110	10305
Architecture, Building & Planning	Employment only	65%		60%	60%
	Work and further study	6%		9%	8%
	Unemployed/ Further Study Only	29%		32%	32%
Architecture, Building & Planning Total		1100		3270	4570
Business & Administrative Studies	Employment only	75%		62%	65%
	Work and further study	12%		9%	10%
	Unemployed/ Further Study Only	13%		29%	25%
Business & Administrative Studies Total		4755		16965	22635
Languages	Employment only	64%	58%	55%	56%
	Work and further study	8%	8%	8%	8%
	Unemployed/ Further Study Only	29%	29%	37%	36%
Languages Total		575	2260	9235	13775
Creative Arts & Design	Employment only	80%		67%	68%
	Work and further study	3%		7%	7%
	Unemployed/ Further Study Only	17%		26%	25%
Creative Arts & Design Total		840		21070	22380
All Subject Areas	Employment only	70%	55%	62%	63%
	Work and further study	9%	8%	8%	8%
	Unemployed/ Further Study Only	22%	37%	30%	29%
All Subject Areas Total		14,545	3,935	171,355	194,815

Table 7.3: Full time first degree qualifiers, by type of placement, subject of study and employment outcome six months after graduation, HESA 2008/9 (Source: 17)

7.5 International Programmes in the Life Sciences Sector

There are already moves within some universities to develop students' skills and employability through international experience. For example, the placement destinations of Bioscience students at Surrey, as part of the University's innovative Professional Training Year, are truly international and significant in number, as illustrated in figure 7.6⁸².

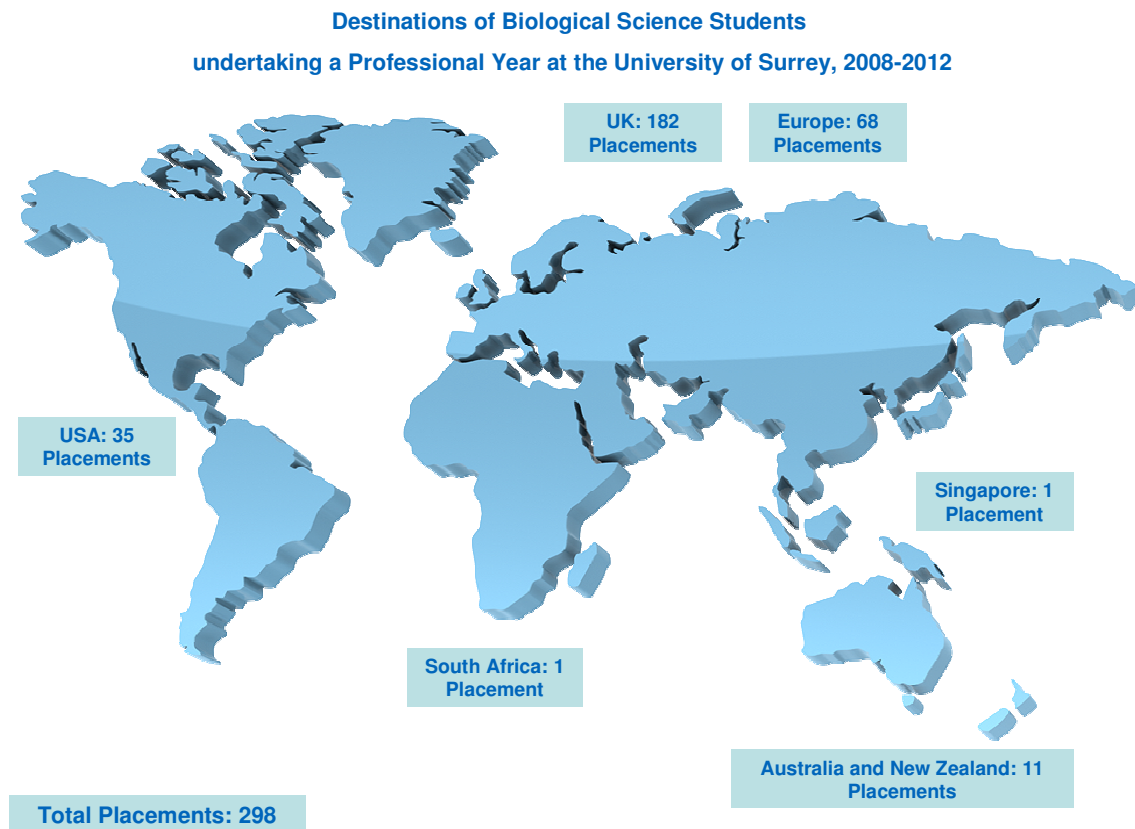


Figure 7.6: Destinations of Biological Science Students undertaking the Professional Year at the University of Surrey, 2008-2012 (Source: 82).

The year in industry has been shown to bring a wide range of benefits⁸², including:

- The delivery of professional experience, including:
 - working with people
 - working to deadlines
 - working under pressure
 - gaining knowledge
- Putting academic studies into context and facilitating the application of knowledge
- Improving a wide range of lab-based and generic employability skills
- Increasing capabilities, developing expertise and capacity
- Helping career decision-making, through identifying strengths, preferences and dislikes
- Increasing networks, including the potential for a work-related reference
- Indirectly improving a student's overall degree grade

Most of all, and as a result of the above, such placements increase participants' employability and enhance their future employment prospects. Depending on the level of remuneration, if any, they may also improve the student's financial status.

It might be expected that a placement beyond the UK will deliver all of the above and more, not only enhancing generic and technical skills but also providing a cross-cultural experience that will set participants in good stead for employment in a global industry.

Students themselves recognise the benefits of this extended industrial experience; they welcome the opportunity to participate, and appreciate the emphasis that the University of Surrey places on this activity.

Industry mirrors this view: in an increasingly global market, the life sciences industry is seeking ways in which to increase the global business and cultural awareness of graduates and postgraduates. There are looking not only to increase the level of UK students participating in industry exchange out of the UK, but also to increase the number of incoming exchanges. It is therefore suggested that such schemes are to be encouraged and facilitated.

7.6 Capitalising on Existing Structures and Initiatives

It is a theme of this report that existing knowledge, experience, best practice and structures should be used wherever possible and appropriate. European Competency Frameworks such as the European Medicines Research Training Network (EMTRAIN) are one such example⁸³. EMTRAIN provides a pan-European platform for education and training covering the whole lifecycle of medicines research. Researchers should be encouraged to participate in order that UK researchers are prepared and mobile within this landscape.

There are a number of sector based approaches to ensure a sustainable route to people movement and collaboration of industry and academia. These approaches maximise resource and effort, but also improve dialogue across academia and industry, and can help inform and influence education and research.

In Scotland, the Scottish Universities Life Sciences Alliance (SULSA) has been organised to deliver a comprehensive package and coordination of funding to help SMEs work on knowledge exchange with researchers across six institutes: Edinburgh, Glasgow, Strathclyde, St Andrews, Dundee and Aberdeen⁸⁴.

This scheme also aids and supports the development of PhDs and People Movement mechanisms, and offers funding support.

In Canada, the Government has invested in the development of Mitacs⁸⁵. This national, not-for-profit research organisation, delivers unique research and training programmes to aid the development of the next generation of innovators with vital scientific and business skills.

In partnership with companies, government and academia, Mitacs coordinates and provides a range of programmes aimed at supporting placements and people movement, offering a single platform for:

- Internships
- STEP Programme
- Elevate for PhD students
- Globalink: undergraduates to be introduced to global R&D
- Enterprise: STEM graduates business and enterprise skills
- Mentoring and Work Based schemes in SMEs

8. Summary: Taking Placements Forward in the Life Sciences Sector

This report covers many topics around the wealth of placement opportunities in this sector and presents extensive evidence on types of placement and associated data. Among the diverse topics covered, some common themes emerge, including the need to improve the practical skills and employability of those entering this sector, to champion the benefits of placements and wider collaboration, and to recognise best practice.

It is clear that there is an ever-increasing appetite and need for placements within this industry in the context of both academic study and research. Yet some key challenges remain; for example, the cost to the employer of providing a placement, and higher undergraduate fee levels, present actual or potential barriers on either side. These critical factors need to be addressed.

8.1 Recommendations to Engage Industry

The UK life sciences industry invests heavily in education and research collaborations, particularly with universities. In recent years, employers have highlighted the difficulty of attracting and recruiting high-quality graduates and highly skilled researchers. A number of reports have expressed shared concerns around recruits' practical and mathematical skills and their ability to apply these in the industrial context, in addition to their subject-specific knowledge⁶.

There are also substantive skills deficits in some core disciplines, many of which are at the heart of translational medicine or are key to the commercialisation of research, including:

- Clinical pharmacology/experimental medicine
- Drug metabolism and ADME
- Pharmacokinetics, pharmacodynamics and modelling
- *In vivo* sciences and supporting animal technologies
- Chemical and process engineering
- Biopharmaceuticals
- Statistics
- Computational chemistry

However, in this period the life sciences sector has changed in both size and shape, with many multifunction sites being rationalised into more focused operational units, and increased outsourcing and collaboration with supply chain companies.

As such, the skills needs of this industry may have become less well defined, with a move away from traditional set job roles to multi-skilling and valuing the diversification of workforce skills. This move has increased the demand for business skills combined with academic skills to allow the UK life sciences sector to compete globally.

As a result employers now prefer to recruit graduates and researchers with experience gained through courses that offer industrial experience, to ensure that these recruits have the desired skills.

Recommendation 1: A platform to discuss the future skills needs of the sector and support greater SME involvement should be facilitated.

Placements are available in the sector and offer a cost-effective way for employers to supplement their skills and knowledge requirements. They can provide extra capacity to deliver projects that

might otherwise require resource from elsewhere in the company. They also provide an opportunity for employers to assess the skills and abilities of a student prior to recruitment. Placement students can also inject new enthusiasm and fresh thinking.

Despite a number of reservations, employers are also beginning to see placements as a way to develop relationships with academia.

Recommendation 2: Case studies that detail good working practice should be produced and used to market the value of placements to industry.

With the increased emphasis on industrial work experience as a route to employability, more universities are seeking to develop links with employers, and competition to secure placements with industry has therefore increased dramatically,

The key challenges facing employers are associated with costs and time, in particular the effort needed to provide supervision for placements and the time and effort to make links with higher education institutions and potential students. Employers may also have difficulty in constructing their provision to meet the specific requirements of placements undertaken as an assessed part of a degree programme.

Recommendation 3: An industry guide should be produced to support companies through the process of devising and delivering a placement, particularly where it is part of an assessed undergraduate year.

Once employers decide to offer placements, they benefit from an increased talent pool, a rigorous process for assessing potential future employees and reduced recruitment costs.

Large pharmaceutical companies are well organised when it comes to offering placements. With larger cohorts, they are able to provide participants with intensive upfront training, and generally prefer to engage with full 'year in industry' schemes, to maximise their potential to assess performance and gain a return on investment.

However, while many employers, particularly small employers, cannot financially resource a full year in industry and therefore prefer to offer shorter placements, they may also find that placements of less than six months' duration bring insufficient return on the upfront training and investment required for the research environment in particular.

Companies that are new to placements often struggle initially and need to be supported.

Universities and employers should think creatively about opening up more "scientific" and "technical" roles as placement opportunities; this would have both recruitment and career learning benefits. In addition, placements in generic support roles should also be encouraged. These opportunities are likely to have wide appeal.

There is a range of existing programmes offering financial support for participants, but these are not widely known.

Recommendation 4: A not-for-profit organisation should be formed to support companies in the delivery of high-quality placements. This organisation should provide assistance in recruitment, management of payroll and human resource functions, and mentoring and training where it is required.

Recommendation 5: Enhanced training prior to placement should be supported for all participants through this organisation.

Recommendation 6: Companies who receive students on full year placements should be able to obtain a tax credit or national insurance contribution freeze proportionate to the salary costs of employing the student.

Recommendation 7: The profile of existing financial support for placements should be raised and employers supported through the application process.

8.2 Recommendations to Engage Higher Education

Universities seek to provide their students and researchers with the education and knowledge relevant to the sector. They want to work with industry to deliver the practical and employability skills required for a long-term career and to increase collaboration for knowledge transfer. They aim to deliver and enhance capacity for employer engagement.

Given the critical skills need in the life sciences sector, work experience embedded into undergraduate and research programmes is increasingly necessary. Through collaboration with industry, there must be the means to sustain and further encourage the delivery of work experience to ensure student and researcher aspirations and university and industry expectations are met. However, there are barriers to increasing placement opportunities and investments are required by both universities and industry to overcome these barriers.

Universities searching for PhD students also tend to recruit graduates with experience gained through courses that offer industrial placements. It has now become commonplace to hear that there are not enough graduates with the right skills to fulfill the employment needs of this sector.

Recommendation 8: The not-for-profit organisation suggested above (Recommendation 4) should support universities to increase collaboration and delivery of high-quality placements with industry partners. This organisation should also provide a commitment from participating companies whilst assisting with financial and administrative support.

However, universities offering high-level experimental courses particularly suited to the research and development sector need to be resourced more appropriately to support practical skills delivery. Enhanced funding for strategically important disciplines such as chemistry, physics and engineering should be extended to include designated biological science courses.

Intensive training of students prior to placement would also be welcomed, particularly for the research and development environment. Training in practical skills should be encouraged alongside complementary 'soft' skills development, including problem-solving, effective communication at work, time management, presentation skills and networking.

Skills gaps relating to business improvement techniques, interdisciplinary collaboration, complex project management and commercial awareness should also be addressed.

Some employers already work with professional training companies to deliver flexible training solutions; this is a good working practice that should be encouraged and rewarded.

Professional accreditation across the sector aims to improve standards, allowing talented candidates to showcase their skills. However, it may not be the only solution. Universities that provide high-quality placements may wish to consider the use of Quality Awards such as those from the National Council for Work Experience (NCWE). Improved visibility of this external validation for prospective students and researchers through Key Information Sets (KIS) would be welcomed.

The value that some universities place on maintaining work experience as a key part of their programmes, and the subsequent enhanced employment prospects that such an experience provides, should be championed.

In addition, there is overwhelming evidence to suggest that when individuals participate in placements, they return highly motivated, more mature, and often attain a higher degree classifications and enhanced career prospects.

Clearly the university has to invest to provide placement opportunities for students: developing and maintaining relationships with employers is time-consuming and is not cost-free. However, although creating new placement destinations requires significant investment, good experiences can lead to repeat placements, at a lower cost, and to further collaboration in other areas of university services.

Recommendation 9: The not-for-profit organisation should support the delivery of placement training, career guidance and open innovation where required, through active collaboration between industry and higher education. Accreditation of training should also be encouraged through a range of stakeholders. Mechanisms to link this work to Key Information Sets (KIS) should be championed.

While new ways of working with industry through open collaboration have been proven beneficial to universities, there can be significant problems with intellectual property (IP) and confidentiality around placements in areas of commercial interest. Students may not always be able to present their work in a manner readily acceptable for assessment and accreditation by the university. In these cases, greater flexibility around confidentiality and legal agreements should be provided in order that placements can be taken forward.

8.3 Recommendations to Engage Students and Graduates

While employers recruiting graduates may use the degree subject as a precondition, they also seek additional characteristics to identify the right candidate for their environment.

In addition, they increasingly seek to employ graduates who have evidence of work experience, and can demonstrate their technical competence, practical/laboratory and analytical skills, and a wide range of employability skills.

As such, what differentiates one recruit different from another is their individual capability, motivation and commitment to the position on offer, and their ability to evidence this.

Data relating to student employment and salary is currently collated just six months after graduation. The data regarding employment outcomes within descriptors of undergraduate courses can therefore be misleading and unhelpful to students faced with a choice of undergraduate courses that seem to meet sector need.

Students will be increasingly seeking high quality placements to meet their needs. This is not just about professional recognition; the use of employer kite marks may also be considered. Quality Awards such as those from the National Council for Work Experience (NCWE) also ensure best practice in placements with employers and universities.

Methods to increase students' awareness of and participation in placements should therefore be considered. Clear messages must be delivered around the value of placements and work experience.

A better and fairer reflection of career pathway and employment would be gained by collecting data at a later point, and noting where work experience was offered as part of a programme. This type of information should supplement the KIS now being provided to prospective students, and would demonstrate the connection between participation in placements and gaining the essential skills to secure a route into employment.

Placements also help with career planning, ensuring that recruits are familiar with and committed to the environment they choose to enter on graduation.

The benefits of placements and internships to the students are manifold, but in summary they are an opportunity to engage in a two way "interview and induction" to the industry.

Placements align student aspirations with the reality of the graduate market, and highlight the importance of considering work in companies across the life sciences sector, particularly in the SMEs and the wider supply chain.

Recommendation 10: The ease with which graduates are able to find and choose a course that provides placement opportunities should be enhanced through the Key Information Sets (KIS) mechanism.

Recommendation 11: Longitudinal analysis of graduate careers, and the value of work experience in this regard, should be presented clearly through KIS.

Students are now faced with increased costs as a result of the new funding system: these include higher tuition fees and interest charges on the student loan during the placement. Students may therefore be reluctant to extend their student debt by undertaking a "year in industry".

Recommendation 12: Students should not suffer financially for taking up a placement. The present regulations permit a tuition fee of up to £4500 for sandwich years. Universities should be encouraged to adopt a lower fee – a guideline fee of £1000 is suggested.

Recommendation 13: The Student Loan Company should suspend interest charges on any existing loan during the period of the placement.

Other factors that act as barriers to participation include the time pressures of application, uncertainty in securing a placement, strong peer-group pressure to opt out, and difficulties in finding a placement close to the university or parents' home. It is in the interests of students, employers and universities that any barriers to uptake are removed.

Work experience also needs to be recorded more formally in order that participating students can demonstrate their skills and employability more readily at the time of recruitment.

Recommendation 14: During the placement, support for the student should be encouraged through a partnership of academic supervision and industry mentoring.

Recommendation 15: Use of the Higher Education Achievement Record (HEAR) to record work experience will allow students to present prospective employers with better information on their skills, progress and attainment. The HEAR also has the potential to increase student self-awareness, a critical characteristic for graduate recruitment.

Ideally, every full-time undergraduate student should have the opportunity to experience at least one structured, university-approved undergraduate placement or internship during their period of study.

Recommendation 16: Graduates should be encouraged to take up internships.

Where such internships are paid, companies should be able to obtain a tax credit proportionate to the salary costs of employing the student.

Where internships are unpaid, universities should use funds arising from their agreements with the Office for Fair Access (OFFA) to support eligible students.

However, recognising the limits of public funding, it is recommended that only companies entering into the graduate internship programme for the first time should be supported by a one-off subsidy; companies and universities should fund repeated graduate internships.

8.4 Recommendations to Engage Researchers

Postgraduate education forms a considerable part of UK Higher Education provision, and unsurprisingly, students' main motivation for undertaking postgraduate study is to improve their employment prospects. Work experience is therefore as crucial for postgraduate students and researchers as for undergraduates and interns.

Work experience contextualises research through practical delivery of skills, often enhancing academic progress, and ultimately employability. Employers also benefit from a period of time to assess the performance of potential future employees, and in the case of research staff, gain fresh insights into cutting edge research and development and knowledge transfer activities.

Research Councils are now focusing on priority research areas and increasing the employability of researchers through a number of programmes.

Although the number of PhD studentships supported by the UK Research Councils has reduced, the resource per individual has increased, and studentships have been extended to four years as standard. This move indicates clear support for “quality over quantity”.

Recommendation 17: Universities and employers should consider providing internships to PhD students to aid the development of skills.

Recommendation 18: Greater awareness of the future skills pipeline through studentships and people exchange mechanisms has been developed by the UK Research Councils: the uptake of these grants should be championed.

All full-time PhD students should have an opportunity to experience at least one 8-12 week internship during their period of study and should be encouraged to attend a short intensive enterprise skills programme alongside other research students.

There is also a need for greater career awareness and guidance, not only among postgraduate students but also postdoctoral researchers.

Recommendation 19: All full-time postdoctoral research staff should have the opportunity to benefit from 8-12 weeks of work experience outside academe. Career guidance should be an integral part of professional development.

8.5 Recommendations to Encourage New Ways of Working

There are emerging models of good working practice across the UK, where universities and industry work together to deliver placements across a consortium.

Consortia models can increase the number of placements available to students in a variety of environments: placements can be in the research laboratory or in manufacturing, but also in roles supporting the business operation. Students may also work as a team to deliver solutions to a business, enhancing project-based learning and teamwork.

These work experience models offer greater flexibility for employers who are unable to offer year-long placements; they maximise benefits and minimise risk of engagement, whilst improving meaningful and consistent commitment to working with academia. Through analysis of the work experience on offer, there is also improved articulation of future industry needs through which academic institutions can learn from and improve provision for future students and researchers.

Consortia models offer employers wider access to administrative and external funding support whilst being more cost effective for the provider and the employer. A single point of contact between universities and industry also aids communication. These models are designed to aid SMEs in particular, and this innovative practice is welcomed.

Boundary-scanning with intelligent brokering to facilitate innovation through collaboration with universities, research funders and business should also be encouraged.

Open innovation projects could provide a valuable resource for the future: such projects should have the capability to network and link companies in relevant sectors to universities seeking collaboration to develop applications for their research, whilst also enhancing people movement.

Recommendation 20: The not-for-profit organisation suggested above (Recommendation 4) should be based on consortia models offering a framework for excellence for open innovation and collaboration, with an emphasis on greater SME engagement.

8.6 Recommendations to Explore Overseas Placements

As the life sciences industry competes on a global scale, we need to raise the importance of the knowledge and skills required to work in this environment.

By promoting these needs and the mechanisms available to support international placement experience, universities, and their students and researchers, will be encouraged to take part in placements outside the UK.

Increasing the uptake of ERASMUS placements by STEM students will only provide a partial solution. Programmes that provide placements beyond the geographical scope of Europe are needed to truly address the needs of this sector. The British Council must be involved in seeking solutions to this requirement.

European Competency Frameworks, such as the European Medicines Research Training Network (EMTRAIN), provide a pan-European platform for education and training covering the whole life-cycle of medicines research. Researchers should be encouraged to participate in order that UK researchers are prepared and mobile within this landscape.

Recommendation 21: Students should be encouraged to take up ERASMUS opportunities; universities and industry should also encourage researchers to participate in professional networks such as EMTRAIN.

Recommendation 22: Overseas placements should be encouraged through an internationally recognised framework of best practice. The Government should facilitate and support this through stakeholders, including the UKTI and the British Council.

8.7 Learning from Other Sector Based Approaches

There are a number of sector-based approaches to ensure a sustainable route to people movement and collaboration of industry and academia. These approaches maximise resource and effort, but also improve dialogue across academia and industry, and can help inform and influence education and research.

In Scotland, the Scottish Universities Life Sciences Alliance (SULSA) has been organised to deliver a comprehensive package and coordination of funding to help SMEs work on knowledge exchange with researchers across six institutes: Edinburgh, Glasgow, Strathclyde, St Andrews, Dundee and Aberdeen.

This scheme also aids and supports the development of PhDs and People Movement mechanisms, and offers funding support.

In Canada, the Government has invested in the development of Mitacs. This national, not-for-profit research organisation, delivers unique research and training programmes to aid the development of the next generation of innovators with vital scientific and business skills.

In partnership with companies, government and academia, Mitacs coordinates and provides a range of programmes aimed at supporting placements and people movement, offering a single platform for:

- Internships
- STEP Programme
- Elevate for PhD students
- Globalink: undergraduates to be introduced to global R&D
- Enterprise: STEM graduates business and enterprise skills
- Mentoring and work-based schemes in SMEs

Recommendation 23: The learning outcomes and support mechanisms offered by successful sector-based approaches should be used to form a national centre of excellence for placements in the life sciences sector. This centre will address the wide ranging collaboration of business, universities and students whilst sustaining and maximising collaborative funding arrangements.

9. A Strategy to Deliver Placements in the Life Sciences Sector

In taking forward placements in the UK life sciences sector, there is agreement that a sector based approach would be welcomed. This would offer business and academia a sustainable method to collaborate, but would also maximise resource and effort across the sector in the long term.

Longitudinal interaction would also help build an improved skills monitoring system, helping to inform and influence the provision and research being undertaken in the academic and industry environment. Improved collaboration would also be achieved.

A number of challenges to uptake of placements could be eased through this sector-based approach.

Firstly, a more formalised audit process across the sector could be achieved. This would provide a more accurate measure of the extent and uptake of opportunities. Adjustment of existing reporting mechanisms could readily provide robust and significant information on the extent and impact of work experience during university.

The formation of an independent not-for-profit organisation to run a clearing house for life sciences placements should be taken forward. This would be national centre of excellence for placements in the life sciences sector.

This organisation would address the recommendations stated above whilst delivering a service to increase placement uptake and considerable benefits to the sector. These would be to support industry, particularly SMEs, to engage and collaborate with academia, to increase awareness and uptake of placements on a cost effective basis, but also to support SMEs to provide quality placements.

The organisation would offer a national training programme to ensure that academics and industry mentors in the life sciences recognise how to support work-based learning and how to prepare students and researchers for industry careers.

The organisation would support participants in their challenge to ease financial burdens through a number of mechanisms:

- Companies who took part in placements would be able to obtain a tax credit or national insurance freeze proportionate to the salary costs.
- Students undertaking placements would challenge universities to adopt a flat tuition fee for the year in industry – a guideline fee of £1000 is suggested.
- In addition, the sector would challenge the Student Loan Company to suspend interest charges on any existing loan during the period of the placement.
- Universities would be challenged to use funds set aside through their agreements with the Office for Fair Access (OFFA) to provide financial support to eligible students wishing to undertake an unpaid undergraduate internship.
- Companies seeking postgraduates, and researchers taking up industrial placements, will be offered support to access grants from the Research Councils and other organisations.

The organisation would arrange a national conference for all life sciences placement participants highlighting the importance of placements and rewarding programmes. For example, an award scheme for best students, best breakthrough inventions, best supervisor, and best learning support would be initiated.

These conferences would also facilitate broader networking across the industry, and provide a focal point for a media campaign, demonstrating the positive impact that placements have on the sector.

Through these mechanisms, the life sciences sector could more readily support skills needs analysis and delivery, ultimately improving education and research. Publication of best practice and case studies would reinforce these developments.

Courses that offer placements, and the funding to support uptake, would be identified more readily, and first point of contact within industry and academia would be readily facilitated.

International profile would also be facilitated through global business partners and other stakeholders including the UKTI and the British Council. Increasing the awareness and availability of international placements would be a key success factor.

Ultimate Goals for the Life Sciences Sector

Although this strategy would formalise placements in the life sciences sector, the formation of a not-for-profit organisation to facilitate and increase placements activity is required to deliver substantive change.

With over 3000 companies in the UK life sciences sector alone, the majority of which being SMEs, the reliance on large pharmaceutical companies to deliver placements is reducing.

If every company in the sector was able to offer a placement of some form, this would improve the skills and mobility of those entering the industry, increase collaboration and innovation whilst easing recruitment from within the UK. If those companies with international reach were also to consider placements outside of the UK, greater UK competitiveness and international exchange may also be achieved.

Successful placements are underpinned by effective and supportive training environments, built on the foundation of strong partnerships between academia, industry and the NHS.

Our ultimate goal is to ensure that senior influencers from all sectors understand the benefits of placements for the individual, the research and the partner organisations.

Consequently the staff and students within these organisations see placements as an integral part of their career progression and continuing professional development - placements would become “mainstreamed” into the life sciences sector career pathways.

10. References

1. Strategy for UK Life Sciences, *The Department for Business, Innovation and Skills*, December 2011
2. Government boost to UK life sciences industry, *The Department for Business, Innovation and Skills*, December 2011
3. Our Hi-Tech Future, *Speech by David Willets, Minister of State for Universities and Science, Policy Exchange, London*, 4th January 2012 (www.bis.gov.uk/news/topstories/2011/Dec/government-boost-to-uk-life-science-industry)
4. A Review of Business-University Collaboration, *Professor Sir Tim Wilson, The Department for Business, Innovation and Skills*, February 2012
5. Life Sciences Blueprint: A Statement from the Office for Life Sciences, *The Department for Business, Innovation and Skills*, July 2009
6. Life Sciences 2010: Delivering the Blueprint, *Office for Life Sciences, The Department for Business, Innovation and Skills*, January 2010
7. Strength & Opportunity: the landscape of medical technology, medical biotechnology and Industrial Biotechnology in the UK (2010), *HM Government*, December 2011
8. Pharmaceuticals and Medical Biotechnology Industry Factsheet, *Cogent*, 2010 (www.cogent-ssc.com/research/Publications/factsheets/Pharmaceuticals_and_Medical_Biotechnology.pdf)
9. Skills for Biomedical Research, *The Association of the British Pharmaceutical Industry (ABPI)*, October 2008
10. Careers Website, *The Association of the British Pharmaceutical Industry (ABPI)* (<http://careers.abpi.org.uk/Pages/default.aspx>)
11. Research Report: Labour Market Survey 2009: Life Sciences, Pharmaceuticals, Biotechnology and Medical Devices, *Semta and Cogent*, March 2010
12. Life Sciences and Pharmaceuticals: A future skills review with recommendations to sustain growth in emerging technologies; *Skills for Health, Semta, Cogent*, March 2010
13. The 2008 R&D Scoreboard: *The Department for Business, Innovation and Skills*, 2008
14. The 2010 R&D Scoreboard: *The Department for Business, Innovation and Skills*, 2010
15. Strategic Skills Needs in the Biomedical Sector: A report for National Strategic Skills Audit for England 2010; Evidence Report 14; *UK Commissions for Employment and Skills*, March 2010
16. Increasing opportunities for high quality higher education work experience: Report to HEFCE, *Oakleigh Consulting and CRAC*, July 2011
17. Work Experience for STEM Students and Graduates: The Science Council, *Robin Mellors-Bourne, Careers Research and Advisory Centre (CRAC)*, April 2011
18. *Stronger Together: Business and Universities in Turbulent Times*, *The Confederation for British Industry*, 2009
19. The Changing Shape of Academic Collaborations, *The Association of the British Pharmaceutical Industry (ABPI)*, August 2010
20. Sustaining the Skills Pipeline in the Pharmaceutical and Biopharmaceutical Industries, *The Association of the British Pharmaceutical Industry (ABPI)*, November 2005

21. In vivo sciences in the UK: sustaining the supply of skills in the 21st century, *The Association of the British Pharmaceutical Industry (ABPI)*, September 2007
22. The Chemical Skills Pipeline, *The Royal Society of Chemistry*, 2009
23. Higher Education in STEM Subjects: A response from the Society of Biology to the House of Lords Science and Technology Sub-Committee 1, *The Society of Biology*, December 2011
24. Ready to Grow: Business Priorities for Education and Skills; Education and Skills Survey, *The Confederation for British Industry*, 2010
25. Degrees of Skill: Student Employability Profiles, *Council for Industry and Higher Education (CIHE)*, September 2006
26. A career development perspective on UK researcher-business interactions, *Vitae, Research Councils UK and the Careers Research & Advisory Centre (CRAC) Ltd*, March 2012
27. Enriching Research, Training Scientists: Results of the ABPI 2011 survey of partnership working between the pharmaceutical industry and the university sector, *The Association of the British Pharmaceutical Industry (ABPI)*, 2012
28. Skills Oracle, *Cogent*, 2011
29. Hidden wealth: The contribution of science to service sector innovation, *The Royal Society*, July 2009
30. Demand for Science, Technology, Engineering and Mathematics (STEM) Skills, *The Department for Innovation, Universities and Skills*, January 2009
31. Technically Higher: Securing Skills for Science and Innovation, *Caroline D Sudworth, Cogent*, December 2009
32. South East Universities Biopharma Skills Consortium Project, *University of Reading*, March 2010
33. The National Council for Work Experience (NCWE): www.work-experience.org/
34. STEP Programme: www.step.org.uk
35. EDT Year in Industry Initiative (YINI): www.etrust.org.uk/year_in_industry.cfm
36. Higher Ambitions: The Future of Universities in a Knowledge Economy, *The Department for Business, Innovation and Skills*, November 2009
37. Graduate Talent Pool: http://graduatetalentpool.direct.gov.uk/cms/ShowPage/Home_page/plcacaefg
38. Graduate identity and employability, *Hinchcliffe and Jolly, British Educational Research Journal*, Volume 37, Number 4, 1 August 2011
39. Learning through Graduates: The Reading-Surrey Biopharma Skills Internship Project, *Rachel Stewart and Sofie Verzytbergen, University of Reading*, July 2011
40. Developing graduate skills for the UK's commercial life sciences sector: Experiences from the Overcoming Recession: Bioscience Investment in Skills (ORBIS) Internship programme, *James Gazzard, Journal of Commercial Biotechnology*, Vol 17(2), 135-150, 2011
41. Gateways to the Professions Collaborative Forum: Common Best Practice Code for High Quality Internships, *Trades Union Congress on behalf of the Gateways to the Professions Collaborative Forum*, July 2011
42. Pharma 2020: The Vision, Which path will you take?, *Price Waterhouse Coopers*, 2007

43. HEA Postgraduate Taught Experience Survey (PTES), *Higher Education Academy*, 2011
44. One Step Beyond: Making the Most of postgraduate education, *The Department for Business, Innovation and Skills*, March 2010
45. Leitch Review of Skills: Prosperity for all in the Global Economy – World Class Skills, 2006
46. Higher Education Facts and Figures, *Universities UK*, 2009
47. Higher Degrees of Freedom: The value of postgraduate study, *Institute of Employment Studies, Brighton*, 2004
48. A Theoretical Review of Skills Shortages and Skill Need, *The UK Commission for Employment and Skills*, 2010
49. What do PhDs do? – Trends, *The UK Grad Programme*, 2007
50. The Scientific Century: securing our future prosperity, *The Royal Society*, 2010
51. Postgraduate Research Experience Survey, *The Higher Education Academy*, 2009
52. What do Researchers do? Career Paths of doctoral graduates, *Vitae*, 2011
53. EPSRC funding for Enterprise and Entrepreneurship transferable skills training for researchers, *RCUK*, 2009
54. Evaluation of Biotechnology YES: Final Report, *BBSRC*, July 2010
www.bbsrc.ac.uk/web/FILES/Reviews/1007-biotechnology-yes-review.pdf
55. Review of Progress implementing the recommendations of Sir Gareth Roberts, regarding employability and career development of PhD students and research staff, *RCUK*, October 2010
56. Talent Fishing: What businesses want from postgraduates, *CIHE*, 2010
57. KTP Scheme: www.ktponline.org.uk
58. KTP Smith Institute: <http://www.smithinst.co.uk/>
59. MRC Website: www.mrc.ac.uk
60. Evaluation of BBSRC Evaluation of the BBSRC Quota Doctoral Training Grant Competition, *BBSRC*, March 2011
61. EPSRC Website: www.epsrc.ac.uk
62. Report of a Review of the Engineering Doctorate Centres, *EPSRC*, March 2007
www.epsrc.ac.uk/SiteCollectionDocuments/Publications/reports/EngDReviewReport.pdf
63. BBSRC Website: www.bbsrc.ac.uk
64. EPSRC DTCs: www.epsrc.ac.uk/funding/students/centres/Pages/default.aspx
65. EPSRC Employers: www.epsrc.ac.uk/funding/grants/business/Pages/default.aspx
66. BBSRC DTPs: www.bbsrc.ac.uk/funding/studentships/doctoral-training-partnerships.aspx
67. BBSRC PIPS: www.bbsrc.ac.uk/web/FILES/Guidelines/dtp-faqs.pdf (page 18)
68. Careers in Research Online Survey (CROS): Analysis of UK aggregated results, *Vitae*, 2001
69. BBSRC FLIP: www.bbsrc.ac.uk/business/people-information/people-information-index.aspx
70. HEBCI, Higher Education Statistics Agency, 2009/10
71. University-Industry Relationships and Open Innovations: Towards a Research Agenda, *International Journal of Management Reviews*, 2007
72. Open Innovation, *H Chesborough, Harvard Business School Press*, 2003
73. Valuing Knowledge Exchange, *Report for CIHE*, 2009

74. *International Comparative Performance of the UK Research Base – 2011; A report prepared for the Department of Business, Innovation and Skills.*
75. Times Higher Education: www.timeshighereducation.co.uk/
76. Graduate Recruitment Survey 2008: Summer Review, *Association of Graduate Recruiters*, 2008
77. How employers value an international study experience, *QS Global Employer Survey*, 2011
78. The Professional Value of ERASMUS mobility, *INCHER*, 2006
79. Graduates Employability Skills, *Institute of Directors Skills Briefing*, December 2007
80. Global Graduates into Global Leaders, *AGR and CIHE*, 2011
81. University of Surrey Professional Year: www.surrey.ac.uk/professionaltraining/
82. EMTRAIN: www.emtrain.eu
83. SULSA: www.sulsa.ac.uk
84. Mitacs: www.mitacs.ca/

11. List of Acronyms

ABPI	The Association for the British Pharmaceutical Industry
AZ	Astra Zeneca
BBSRC	Biotechnology and Biological Science Research Council
BERD	Business Enterprise Research and Development
BIA	BioIndustry Association
BIS	Department for Business, Innovation and Skills
BSc	Bachelor of Science
CBI	Confederation of British Industry
CPD	Continuing Professional Development
CRAC	Careers Research and Advisory Centre
CRO	Contract Research Organisation
DHLE	Destinations of Leavers from Higher Education
DTC/P	Doctoral Training Centre/Partnership
ECIF	Economic Challenge Investment Fund
EDT YINI	Engineering Development Trust Year In Industry
EMTRAIN	European Medicines Research Training Network
EngD	Engineering Doctorate
EPSRC	Engineering and Physical Sciences Research Council
ERASMUS	European Community Action Scheme for the Mobility of University Students
FLIP	Flexible Interchange Programme
GERD	Total Gross Expenditure on Research and Development
GOVERD	Government Research and Development
GSK	GlaxoSmithKline
GVA	Gross Value Added
HE (I)	Higher Education (Institution)
HEAR	Higher Education Achievement Record
HEFCE	Higher Education Funding Council for England
HERD	Higher Education Research and Development
HESA	Higher Education Statistics Agency
IP	Intellectual Property
IT	Information Technology
KIS	Key Information Sets
KTP	Knowledge Transfer Partnership
LBIC	London Bioscience Innovation Centre
LFS	Labour Force Survey
MChem	Master of Chemistry
MICA	MRC Industry Collaboration Agreement
MPhil	Master of Philosophy
MRC	Medical Research Council
MSc/MSci	Master of Science
NCWE	National Council for Work Experience
NERC	Natural Environment Research Council
NESS	National Employer Skills Survey
NGO	Non Government Organisation
NHS	National Health Service
OFFA	Office for Fair Access
OLS	Office for Life Sciences
ORBIS	Overcoming Recession: Bioscience Investment in Skills
PhD	Doctor of Philosophy
PIPS	Professional Internships for PhD Students
PRES	Postgraduate Research Experience Survey
PWC	Price Waterhouse Coopers
R&D	Research and Development
RCUK	Research Councils UK
REF	Research Excellence Framework
RSC	Royal Society of Chemistry

RVC	Royal Veterinary College
SIC	Standard Industrial Classification
SME	Small Medium Enterprise
SSC	Sector Skills Council
STEM	Science, Technology, Engineering and Mathematics
STEP	Shell Sponsored STEP Placement Programme
SULSA	Scottish Universities Life Sciences Alliance
THE	Times Higher Education
TSB	Technology Strategy Board
UKCES	UK Commission for Employment and Skills
UKIERI	UK India Education and Research Initiative
UKTI	UK Trade and Investment
WOW	World of Work
YES	Biotechnology Young Entrepreneurs Scheme

12. Appendices

12.1 Placements Working Group Terms of Reference

The Placements Working Group has been established to facilitate active discussion between employers and education providers seeking the delivery of solutions to aid an increase in placements of various forms across the life sciences sector.

The Working Group will be chaired initially by Malcolm Skingle of GSK. The Placements Working Group will run for 6 months (with a review close to the end of this period) to take stock on future purpose and remit. It will meet every three weeks during this 6 month period. The secretariat will be provided by Cogent.

During this period, the working group will discuss and prepare a summary report for the Life Sciences Advisory Committee, highlighting key issues and best practice and recommending solutions to placements within the sector.

For reference, placements are defined as:

- Undergraduate placements (short to year in industry/research facilities)
- Internships
- Postgraduate placements (including CASE-type studentships)
- Placement exchange between industry and higher education institutions

The Group will consider existing good practice through these placement models, investigate incentives for future placements, map and co-ordinate information about placements, inform the benefits of placements to all parties, determine and provide solutions barriers to entry, and investigate the specific needs of the SME community.

The Group will also provide a forum to develop ONE VOICE on placements in the life sciences industry, whilst determining the future skills that businesses need, and developing a collaborative approach to meet the challenges facing employers and education providers. This work will be used to inform and be co-ordinated with the work of the Future Skills working group.

The Group will provide commentary and support for Cogent's bids to the future Growth Innovation Funds. With the shared ambition of raising standards and sharing best practice with others, avenues such as accreditation, kite marking and graduate employability will be considered in order to raise work experience opportunities.

The Group will also consider recommendations and responses to policy that affect work experience opportunities through universities, and address the specific impact of student fees on placements. This will also be coordinated through responses to the review being undertaken by Sir Tim Wilson.

The Group will consider datasets that offer an opportunity to monitor and measure placements, and their impact.

The working group will prepare a summary report for the Life Sciences Advisory Committee in February 2012, and agree recommendations for policy guidance for placements in the life sciences sector.

12.2 ORBIS Case Studies

Biocaldol and Jayannie Meinerikandathevan Case Study

Biocaldol Ltd is a young SME company specialising in developing turnkey solutions designed to transform the agro-industry. These solutions comprise proprietary, environmentally-friendly micro-organisms, custom-made process design and engineering for the production of second-generation biofuels, animal feed and other biomass-derived products. The attraction of an ORBIS intern for Biocaldol's Research and Development Director, Muhammad Javed, was that he could choose from a wide range of candidates who matched their requirements and the intern was paid through the programme keeping the cost to Biocaldol very low. Biocaldol were not necessarily looking for an intern but they did need a new member of staff – ORBIS enabled them to work with someone for 26 weeks to find out their abilities and how they fitted with the team.

Muhammad selected Jayannie Meinerikandathevan, a masters graduate. Jayannie had found it difficult to find a job as employers wanted someone with experience and she had very limited knowledge of working in a commercial bioscience sector company. To participate in ORBIS she did not need much work experience and she found the intern interview with Biocaldol less formal and stressful than a job interview. As Jayannie says, "The ORBIS internship seemed like a good way to try and get some experience."

Whilst at Biocaldol Jayannie has worked on medium scale sterilisation techniques within their laboratory. She has been trained on more advanced laboratory skills such as analytical techniques by Biocaldol and has recently been given more challenging work so that she can enhance her skills further. Initially she worked with senior colleagues but Jayannie was able to learn things fast and became comfortable with the procedures so she started to work independently fairly quickly. Apart from the benchwork Jayannie has conducted risk assessments and completed essential regulatory paperwork such as COSHH (control of substances hazardous to health) and SOP (standard operating procedures) forms. She has done this without needing any help from her colleagues, which has been valuable to Biocaldol. Jayannie is enjoying the lab experience she is gaining. Working with analytical equipment is something she has always wanted to do and she feels that she is being trained up very well. She knows she can always ask for guidance if she needs it.

Through the ORBIS programme Jayannie has received 12 days of bio-business training alongside her internship at Biocaldol. This has included training in goal setting and self awareness in the workplace, making meetings work, presentation skills, lean six sigma, influencing and networking skills, intellectual property, and teamworking. Jayannie has never had this kind of training before and she feels that the meeting, presentation and networking skills have particularly helped her to find out how best she should compose herself for different workplace situations.

Both Muhammad and Jayannie would recommend the ORBIS programme to other companies and potential interns. Jayannie recently recommended one of her friends for BRIO, another internship scheme run by the Royal Veterinary College and London Bioscience Innovation Centre, and her friend has been selected as an intern to work on a research project. Muhammad feels that this programme offers a lot through the funding and the ability to find an intern that closely matches their needs. He also thinks that the ORBIS training is very good. He came to some of the training days available for company staff and the mentoring session in particular gave him many benefits. He believes that it is useful to take an intern on knowing that there is no obligation once the placement has ended and he would have taken another one on through ORBIS if he needed to. However, Jayannie has proved herself to be such a valuable member of Biocaldol's team they have offered her a permanent position with them, which she has accepted. She is delighted to be working with great colleagues doing work that she has always wanted to do.

ORBIS INTERN CASE STUDY

Your Name: Nick Sawers

Which company was your internship at: The London Bioscience Innovation Centre

What were the reasons you wanted to participate in ORBIS?

I wanted to have a career in the business side of science. ORBIS provided a great chance to develop my business skills in an industry that I am interested in. The 12 days of business training and mentor schemes really attracted me to this programme as well as a chance to network with experts in the bioscience industry. The length of the internship was also key for me, 6 months allows you to really get involved and get responsibilities.

What did you do as an intern?

I have several responsibilities including energy management, operations assistance, financial invoicing, marketing and sales. The role involves a lot of face-to-face client interface where my skills have developed a lot. My key role is energy manager where I have written environmental policies, implemented energy saving ideas and worked alongside government agencies such as the Carbon Trust. We are a service-based company so I have lots of involvement with our clients and service providers, troubleshooting and general operations of the building. Being a part of the business development team has also allowed me to get involved in lab supplier days and market research analysis.

What skills/experience have you gained through your placement and the training?

I believe that I have gained great confidence in my own ability. I have been given a high level of responsibility which has really helped develop my organisation and time management skills. The business training sessions like "How To Network" and "Myers Briggs" gave me some great impetus to meet people and network across the bioscience sector. I believe that the ORBIS training programme is the stand out part of my CV and I am very proud of it.

Has the internship led to further opportunities? If so, please describe them.

Not yet, I am hoping to continue my placement here at the London Bioscience Sector or even get a job in the energy/biofuels sector, this has really interested me.

Would you recommend participating in a scheme like this to others? If so, why?

I would definitely recommend this scheme to others just graduating or looking to get into the bioscience sector. It has been such a learning curve for me and a great chance for me to develop myself and my career. The chance to meet up with other interns from other companies has also been a great social part of the programme.

ORBIS INTERN CASE STUDY

Your Name: Matthew Collis

Which company was your internship at: Dechra Pharmaceuticals PLC

What were the reasons you wanted to participate in ORBIS?

After graduating from university in 2008 and taking temporary roles with various companies I decided it was time to do something that would benefit me and help me stand out from other graduates. The ORBIS project looked like a great opportunity to gain valuable work experience with a top bioscience company and also receive training from various experts in areas that many graduates lack when leaving university.

What did you do as an intern?

I was working in the regulatory department and was given the task of dealing with a Clinical trial that had been conducted in Germany. My role was varied and had me translating the entire study from German to English with the help of external translators; liaising with colleagues based in Germany and bio statisticians in the US as well as auditing the clinical trial database. I have written three reports based on the findings of the clinical study which will be submitted to the FDA in America for approval on completion of work which is being done in parallel.

What skills/experience have you gained through your placement and the training?

My internship taught me a lot of new skills; writing a report which is going to be scrutinised by the likes of the FDA was a daunting task at first, but with the help of my boss I have managed it. The training days have been brilliant; meeting up with the other interns was always a fun occasion and we covered some very interesting topics. I learnt a lot from the networking and powers of persuasion sessions but the most helpful session was on Presentations skills; it really made you think about how you present yourself to others in situations like job interviews; that sort of information is invaluable.

Has the internship led to further opportunities? If so, please describe them.

Unfortunately I haven't been offered a contract extension or a job like several of the other interns but I am not disheartened by this as the skills I have learnt whilst partaking in the ORBIS project now stand me in a far better position to go and gain employment elsewhere; the experience has been nothing other than positive.

Would you recommend participating in a scheme like this to others? If so, why?

The ORBIS project has helped me no end; I have had to completely rework my C.V. to make space for all the training and new skills I have learnt, which can only be a good thing. I would certainly recommend this scheme and ones like it to anyone looking for a helping hand in the bioscience sector; the opportunity to undertake an internship whilst receiving really beneficial training is definitely priceless.

ORBIS INTERN CASE STUDY

Your Name: Faith Wong

Which company was your internship at: GlaxoSmithKline Research & Development

What did you do as an intern?

During my time at GSK, I was responsible for investigating one of the latest models of a Mid-InfraRed Spectrometer and to determine whether it was possible to develop a quantitative method for it. Basically what I had to do was to design the experiments, acquiring data, carrying out data processing using specific software, discuss the results with my supervisor to draw conclusions and decide if further investigations had to be taken.

Other than my own responsibilities, my supervisor allowed me to shadow him on his projects so I could understand more about the flow of the real-time projects. I was also invited to all the group meetings including one global PAT (process analytical technology) group meeting and a few other joint meetings with the PAT group of the other UK sites. From these meetings I learnt more about their responsibilities and how they interact with each other working on the same projects remotely.

What skills/experience have you gained through your placement and training

The Credit Crunch happened just a few months before I graduated and the economy was quite bad which made getting a job harder than I, and most of my course mates, expected. The ORBIS (*Overcome Recession: Bioscience Investment in Skills*) bio-business skills training programme provided me with a chance to learn and earn. Although I was passionate in learning new things, the business training still sounded a bit boring. However, we interns became friends via some interacting activities and then it all became fun! A group of friends attending training together, going for drinks when training finished and getting paid as a normal working day, how joyful that is!

Over the last six months, I had a wonderful experience at GSK and received training sessions which taught me useful practical skills such as networking, persuasion and how to make the most out of meetings. The mentor-mentee relationship that we had to set up with a supervisor of another intern should also be mentioned. It was such an advantage for us to have another professional (not our supervisor) advise on our behaviour as well as challenging our ambitions and guiding us towards our goals. I share a lot with my mentor and so does she. Instead of a mentor-mentee relationship, it is more like a friendship now and we are definitely going to keep in contact even though this programme will be finished soon.

Would you recommend an internship to others?

Indeed, I have already told some of my friends and two of them have already applied to this ORBIS programme in January 2010. The reason that this programme is highly recommended is not just because of the work experience, but the business training received. After these six months, I am sure other ORBIS interns must be feeling the same like I do - more competitive.

If you are not sure about where you want to place yourself at for the next few years time - while you want to learn more and develop some useful skills, I think ORBIS is the programme you are looking for.

ORBIS BioScience Graduate Internships: Growth for Costello Medical

Costello Medical Consulting is a young SME providing specialised market access and medical communication services to the pharmaceutical industry.

For Richard Short, Director of Finance and Operations at Costello Medical, the attraction of the Royal Veterinary College's 26 week ORBIS Bioscience Graduate Training Programme was the opportunity to be able to add a high-calibre member of staff to the team at an early stage in the growth of the company, without having to commit to a permanent staff member on a full-time salary. Costello Medical needed to focus on business development during the first half of 2010, and they could see immediately that the wide remit of the ORBIS internship would enable them to do this. They found the application process wonderfully quick and efficient: knowing at an early stage that they had been selected to host an intern made the time and expense involved in the recruitment process worthwhile.

After interviewing a few of the candidates that matched their requirements Costello Medical selected Nia Hamer as their intern. Upon graduating from university with a biology degree, Nia knew she wanted to have a career in the bioscience sector but she was relatively undecided as to the exact role she wanted to pursue. She liked the idea that ORBIS could match her with an internship in a company or area that she might not have considered before – and she realised that in the difficult economic climate, any workplace experience within the sector would provide her with the skills and commercial awareness that would be desirable to potential future employers. After graduating Nia had moved back home to Shropshire but she knew she needed to look further afield for internships or work experience – an unpaid position was not a viable option financially. The fact that ORBIS provided enough income to live on during the period of the internship was a key reason for applying to the scheme, as was the 6-month duration of the placement. Nia felt that, compared to a shorter period of work experience, 6 months was sufficiently long to gain a real taste of working life, would enable her to gain confidence in her abilities and allow her to contribute to the host company in a meaningful way. Compared to an independently acquired internship, Nia thought that the training days offered by the ORBIS programme alongside the internship sounded really useful, and she knew she could go to the ORBIS organisers or her scheme mentor for help and advice if necessary. Nia was glad she was interviewed for her internship, as she wanted to practice her interview skills and she was grateful for the opportunity to learn a bit more about Costello Medical.

Costello Medical found ORBIS flexible in that they were able to define the internship project and get their intern involved in day-to-day project work for clients. During Nia's internship she researched the product pipelines and company information of pharmaceutical companies considered to be potential clients. Nia built up a valuable database which has been regularly used by senior staff to support Costello Medical's communication with potential clients and as a reference tool to review information about a client company or their products. During Nia's internship, Costello Medical were asked to submit numerous project proposals which often had to be produced under severe time constraints. Nia's database work put her in an ideal position to provide research support to these proposals and they were much improved as a result. In addition, Nia worked directly on projects for clients where she demonstrated an impressive aptitude for handling difficult scientific concepts involving clinical and economic aspects of healthcare. She worked on value dossiers, educational materials for use by pharma



companies to provide up-to-date information about pipeline products in development and those already on the market, and communication material for data presented at international conferences. Nia has also been involved in recruiting new people to join the team. She has participated in interviews and contributed to the decisions made about who to recruit. This experience has been really useful for Nia as it highlighted what to do - and what *not* to do - in an interview situation, as well as what potential employers like to see in a CV/cover letter.

Costello Medical did not expect to find someone so well qualified. Nia has a very good degree and stellar references. She also possesses an exceptional work ethic, a good sense of humour and a collaborative nature, all of which have gone down well in the team. Costello Medical were surprised that her business development work was so extraordinarily successful. The most dramatic outcome was the acceptance by a subsidiary of Johnson & Johnson of four project proposals to which Nia had contributed vital background research. Richard Short explains that "For a small and growing company, it is difficult to overstate the impact of winning a client of that calibre at this early stage."

Throughout the internship Nia has learned not only from her company supervisor and colleagues but also from her fellow interns that she met at training days. Nia acquired a whole host of skills from her placement and the training including how to present herself professionally, communication skills within the workplace, and an ability to work effectively with different personality types. She believes that the training provided lots of good practical advice applicable to a future career – such as performing well at an assessment centre/interview, planning effective meetings, minimising inefficiencies in a business and communicating well with a range of different people. One of the most helpful aspects of ORBIS was the feedback that interns were encouraged to get on their performances both at work and during training exercises. Nia has learned that getting constructive feedback and acting upon it is one of the best ways to improve. ORBIS has greatly boosted Nia's recognition of what she has to offer an employer and she has been surprised to realise that she is more capable and confident than she thought.

Nia feels that an ORBIS internship provides a great opportunity to experience work in a commercial bioscience environment, to learn about yourself, what you want from a career and what types of career are available in the sector. She was pleasantly surprised by how good a match Costello Medical is to what she, unknowingly, had been looking for all along – both in terms of the work, and the size and style of the company. Before ORBIS she hadn't realised that such a company existed!

Nia met and surpassed all of the goals that Costello Medical set her during her internship and they have offered her a permanent role after her internship ends. Both Richard and Nia highly recommend the ORBIS programme and the opportunity that it creates for funded internships in companies that might otherwise not be able to offer such positions. Nia's impact on Costello Medical through ORBIS was tremendous. She enabled the company to increase productivity by 25% while they focused their investment on other elements of rapid growth, including significant capital expenditure on computer equipment and office furniture, a move into a larger unit ready for the next phase of expansion and, more recently, advanced training for the company's Analysts.

Richard Short says "Costello Medical benefited from the ORBIS programme at a critical juncture, and it has undoubtedly accelerated our growth in the first half of our second year well beyond what it would otherwise have been. The benefit will be even more marked now that Nia has decided to stay with us in a permanent role and commit to a professional training qualification by distance learning. Nia already knows a great deal about what we do and has already made a tremendous contribution. As she gains still greater knowledge and experience and begins to take on managerial and client responsibility, her contribution will become still more important to the company's success. " Nia adds "Even if my host company had not been in the position to make such an offer, I know that I would have come away from my internship having achieved my goals: clarification of what I want to do in terms of a career; understanding what next steps I needed to take to advance in that area; and a new set of skills that would be desirable to potential employers and make me stand out from other applicants. "

For more information about ORBIS visit www.rvc.ac.uk/enterprise/ORBIS or email orbis@rvc.ac.uk

12.3 CASE Studentship Summary



BBSRC, EPSRC and MRC CASE PhD Studentships – A Summary

Purpose

This document provides an overview of BBSRC, EPSRC and MRC CASE PhD Studentship strategy and provision.

Vision and Strategy

The CASE scheme forms an integral part of each council's research, training and skills strategy. It fits with EPSRC, BBSRC and MRC's ambition to address skills gaps in key sectors of the UK economy as well as to encourage and facilitate collaboration between academia and industry, through cross-fertilisation of training and ideas.

The councils have agreed a shared vision for CASE studentships:

BBSRC / EPSRC / MRC Vision of CASE Studentships

CASE awards will provide PhD students with a first-rate, challenging research training experience, within the context of a mutually beneficial research collaboration between academic and partner organisations e.g. industry and policy making bodies.

Benefits to the student – CASE provides outstanding students access to training, facilities and expertise not available in an academic setting alone. Students benefit from a diversity of experimental approaches with an applied/translational dimension. Students have an opportunity to develop a range of valuable skills and significantly enhance their future employability; many will become research leaders of the future.

Benefits to the academic / partner organisations - CASE studentships encourage productive engagement between partners who benefit from a motivated, high-quality PhD student undertaking cutting-edge research relevant to the organisations' priorities and objectives. CASE provides opportunities to explore novel research collaborations and strengthen current partnerships.

Defining an excellent CASE Studentship :

High-quality project – A challenging, feasible and realistically achievable PhD project which stimulates excellent hypothesis-driven research. Through a truly collaborative approach, it provides tangible benefits to all partners.

High-quality training environment – Through access to distinctive but complementary environments, partners provide a stimulating framework for research training in the proposed field. Joint supervision gives a unique and broadening perspective on the impact of collaborative research.

High-quality student experience – An enriched integrated training experience allows the student to acquire novel skills and expertise. The student gains a wider understanding of, for example, applied research or policy development that will enhance their future career prospects.

Eligibility

The councils have also agreed a common eligibility statement for partner organisations submitting CASE applications, in collaboration with an academic organisation:

BBSRC/ EPSRC / MRC Non-Academic Partner Eligibility

UK-based organisations can be considered as the non-academic partner if they can provide students with distinctive research training and experience not available in an academic setting. Organisations eligible for Research Council funding cannot act as a non-academic partner¹. Where the non-academic partner is a company, it must have an established UK-based research and/or commercial production capability. In exceptional cases, organisations based overseas may be eligible, but only where they can provide the student with an opportunity to gain skills not currently available in the UK. If eligibility remains unclear, applicants should make contact before submitting a proposal.

¹ A list of organisations eligible for Research Council funding can be found at:
<http://www.rcuk.ac.uk/research/Pages/Eligibilityforrcs.aspx>

How to Apply for a CASE Studentship

Council's work together to ensure that where we offer common mechanisms to support CASE studentships, this is reflected in harmonised application processes as far as practicable. An overview of BBSRC, EPSRC and MRC CASE studentship schemes is provided below. For more detailed information please refer to the individual web pages.

1. Applications for Individual CASE Studentships

- Available from BBSRC and MRC

Detailed Scheme Info

- BBSRC Industrial CASE Awards:
<http://www.bbsrc.ac.uk/business/training/industrial-case.aspx>
- MRC Industrial CASE Studentships:
<http://www.mrc.ac.uk/Fundingopportunities/Studentships/IndustrialCASE/MRC004608>

Common Features

- Max of 1 studentship per application
- Submitted by at least 2 supervisors (one academic, one industry)
- Can be led by either the industry or academic supervisor
- Open competition
 - o Applications from SMEs encouraged (through targeted communications and financial incentives¹)

¹ Financial incentives provided by MRC scheme only

- Based on a collaborative PhD project proposal
 - o Student does not need to be identified prior to application
- Submitted via the Joint electronic Submission (Je-S) system (<https://je-s.rcuk.ac.uk>)
- Harmonised joint annual deadline (in ~ July each year)
- Awards made in December for students starting in the following academic year
- Applicants submit to appropriate Council (depending on scientific remit (health = MRC, underpinning biology = BBSRC)
 - o Possible to transfer between councils post-application if essential
 - o e.g. in 2010 MRC accepted 11 out-of-remit BBSRC CASE studentship applications, of which 2 were awarded. Prior to harmonisation such applications would have been rejected without review.

2. Block Awards for Multiple CASE Studentships

- Available from BBSRC and EPSRC

Scheme Info

- BBSRC Industrial CASE Partnerships:
<http://www.bbsrc.ac.uk/funding/studentships/allocations-3.aspx>
- EPSRC Industrial CASE
<http://www.epsrc.ac.uk/funding/students/coll/icase/Pages/default.aspx>

Common Features

- Awards made directly to company for multiple studentships
- Company responsible for identifying student and academic partner(s)
- Allocations made either by:
 - BBSRC
 - o Scheme – based on company’s training strategy, its approach to student support and the additional training opportunities it will make available to students.
 - EPSRC
 - o Strategic - allocated to companies based on their participation in EPSRC-funded research (algorithm based on their financial contributions over the last 3 years) and other strategic considerations.
 - o Through Industrial CASE ‘agents’ (mainly knowledge transfer networks in 2011) to help involve small and medium-sized enterprises (SMEs) in the scheme.

3. Other Opportunities for academic-industry collaborative PhD studentship training

Each council also offer wider opportunities for PhD studentship provision within joint academic-industry collaborative environments. For example:

- EPSRC Industrial Doctorate Centres:
<http://www.epsrc.ac.uk/funding/students/coll/Pages/idc.aspx>
- EPSRC also actively encourages industrial collaboration through the Doctoral Training Account route by setting research organisations a target of converting 10% of its (DTA) funds into CASE awards.

- BBSRC Doctoral Training Partnerships:
<http://www.bbsrc.ac.uk/funding/studentships/doctoral-training-partnerships.aspx>
- MRC Integrative Toxicology Training Partnership:
<http://www.mrctox.le.ac.uk/home/ittp/>
- MRC clinical pharmacology and pathology fellowship programmes where clinicians undertake a PhD fellowship programme incorporating joint supervision with industry.

Ongoing Council Collaboration

The councils continue to meet on a quarterly basis to facilitate collaboration and ongoing strategic discussion of CASE studentship provision. Ongoing work includes development of a harmonised JeS application form.

The remit of the cross-council CASE collaborative working group was recently extended to include the Natural Environment Research Council (NERC).

BBSRC are currently undertaking an evaluation of its Industrial CASE studentship scheme. See Terms of Reference included in *Annex 1* below. The evaluation is expected to report in Summer 2012. Lessons learned from this exercise will be shared by the councils.

BBSRC INDUSTRIAL CASE SCHEME EVALUATION

TERMS OF REFERENCE FOR THE REVIEW PANEL

1. The task of the Review Panel is to conduct an independent evaluation of the training supported through BBSRC's Industrial CASE scheme, with a focus on studentships with start dates between 2004 and 2010. The evaluation will cover standard Industrial CASE and Industrial CASE Partnership studentships.
2. Specifically, the Panel is asked to review the information presented and to:
 - a. assess the quality of the training supported through the Industrial CASE scheme, with a particular emphasis on the training provided by industry partners:
 - i. the industry placement
 - ii. training in skills not typically acquired through an academic setting
 - b. assess the outcomes and achievements of the postgraduate research and training including, where appropriate, any economic or societal impacts
 - c. identify the benefits from supporting postgraduate training through the Industrial CASE scheme in comparison to non-CASE, considering the benefits to students, industry and academia
 - d. examine the drivers and barriers which influence industry, academia and student participation in the schemes
 - e. consider whether the current requirements for financial contributions from industry are appropriate
 - f. comment on the balance and coverage of the Industrial CASE scheme portfolio, including the extent to which the scheme is supporting training and research across BBSRC's remit and strategic priority areas
 - g. comment on the range of industry partners that participate in the scheme (e.g. sectors, SME representation)
 - h. comment on the scheme's application and administration processes
 - i. identify any examples of best practice in the provision of collaborative training with industry
 - j. identify strengths, gaps and weaknesses in the scheme's support for postgraduate training; comment on ways to build on successes and ways to address any identified gaps and issues

12.4 MRC Case Studies



Enabling great science through partnerships with industry

From January 2012, existing and new MRC fellows will be able to add a component of industry collaboration to their fellowship and access individual advice on partnering with industry from an expert panel.

The MRC plays a leading role in training the nation's future research leaders across a range of biomedical, clinical and health disciplines. At any one time the MRC supports around 1,900 PhD students and 200 postdoctoral fellows. This talent pool offers a fantastic intellectual and practical resource for UK industry.

As part of the MRC's commitment to engage with a wide range of life sciences industries to drive mutually beneficial research partnerships, we are now offering new ways for MRC research fellows to enhance their research — and their careers.

By supporting fellows flexibly in a variety of ways, we will be helping to create a new cadre of leading researchers, comfortable working in the ambitious and open academia-industry partnerships that will deliver high impact science for the future.

For more information about career development and industry, visit www.mrc.ac.uk/careerandindustry or email fellows@headoffice.mrc.ac.uk



Partnership Awards for existing MRC fellows

Partnership Awards are a new award open to existing MRC fellows wishing to access extra funding to collaborate with industry.

- A Partnership Award is flexible both in terms of funds, duration, type of project and level of industry contribution.
- Applicants are expected to be at least half-way through their fellowship.
- Partnerships can take a variety of forms, not only a conventional 'research project'.

Collaborations for new MRC fellows

New fellowship applicants can incorporate industry collaboration into their research proposals, applying through the MRC's various fellowship schemes and attaching an MRC Industry Collaboration Agreement (MICA) form.

Collaborations for MRC PhD students

MRC Industry CASE Awards offer PhD students an opportunity to train in a demanding and challenging commercial environment.

- Each Industry CASE student has two committed PhD supervisors, one academic and one from the industry partner.
- The PhD student will spend a period of at least three months based in the company.
- Companies benefit by gaining a different, innovative perspective on a research project, and by acquiring or sustaining important links with academia.

Advice stage for fellows

Existing or prospective MRC fellows considering collaboration with industry can now access information and guidance directly and in person from industry experts by attending an advice panel meeting at the MRC head office in London.



Related opportunities

Knowledge Transfer Partnerships (KTP) are three-way projects between a KTP Associate (early-career researcher), a company and an academic research organisation. KTPs are managed by the Technology Strategy Board and partially funded by the MRC. For more information please visit www.ktponline.org.uk

For more information about all of the MRC's industry-related activities please visit www.mrc.ac.uk/industry or email industry@headoffice.mrc.ac.uk

A recent success

The £3-million, three-year, Liverpool-Manchester MRC doctoral training programme in Clinical Pharmacology and Therapeutics is providing clinical research training for 12 clinical fellows in a unique translational medicine environment reaching across academia, industry and regulation. It is led jointly by the Universities Liverpool and Manchester in partnership with AstraZeneca, ICON, the Medicine Evaluations Unit (MEU) and GlaxoSmithKline.

Shared expertise

Dr Ian Douglas is an MRC methodology research fellow at the London School of Hygiene and Tropical Medicine. He works one day a week with pharmaceutical companies such as GlaxoSmithKline, Gilead and Takeda, investigating drug safety using patient data.

"[Working with industry] means I can work collaboratively with non-academic experts in the field, so we all benefit from shared expertise and hopefully improve the way we look at drug safety problems."

"I'd recommend that fellows work with industry if both sides are likely to benefit — having a rounded experience of the field you work in is generally going to be a good thing. My work with industry complements, strengthens and draws on my fellowship work."

Ian Douglas
MRC fellow
London School of Hygiene and Tropical Medicine



Network building

Dr Matt Jones is an MRC senior non-clinical fellow at the University of Bristol. His research into neuronal networks and control of cognitive behaviour is underpinned by a number of productive industrial collaborations with Eli Lilly & Co, Janssen, GlaxoSmithKline, Pfizer and others.

"I've always collaborated with industry. Ultimately, if you want to have a positive impact on patients, then you need industry's support ... common scientific interests and goals mean I've always found industrial collaborations invigorating."

Dr Matt Jones
MRC fellow
University of Bristol



Accessing resources

Emily Davies is approaching the end of her PhD studying the physiology of pain at the University of Bristol. The PhD was funded through an MRC Industry CASE Award, during which Emily spent eight months on a placement at GlaxoSmithKline.

"The time I spent working in industry has highlighted the benefits of industrial and academic collaborations, and I will certainly aim to make new collaborations with industry in my new postdoctoral role."

"The industry collaboration provided me with additional intellectual input, experimental support in terms of equipment and funding, and establishing contacts within the field that have furthered my career."

Emily Davies
MRC PhD student
University of Bristol/GlaxoSmithKline



For more information about career development and industry, visit www.mrc.ac.uk/careerandindustry or email fellows@headoffice.mrc.ac.uk

For information about all of the MRC's industry-related activities, visit www.mrc.ac.uk/industry or email industry@headoffice.mrc.ac.uk



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Published January 2012 © Medical Research Council 2012



MRC Industry CASE studentships

MRC Industry CASE Scheme website:

www.mrc.ac.uk/Fundingopportunities/Studentships/IndustrialCASE/MRC004608

Industry CASE PhDs: knowledge & technology



- PhD at Bristol University and GlaxoSmithKline
- Research on the physiology of pain
- 8 months at GSK's Clinical Unit in Cambridge
- *"Coming back to the university, I've got more confidence driving my own research."*



"My industry placement gave me broader knowledge of the field and valuable experience using the latest technology."

Emily Davies

Emily Davies studies the physiology of pain at the University of Bristol: her PhD is funded through an MRC Industrial CASE Award. *"Doing an industry placement early on in my PhD gave me broader knowledge of the field and valuable experience using the latest technology. Coming back to the university, I'm more focused on my aims and I've got more confidence driving my own research. I was keen to get experience of industry as well as academic research during my PhD, so the CASE award was perfect for me. It involved a commitment of three months with GlaxoSmithKline (GSK) in addition to the standard three years at the University of Bristol. In the end, I was at GSK's Clinical Unit in Cambridge for eight months so that I could see my research project through from start to finish. I am still in touch with the team there, helping write up a paper and maintaining the collaboration."*

"The time I spent working in industry has highlighted the benefits of industrial and academic collaborations, and I will certainly aim to make new collaborations with industry in my new postdoctoral role. The industry collaboration provided me with additional intellectual input, experimental support in terms of equipment and funding, and establishing contacts within the field that have furthered my career."

www.mrc.ac.uk/Achievementsimpact/Profiles/EmilyDavies/index.htm

- PhD at King's College London and Proximagen
- Research is on a potential new treatment for Parkinson's disease
- Attends company business meetings – insight into drug development process
- *"I've learned that business and science can work together"*



"The MRC CASE studentship allowed me to have interests in several different areas without having to put everything in one boat."

Tamara Hirsch

Tamara is researching a potential new treatment for Parkinson's disease. *"I absolutely love science. But I'm interested in so many different things, so for me doing a CASE studentship allowed me to have interests in several different areas without having to put everything in one boat,"* she says. Conveniently, Proximagen, the company for which Tamara works, is just down the corridor from her university laboratory, because it's a spin-out company from King's College. She attends the company's business meetings which is giving her an insight into the drug development process. *"Proximagen has very nice new labs and new equipment, and the people who work there are very knowledgeable in their areas, so I get the benefits of that too."*

Tamara spends half her time in the lab, and the rest analysing results and reading research papers. Her research involves testing different doses of a new compound which holds promise for treating the side-effects of the standard Parkinson's disease treatment. Doing a PhD with an industrial component has made Tamara think more commercially about research.

"I've learned that business and science can work together," she explains. *"Spin-out companies are beneficial for the university as a whole, because the university ends up having shares in the company, but the academics benefit from them too as the monetary gain goes back into their research. The best part of my job is knowing that when I come in, I'm making the decisions about what I'm going to do. My supervisor's obviously giving me direction, but ultimately it's my reading and my research that informs my daily activities. My hours can be quite unpredictable, but I don't mind – I feel more motivated because I'm working for myself."*

www.mrc.ac.uk/Achievementsimpact/Profiles/TamaraHirsch/index.htm

- "CASE allows us to pursue exciting and productive research collaborations with industry,
- Students gain a first rate training experience that equips them for a successful career in research."



"MRC CASE is a wonderful scheme..."

Professor Ian Kimber
(Industry CASE supervisor)

MRC Fellowships Incorporating Industry Collaboration

MRC Fellowships website:

www.mrc.ac.uk/Fundingopportunities/Fellowships/index.htm

Dr Matt Jones – MRC Senior Non-Clinical Fellow, University of Bristol

Dr Matt Jones is an MRC Senior Non-Clinical Fellow in the School of Physiology and Pharmacology, University of Bristol. His research into neuronal networks and control of cognitive behaviour is underpinned by a number of productive industrial collaborations.



"I've always collaborated with industry," says Matt. "A range of companies have provided access to the pharmacological tools, disease models and techniques that I need for my research. Ultimately, if you want to have a positive impact on patients, then you need industry's support."

Indeed, Matt's first postdoctoral position was at the MRC National Institute for Medical Research, funded by an industrial collaboration grant linking the MRC and Glaxo Wellcome, now GlaxoSmithKline (GSK). It gave him access to early transgenic mouse models of Alzheimer's disease, an area he was just moving into researching,

and Matt remains in touch with those early collaborators.

"I'm less wary of industry than many academics tend to be," he admits. "Approaches do vary from company to company but common scientific interests and goals mean I've always found industrial collaborations

invigorating. For non-clinicians, industry can provide a bridge to patient data and they have a much better appreciation of what's important in the clinic."

Matt has cultivated collaborations with Eli Lilly & Co, Janssen, GSK, Pfizer and others, always driven by scientific need. "I'm fortunate that our research on neural networks and cognition is riding a wave at the moment," says Matt. "Saying that, it's not enough just to be in the right place at the right time – you need to know that you are. So a broad network of contacts is vital. It's an exciting time for me and for the field. But it's a bleak picture in industry where improved psychiatric treatments are concerned – there are few new drugs in the pipeline and there's a growing appreciation that companies need to be supporting research into fundamental mechanisms of brain function."

Through his contacts and collaborations, most of the PhD students in Matt's lab have some involvement with industry through MRC Industrial CASE studentships or similar schemes. "It benefits the student because they get experience of industry," says Matt. "It benefits me because I get to access the tools and expertise that industry has. And it benefits the company because they get access to our unique electrophysiology and broader view of mechanisms of cognition."

As part of his MRC Fellowship, Matt will spend time at Lilly's Centre for Cognitive Neuroscience (CCN, directed by Dr Mark Tricklebank of Lilly), using proprietary technology to study altered sleep states that contribute to cognitive symptoms in schizophrenia. "The Lilly CCN model of jointly supervised postdoctoral Fellows and a broad range of academic collaborations has set a powerful precedent," he says. "It's been hugely productive and enjoyable and, alongside academic-industry links, has also fostered new academic collaborations amongst the universities involved."

Given his success in working with industry, does Matt have any advice for academics who want to follow his lead?

"All my industry collaborations have been about answering specific scientific questions that can help people – disregard academic and industrial stereotypes to focus on your common goals and you will certainly find common benefits. The landscape has changed in industry in the last five years, especially in psychiatric research. The business of industrial R&D is always in flux but they know that academic collaborations offer an invaluable knowledge and skills base and – provided the expectations of both parties are realistic – good value for money. Perhaps academics need advertise their wares a little more actively."

www.mrc.ac.uk/Achievementsimpact/Profiles/MattJones/index.htm



“We all benefit from shared expertise...”

Dr Ian Douglas,
Methodology Research Fellow

Dr Ian Douglas is an MRC Methodology Research Fellow at the London School of Hygiene and Tropical Medicine. He works one day a week with pharmaceutical companies such as GlaxoSmithKline, Gilead and Takeda, investigating drug safety using patient data.

*“[Working with industry] means I can work collaboratively with non-academic experts in the field, so **we all benefit from shared expertise** and hopefully improve the way we look at drug safety problems.*

“I’d recommend that fellows work with industry if both sides are likely to benefit — having a rounded experience of the field you work in is generally going to be a good thing. My work with industry complements, strengthens and draws on my fellowship work.”

www.mrc.ac.uk/Achievementsimpact/Profiles/IanDouglas/index.htm

Training Programmes Built on Open Innovation Platforms with Industry

MRC Clinical Pharmacology & Pathology Initiative

The £3-million, three-year, Liverpool-Manchester MRC doctoral training programme in Clinical Pharmacology and Therapeutics is providing clinical research training for 12 clinical fellows in a unique translational medicine environment reaching across academia, industry and regulation. It is led jointly by the Universities Liverpool and Manchester in partnership with AstraZeneca, ICON, the Medicine Evaluations Unit (MEU) and GlaxoSmithKline.

Prof Chris Griffiths, [programme leader at the University] Manchester says “The scheme is an excellent example of collaborative working between academia and industry and plays to the synergistic strengths of the Universities of Manchester and Liverpool in biomedical research. We believe that the Fellows¹ graduating from this Programme will be at the forefront of a new breed of academic who understands the importance and advantages of joint working with industry.”

See press release at: <https://news.liv.ac.uk/2011/12/08/university-awarded-mrc-fellowship-scheme/>

Case-studies of joint academic-industry clinical training fellows recruited to the programme can also be found at: www.liv.ac.uk/mrc-cpt-fellowship/Fellows.htm

¹ NB Clinician PhDs also referred to as Clinical Research Training Fellowships

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