From the Classroom

Developing graduate skills for the United Kingdom's commercial life science sector: Experiences from the ORBIS internship programme

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The ORBIS programme was shortlisted for the Times Higher Education Awards' 2010 Outstanding Employers Engagement Initiative and the One Nucleus' 2010 Genesis Awards' Professional Service Provider of the Year.

ABSTRACT **The United Kingdom's commercial life science sector is dependent on a pipeline of skilled professionals to retain a leading position in a globally competitive sector. Work placements are one of a range of approaches available to support the development of the required graduate-level knowledge, skills and attitudes. This article describes the design, implementation and outcomes of the ORBIS (Overcome Recession: Bioscience Investment in Skills) Bioscience Graduate Internship Programme. 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 known sector skills deficits. The programme was found to positively impact on the skills development and employability of interns, and was broadly welcomed by industry. The programme's outcomes emphasised that work placements must be thoughtfully developed to meet the specific demands of participants and the critical need to provide an adequate quantity of high-quality work placements in order to support the development of key scientific and commercial skills. The findings are of broad relevance to training providers in industry and academia, and educational policy makers.**

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INTRODUCTION

UK commercial bioscience sector

The United Kingdom is a world leader in the life sciences; it is the largest bio-economy in Europe.[1] The pharmaceutical sector employs 67 000 people, 40 per cent of the headcount working in R&D roles, across 600 companies with annual sales in excess of £15 billion, and invests more than £4 billion in R&D each year.[2] Two of the top 10 global pharmaceutical companies by revenue are headquartered in the United Kingdom. The UK medical biotechnology sector employs 24 000 people across 780 companies with a combined turnover of over £4 billion.[2] The UK medical technology sector employs a further 52 000 people in 2800 companies, generating a turnover of £10.6 billion.[2] Nearly all UK-based commercial life science firms are small- to medium-sized enterprises (SMEs), most having fewer than 50 employees, and are predominantly grouped around the Oxford–London–Cambridge super bio-cluster, the North West of England and Edinburgh–Glasgow in Scotland.[3]

The importance of the life science sector to the UK economy has been recognised by successive governments; its role in improving health, sustaining high value-added employment and driving economic growth is well documented.[2,4–6]

The United Kingdom's prominence as a global leader in the commercial life science sector is under threat, particularly due to its high cost base. For example, in March 2010 AstraZeneca announced the closure of its Charnwood R&D site with the loss of 1000 jobs and the cancellation of development projects in various therapeutic areas.[7] At around the same time GlaxoSmithKline announced 380 redundancies at the firm's UK neurosciences research centre[8] while its new neuroscience centre in Shanghai, China is due to grow to employ 1000 scientists by the end of 2010.[9] Most recently, Pfizer has announced the closure of its R&D site in Sandwich, Kent with the loss of up to 2400 jobs.

Although there is currently no substantive evidence to suggest that the United Kingdom's bio-economy is in decline, indeed over 315 new R&D-intensive bioscience companies were formed in the United Kingdom between 2004 and 2009,[10] the loss of highly skilled jobs in established pharmaceutical companies is an alarming trend. A viable bio-economy is dependent on an integrated value chain (spanning research, development, manufacturing and so on) of small and large companies. In addition the sector must be fuelled by universities able to respond rapidly to the skills requirements of employers.

If the United Kingdom is to build on its strong bio-economy in the face of global competitive pressure it will presumably depend heavily on its human capital as its high cost base is likely to be a major impediment in a sector where there is pressure on both commercial R&D budgets and the need to produce affordable products to customers in developing economies; it therefore must do more to develop the knowledge, skills and attitudes required by commercial life science sector employers if any form of competitive advantage is to be maintained.[4]

Bioscience skills agenda

As the 2009 Office for Life Sciences 'Life Sciences Blueprint'[4] report states, the supply of motivated, innovative and skilled employees must be maintained if the United Kingdom is to flourish as the location of choice for life sciences companies. However, industry has reported that there has not been a coordinated mechanism for it to discuss its skills needs with universities and funders in a coherent and collective way. Presumably as a consequence there has been criticism that many UK graduates leave university lacking the relevant core skills to equip them for a career in the commercial life sciences. Although it may be argued that larger companies are able to support the skills development of their employees, the skills gaps of graduates and postgraduates may particularly affect smaller firms, which form

the bulk of the UK commercial life science sector.

The UK pharmaceutical sector absorbs at least 1000 graduates and postgraduates each year.[3] Approximately half of the 1000 are science graduates; 60 per cent (approximately 300) of these are chemistry graduates and 40 per cent (approximately 200) biology graduates. It may be further estimated, in the absence of accessible data, that the UK medical biotechnology and medical technology sectors collectively absorb a similar number of university leavers each year, in addition to those recruited by the pharmaceutical sector. This demonstrates, using the biosciences as an example, that only approximately 400 graduates and postgraduates studying bioscience, from the total pool of over 160 000 bioscience students currently studying at UK universities,[3] are recruited each year. Even when the subsequent numbers of graduates entering professions allied to the commercial biosciences (for example, trainee patent attorneys) are considered, it is clearly the case that it is the type and quality of skills possessed by graduates that is the critical issue, rather than an overall shortage of science graduates. However, with reference to skills, it should not be overlooked that there are many thousands of mid-career graduates and postgraduates currently employed within the bio-economy with up-skilling and re-skilling needs as a consequence of continuously evolving technological and commercial challenges faced by the commercial life science sector.

It is broadly agreed that the bioscience sector, in terms of skills, will become increasingly high-tech and more interdisciplinary.[3] Over the past decade considerable effort has gone into identifying graduate-level skills gaps in the commercial bioscience sector. For example, The Association of the British Pharmaceutical Industry (ABPI)'s 2008 survey[6] found fundamental skills gaps among graduates in mathematical capability, practical skills and the ability to apply scientific theory to practice. Specific scientific skills gaps were found in areas such as *in vivo* sciences and clinical pharmacology. Numerous other reports[5,11,12] have identified non-scientific skills gaps in management and leadership, and business improvement techniques. The need for broad employee skill sets that bridge scientific expertise and commercial acumen is well documented.

Semta's Bioscience Sector Skills Agreement[13] identified four themes for action: increasing the sector's attractiveness to talented students; achieving a top quality workforce by increasing practical scientific skills education and changing undergraduate courses to reflect the need of employers; leadership and entrepreneurship and improved employer engagement. It may be argued that these themes, and identified skills gaps outlined above, may be addressed through the delivery of high-quality work placements.

Work placements in the biosciences

University-led, industry-led and informal work placements are an established feature of the bioscience sector. Placements can provide industry with a cost-effective labour pool and develop a pipeline of motivated and competent future employees.[14] Similarly, work placements have been found in other fields to enhance student learning by linking theory to practice, allowing them to develop employability skills and building a bridge to the world of work.[14,15] Indeed, there is evidence to suggest that many employers will only now consider employing graduates who have some level of relevant placement experience.[14] From the university perspective placements can add depth and value to educational courses thereby enhancing the student learning experience and also may present opportunities for links to be developed with industry that may lead to new research collaborations and the generation of commercially applicable intellectual property.

In the United Kingdom, university-led placement programmes have traditionally focused on undergraduate placement years that typically occur between the penultimate

and final years of the degree course. However, concern has been recently been expressed about the decline in the students undertaking placements. An ABPI survey of members[16] highlighted a sharp decline in undergraduate industrial placements, decreasing from 530 placements in 2007 to 355 placements in 2009. Although it must be taken into account that this decline occurred during the height of the global economic crisis, the cost of industrial placement years to host companies (in addition to consumables and training costs, undergraduate placement students can expect to earn in the region of £15 000 per annum) and the trend towards the off-shoring of UK pharmaceutical R&D is likely to place continued pressure on the availability of these places. Given that the costs of these placements are borne exclusively by the host company it seems unlikely, without state subsidised incentives, that bioscience SMEs will be able to fully take up the shortfall. In addition universities report that managing industrial placement is resource intensive[17] and factors such as the fierce levels of competition to gain paid placements is threatening student engagement.[16]

At the postgraduate level there are doctoral training grants such as the Collaborative Awards in Science and Engineering (CASE) funding programme that includes an industrial placement component. CASE is supported by UK research councils and requires the industrial partner to provide an element of co-funding. CASE awards stipulate that a university-based academic researcher and an industrial partner jointly supervise a doctoral student engaged on a project of mutual interest; the doctoral student will spend a period of 6–18 months based with the industrial partner. While based with the company, in addition to scientific training, the students are expected to learn about industrial project management and develop an awareness of business. Approximately 65 per cent of more than 600 ongoing academic–pharmaceutical industry collaborative doctoral studentships operate under the CASE programme.[16]

A further industrial placement option for graduates and postgraduates is a UK-wide programme called Knowledge Transfer Partnerships (KTPs).[18] KTP aims to improve business competitiveness, increase the links between universities and business, and develop industry-relevant skills in graduates. The programme is funded via the United Kingdom's Technology Strategy Board and requires a financial contribution from the participating company. KTPs are a partnership between an academic researcher, business and a recently qualified graduate (KTP 'Associate'). The KTP scheme now also allows postdoctoral trainees who undertook a collaborative doctoral degree, such as CASE, to participate in the programme. The paid Associate is engaged on a knowledge-intensive project based in the company, supported by the academic. The project duration ranges from 10 weeks to 3 years. During the 5-year period up to an including 2008/2009 over 4800 KTPs have been undertaken.[19] However, a review of the KTP website found only 14 of over 350 logged case studies were categorised as 'bioscience' sector projects.[18]

UK universities have only relatively recently become coordinators of graduate internship programmes in which recent graduates undertake a period of supervised training in industry. For example, the Higher Education Funding Council for England (HEFCE) has funded English universities to work with industry to generate over 11 000 work placements in 2009–2010 through its Economic Challenge Investment Fund (ECIF)[20] and graduate internship funding schemes. Two graduate internship programmes specifically for the commercial bioscience sector were created using ECIF funding. The Universities of Reading and Surrey delivered 30 graduate internships working with a range of large and SME bio-pharmaceutical companies based in the south east of England.[21] The Royal Veterinary College (RVC) delivered a programme called ORBIS that is described fully below.

In addition, RVC collaborated with the University College London on a further HEFCE grant to deliver 42 8-week internship placements in the biosciences. The programme was called BRIO (Bioscience Responds with Internship Opportunities).

Through undergraduate placements, CASE, KTPs and internships it is clear that universities and industry are working together to provide an array of work-based learning opportunities in the biosciences. As the United Kingdom's commercial life sciences sector recruits approximately 400 biology and 600 chemistry graduates each year, this author suggests that at least 800 funded bioscience work placements and 1200 chemistry placements are required each year in order to provide the UK bio-pharmaceutical industry, and associated sectors, with a sufficient skilled labour pool from which to recruit. However, the total number of funded undergraduate and postgraduate UK work placements relevant to the commercial life science sector is currently estimated to be well under 1000, less than half the proposed required minimum number. Clearly bio-pharmaceutical companies have the option to recruit suitable graduates from across the European Union or elsewhere (subject to work permits); however, it would be unfortunate not to allow the vast reservoir of UK-trained graduates and postgraduates the opportunity to compete for these jobs. The employability skills gained from work placements could also be utilised by graduates entering allied commercial sectors, and would benefit those bioscience graduates planning to become school teachers or university academics, providing them with a better understanding of industry.

It is certainly the case that work placements, such as internships, are highly regarded by policy makers, educationalists and industry as a valuable component of the skills development agenda.[4–6,17] Yet despite their popularity across a range of sectors, it is interesting to note that surprisingly little has been written about internships, their organisation and impact on skills development.[22] There is a clear need to understand how internships support the skills development agenda in the biosciences. Conroy and Khan,[23] for example, have described an innovative virtual online internship programme in the biosciences; however, little appears to have been written in the extant literature about the design, educational impact and host company perceptions of work-based graduate internships in the biosciences. Although extrapolations can be made from other sectors, it has been established that work-based learning varies in its scope and effectiveness from sector to sector.[24] Specifically, this article will reflect on the findings from the ORBIS Bioscience Graduate Internship Programme.

METHODOLOGY

ORBIS programme design: a review of the bio-pharmaceutical skills and work-based learning literature was undertaken in order to develop a framework for an industry focus group in summer 2009. The results from the literature review and associated focus group informed the overarching programme design and the content of specific training sessions.

Feedback on ORBIS: for the purposes of this report a mixed methodology was employed. Basic demographic information was taken from company and intern application details. Informal and written feedback was collected from training events. Of the 60 ORBIS interns 50 completed a detailed electronic survey within 4 weeks of completing their internship, capturing their views on the organisation and effectiveness of the programme. In addition 24 interns completed a destination survey 3 or more months after completing their internship, and seven interns provided self-authored case reports of their internships. Data were collected from host companies through regular oral feedback throughout the programme and three detailed case studies in which companies participated.

RESULTS AND DISCUSSION

ORBIS model

The author sought to design a novel programme that responded to the identified bioscience skills gaps and utilised contemporary work-relevant pedagogies. The overarching pedagogical approach to the ORBIS programme is shown in Figure 1. The author elected to design a programme that intended to create a genuine training partnership between bioscience firms (primarily SMEs and large companies based in the Oxford–London–Cambridge super bio-cluster) and recently qualified graduates and postgraduates. The stated aims of the programme are shown in Box 1.

The ORBIS programme was led and coordinated by RVC and its bio-incubator LBIC (London BioScience Innovation

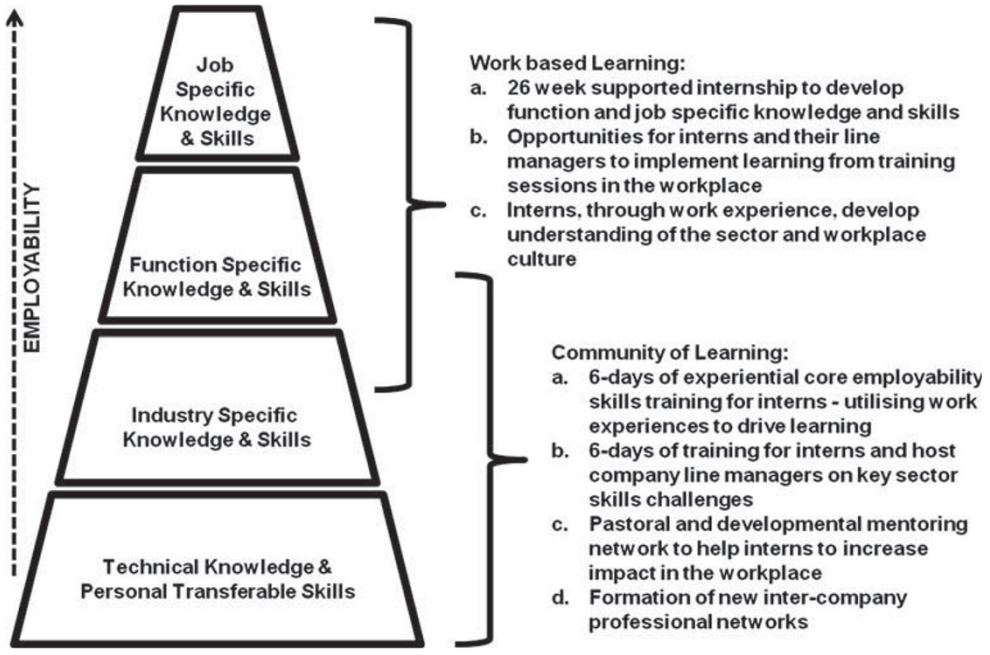

Figure 1: ORBIS Bioscience Graduate Internship Programme Design.
Note: The programme was planned so that knowledge and skills developed in the workplace could be further explored in the community of learning training sessions and vice versa.

Box 1: Objectives of the ORBIS Bioscience Graduate Internship Programme

- To help the UK bioscience industries weather the economic downturn through affordable access to the graduate and postgraduate labour pool. Specifically, to use this manpower to maintain or commence innovative R&D or business development projects that would otherwise be mothballed or shelved.
- To enable graduates and postgraduates to access a well-planned and managed programme of work-based learning within the commercial bioscience sector to improve their future employability.
- To create a community of learning through a series of training events that respond to bioscience sector skills gaps, and encourage interns and their managers to interact to form new networks and inter-company collaborations.
- To provide a mentoring scheme to enable interns to access pastoral and developmental support from seasoned industrial professionals to further develop their employability and enhance their career planning capability.
- To collectively produce a return on the bottom line for host companies, to catalyse the creation of new graduate-level jobs and to develop new knowledge and skills that will support the sector.

Centre). A total of £493 000 of funding was received from HEFCE ECIF, in addition to matched in-kind funding from both RVC and participating host companies. Participating companies also contributed £1000 for each intern supervised. The total direct and in-kind project funding was approximately £1 million.

The planning commenced in April 2009 following the recruitment of a full-time ORBIS project manager, with the first internship undertaken in late July 2009; a funding criterion was that programmes should respond rapidly to the economic recession. The programme concluded in September 2010.

ORBIS offered 60 26-week internships, the equivalent of 30 man years of work. With little information available regarding preferable duration of an internship the author determined, taking into account feedback from industry, that 6 months was the minimum duration to enable companies to train interns and achieve a meaningful return on their investments, particularly in technical disciplines, while this time period allowed interns to gain a breadth and depth of experience without being locked into an extended commitment.

Host companies were recruited through sector networks; for example, companies based at LBIC and companies collaborating with RVC academics. Companies were provided with an overview of the programme aims and details of the financial contribution. It is important to note that interns were paid a training stipend of £220 per week by the ECIF grant, limiting the financial contribution for companies to £1000. It was felt that an upfront fee was required to ensure all companies were committed to the programme, but the fee should be affordable particularly during the economic downturn and to ensure SME involvement. Once companies submitted their project proposals via an online application portal they were contacted by phone and asked to provide further information and to ascertain their motivations for participating in the programme. Those companies offering a stimulating internship project focused on skills development and a supportive learning environment were invited to take part in the programme.

Recent graduates and postgraduates were contacted through a range of graduate recruitment websites and university careers offices. Interested parties were directed to the ORBIS website and an online application portal. Potential interns submitted their academic credentials and their motivations for participating in the programme. Those applicants failing to complete the application correctly, lacking required visas or holding the lowest classifications of undergraduate degree were removed from the applicant pool.

Each participating company was typically provided with details of 6–12 screened applicants. The applicants were skills matched by the ORBIS project manager to the requirements specified by the host company. Companies were able to request details of more applicants if none of those initially selected met their criteria. The companies led the selection process, arranged interviews and, in some cases, assessment centres before selecting an intern to undertake their project.

The programme was divided into three cohorts of 17, 22 and 21 internships. The first cohort commenced during July 2009, the second in November and the third in January 2010. The host companies were required to provide a named line manager who would be responsible for supporting work-based skills development and managing the intern while undertaking the project. The interns were tasked with working with their line manager and mentor (see below) to ensure they maximised their work-based learning in a manner that is most relevant to their learning needs. Interns were not expected, as required by some work-based placements, to keep learning journals or submit a written report on their experiences; however, the ORBIS training sessions (see below) required interns to draw on their work-based experiences as

substrate for their learning, and to encourage further reflection around their competences, skills gaps and workplace attitudes.

Each cohort of interns took part in a series of 12 experiential training days. Of the 12 training days 6 were open to both interns and their line managers and a second member of the host company's staff if desired. The aim of the training days was to address some of the key sector skills gaps in an engaging and effective manner that would be of lasting benefit to participants and their employers, and to form a community of learning where interns and their line managers engaged in peer-to-peer learning and networking. In particular the author elected to address skills gaps relating to business improvement techniques, interdisciplinary collaboration, complex project management and commercial awareness. Professional trainers currently working in the bioscience sector, rather than university academics, were predominantly employed to deliver training on the advice of participating companies. This approach was intended to ensure that the training focused predominantly on work practices rather than theoretical concepts.

The sessions in which the interns and their managers participated included a 4-day green belt Lean Six Sigma training programme focused on driving business improvement in their own workplace, influencing skills in the workplace and (in later cohorts) a mock assessment centre in which managers ran the assessment stations in which the interns participated to develop key employability skills (Figure 2). The training days specifically for interns included sessions on goal setting, understanding workplace culture, networking skills, presentation skills and understanding the commercial bioscience sector and bioentrepreneurship.

An intra-cohort pastoral mentoring network was established with the purpose of helping interns to contemplate the workplace, their skills gaps and career planning. Interns were able to select a mentor from the pool of line managers in their cohort. Mentoring meetings were encouraged to take place by phone or face-to-face before the cohort training sessions. For reasons of commercial

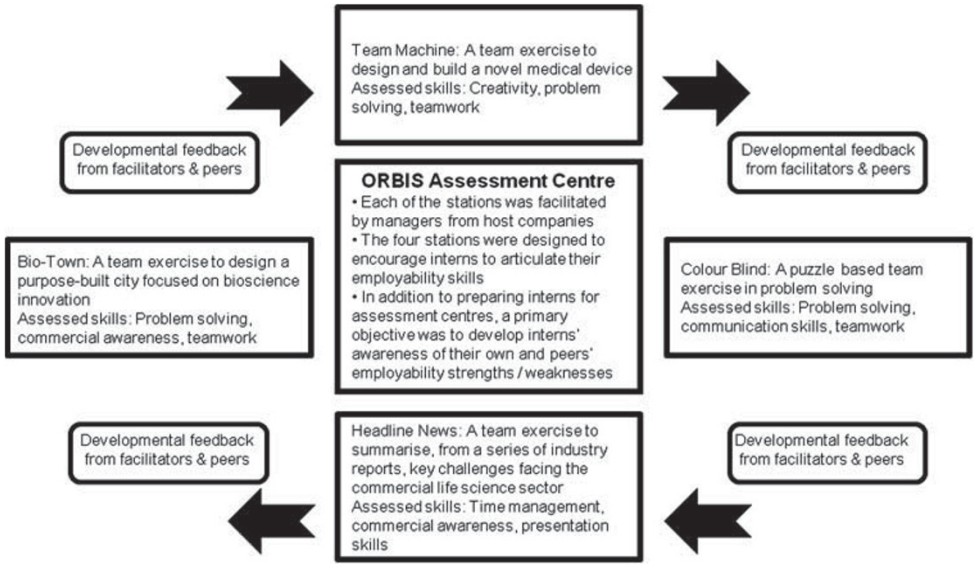

Figure 2: Example of a training day in the ORBIS Community of Learning.
Note: In this Assessment Centre the interns' individual and team performance in four facilitated tasks was considered by line managers from the host companies, encouraging debate, reflection and learning around key sector employability skills.

confidentiality the mentors and mentees were advised not to discuss technical or project-specific matters. The first training day for each cohort focused on mentoring skills and matching interns to mentors.

Those interns successfully completing the work-based internship and associated training programme were awarded a certificate of participation.

Company participation

Over 75 projects were submitted by more than 40 different bioscience companies. From the 60 projects selected 39 were provided by SMEs. In total, 28 different SMEs, 6 larger companies and the commercial functions of two universities participated to host interns, with a number of companies providing multiple internship projects. Fifty-two of the projects were undertaken within the Oxford–London–Cambridge super bio-cluster. Participating companies were drawn from fields including human and veterinary pharmaceuticals, medical biotechnology, medical technology, clean biotechnology, contract research organisations, sector consultancy, applied academic research, technology transfer, animal nutrition, veterinary practices, regional bioscience network organisations and medical research charities.

Recruiting sufficient companies to the ORBIS programme, with limited overt marketing, was straightforward. This is perhaps unsurprising, given that the participating companies' only financial contribution was a £1000 participation fee. In return they received 6 months of graduate labour and access to a training package for up to two of their current employees. However, the fact that the internship programme was welcomed by industry refutes anecdotal reports that bioscience companies are increasingly unsupportive of work placements. The barrier to bioscience companies providing placements would appear to have more to do with the affordability than lack of interest; ORBIS was heavily subsidised and hence drew industry engagement. Importantly, as is witnessed through the ORBIS programme, SMEs are keen to participate in internship programmes when it is cost effective to do so; any future programmes should be modelled to encourage SME participation. One potential option for future internship programmes may be a tiered pricing strategy based on the size of the company, with larger companies paying more to participate. However, one of the strengths of ORBIS was that its cohorts mirrored the make-up of UK bioscience sector, and therefore any pricing structure should strive to maintain this balance.

On a cautionary note, when initially questioned about their motivations for participating in the programme the majority of host companies, understandably, cited access to affordable labour rather than supporting work-based learning as their key driver for hosting an intern. It was noticeable that this attitude changed as the internship and training programme progressed, with many companies becoming strong advocates of the developmental aspects of the programme. However their initial attitudes may suggest that many non-participating companies may view work-based learning as unimportant or a distraction. Universities must do more to communicate the commercial merits of work-based learning to employers.

Participating companies also repeatedly reported that the mode of intern recruitment was effective on a number of levels. Companies did not have to invest in advertising their placements as they were promoted through ORBIS, and the companies had ready access to a large pool of talented graduates. In addition, companies were supportive of running their own interview-based selection process rather than having a candidate selected for them by the internship organisers, as this allowed them to secure candidates with the required 'organisational fit'.

The companies' comments on recruitment support the notion of creating a UK-wide

placement clearing house for the biosciences, in which companies post their placement opportunities and students submit their credentials and are pre-screened for their suitability, before attending interviews led by the companies. Such a clearing house may further reduce the barriers to participation facing companies and allow potential interns to consider a full range of placements opportunities. A clearing house may also become a suitable body around which universities and bioscience firms could enter into a dialogue to determine benchmarks for graduate employability skills and appropriate approaches for smoothing the transition of students from academia to the workplace. Moreover a central body could be a mechanism for cost effectively distributing bursaries to qualified interns or funding to SMEs seeking financial support to host a placement.

Of 60 projects provided by the host companies 35 were laboratory based or predominantly R&D focused. The other projects focused on business development. The vast majority of companies reported that the internship had achieved its commercial goals. Specifically, line managers stated that their participation allowed them to cost effectively undertake projects without having to recruit a permanent member of staff in the first instance, reflect on the challenges facing new graduates entering the workplace and, consequently, reconsider how to manage graduates and determine the suitability of the intern for a permanent position – some companies described the internship as 'an extended job interview'. A subset of companies referred to their 'corporate responsibility' as R&D companies to recruit and train the next generation of graduates, particularly given the decline of graduate training programmes; ORBIS allowed them a route to fulfil this role.

Graduate participation

One thousand and thirty-five graduates applied for the ORBIS programme between June 2009 and June 2010, of whom 53 per cent were women. Eighty per cent of the applicant pool sought laboratory-based projects whereas the other 20 per cent requested commercial experience; the demand for laboratory experience may reflect the decline in the practical components of undergraduate degrees. The most frequently requested internships were those based in pharmaceutical, biotechnology, health-care services and clinical trials settings. Sixty-seven per cent of applicants were unemployed graduates, 17 per cent were under-employed graduates (for example, working in non-graduate jobs in bars and restaurants) with the remainder being students completing master's or doctoral studies. Only 7 per cent of applicants held doctoral degrees; further investigations are needed to determine whether the postdoctoral community seeks to engage with industry-based internships and, if so, how internship programmes can better reach out to this group. The majority of applicants held qualifications in the biological sciences, although 36 per cent of applicants cited their academic background as business and management, IT, or other non-bioscience subject areas. This serves as a reminder of the fact that the bio-pharmaceutical sector is an attractive career destination for both the scientifically qualified and non-scientists alike.

The demand for places was incredibly strong despite only limited advertising. The opportunity to gain experience within leading bioscience companies was an attractive proposition, and applicants also cited the training component of the programme as a key draw. The modest training bursary was not typically viewed as a disincentive by applicants, presumably owing to the poor state of the job market and the potential doors opened by spending time working for a potential employer.

Of the 60 interns recruited by host companies, 38 were women. Forty interns were aged between 21–25 years of age, only seven were aged over 31 years. Twenty-eight were unemployed before joining the

programme, 13 under employed and the others were undertaking a planned activity such as completing studies or voluntary work. Forty-five interns had less than 1 year's graduate-level work experience; it was pleasing to see that the ORBIS had predominantly provided opportunities to graduates with limited work experience. Thirty-six interns had postgraduate degrees emphasising the value employers place on postgraduate qualifications. Fifty of the successful applicants obtained their undergraduate degrees from research-intensive traditional UK or overseas universities, which suggested that employers continue to favour candidates with qualifications from established universities. To some extent this was contradicted by the view expressed by two large pharmaceutical companies who stated that they were keen to use ORBIS to provide opportunities to graduates from non-traditional backgrounds.

Interns overwhelmingly felt that they had benefited from their internship; 48 of 50 responding interns felt that their internship had been a positive experience, suggesting that their learning and career development aims were partially or fully met.

Skills development and learning

Fifty-four per cent of interns responding to the survey stated that the most valuable aspect of their internship was technical skills developed in the workplace, while 24 per cent found that generic skills (such as team work and interpersonal communications) learnt in the workplace were the most valuable elements. The remaining 22 per cent found that either the technical or generic skills learnt in the training sessions were the most valuable components of the programme. It is interesting to consider that, despite the heavy emphasis placed on the 12 days of training, the work-based technical and generic skills acquisition formed the predominant aspects of the learning while on placement. On a related theme, 76 per cent of interns agreed or strongly agreed that their workplace supervisor had helped them to plan and run an effective project. Although the quality of workplace supervision and learning support was highly regarded by most interns, some supervisors reported that they found managing interns challenging. Future internship programmes in the biosciences should consider providing additional support and guidance for line managers. Such measures might have the additional benefit of improving the management of graduate entrants across the sector.

From a list of 25 employability skills focused on five key themes: (1) problem solving and critical thinking, (2) commercial awareness, (3) core skills including project management, objective setting and so on, (4) key mindsets relating to responsibility, enterprise, innovation and resilience and so on, and (5) career planning, surveyed interns signalled (Table 1) that the knowledge, skills

Table 1: ORBIS interns were asked on a scale of 1–5 (1 being not at all, 5 being to a great extent) to what extent their internship had allowed them to develop a wide range of knowledge, skills and attitudes relevant to graduate employability

Taking responsibility for own actions	4.16
Communicating your ideas	4.15
Commercial awareness	4.12
Understanding workplace culture	4.02
Team working	3.94
Working to deadlines	3.90
Presentation skills	3.90
Responsibility for continued learning	3.88
Setting objectives	3.86
Taking a global outlook	3.78
Active listening	3.76
Managing a project	3.76
Understanding innovation process	3.74
Career planning	3.72
Problem solving	3.72
Responding positively to change	3.71
Summarising information	3.62
Searching for information	3.59
Taking decisions	3.57
Critical thinking	3.54
Enterprising thinking	3.48
Responding positively to failure	3.46
Leading a project	3.38
Understanding risk	3.33
IT skills	2.94

and attitudes most developed by their work placements included taking responsibility for your own actions, workplace communication skills and commercial awareness. The least developed skills included IT skills, understanding risk, leading a project and responding positively to failure. It appeared that 26-week internship projects may be too short in duration for line managers to set high-risk projects. It seemed that projects were led by the interns' line managers and were designed to be safe and deliverable. This, arguably, may suggest that short work placements present an artificial view of high-risk, innovation-dependent sectors such as commercial bioscience, and do not allow interns to develop project leadership skills.

Ninety per cent of interns considered that the ORBIS training programme was either good or excellent. The interns perceived the most valuable aspects of the training programme to be presentation skills, networking skills and the mock assessment centre. The relevance of business networking to support problem solving, business development and career progression was well recognised by interns. Furthermore the importance of sharing workplace experiences should not be underestimated as a learning and career-planning support mechanism as cohorts formed into professional and social networks.

The least valuable components were deemed to be Lean Six Sigma and intellectual property awareness training. It was disappointing to note that the Lean Six Sigma course, which was included to provide interns with a toolkit to drive business improvement, was not more positively regarded. Interns provided feedback indicating that they felt that the Six Sigma approach could not be applied to their projects, or that it was too complex, and that simpler approaches to business improvement were likely have been more relevant to recent graduates. In the third cohort an introduction to project management training session was included with the aim of contextualising the role of Lean Six Sigma, with a concomitant improvement of the feedback around the subsequent Six Sigma training.

A challenging aspect of the training programme was the limited level of engagement from line managers and their colleagues. By design the ORBIS programme provided two training places, on 6 training days, for existing employees for each intern hosted. As many firms indicated that their training budget had been frozen as a consequence of the economic downturn we anticipated that take-up of what was effectively a free training programme would be strong. However, only around one-third of the 120 places available were taken, and attendance was patchy across the training programme. Although many line managers stated that the training they attended was of high quality, they struggled to find the time to attend. This is understandable, particularly for SMEs. However, the learning model had aspired to create an environment where recent graduates and more experienced professionals learnt together; sharing their knowledge, experiences and viewpoints. Future internship programmes with a training component should secure a commitment to the training from firms while inducting them to the programme and consider utilising alternative modes of delivery such as web-based teaching in order to encourage participation.

There were mixed opinions over the effectiveness of the mentoring programme; only 44 per cent of interns agreed or strongly agreed that their mentor had helped to develop their thinking about the workplace. After the initial mentoring, training and matching sessions interns were given responsibility for driving the mentoring relationship. Some interns failed to establish a relationship, whereas others felt that a mentoring relationship would not be beneficial and did not seek to engage with this aspect of the programme. A number of mentors provided feedback expressing their

disappointment that this element of the programme had not been more structured and viewed as compulsory.

Career planning and employability

The ORBIS programme was seen by interns as performing strongly in terms of developing positive underpinning attitudes regarding workplace confidence and increasing their perceived competitiveness in the job market. Considerable emphasis was placed throughout the programme on helping interns to articulate their emerging skill set. The responses from interns strongly suggested that their internship increased the likelihood that they will seek a career in the biosciences, and enabled them to determine their suitability for a particular job role. However, comments from interns showed that they would have welcomed greater focus on career planning, suggesting that future internship programmes should consider working closely with a university careers office to ensure this aspect of the programme is properly addressed.

Of the 24 ORBIS interns we have up-to-date information for, 11 had secured either a permanent graduate-level job or a contract extension with the company that hosted their internship, eight had secured graduate-level employment in the bioscience sector and two had commenced a course of postgraduate study. Only three were unemployed or engaged with casual work. In addition, 20 of the 24 respondents signalled their belief that the internship programme significantly increased their employability. Although the strong possibility of response bias has to be considered, it is very pleasing to see that ORBIS interns have been retained within the sector, and particularly satisfying to observe the high retention of interns by the host company. Further data would need to be ascertained to establish whether ORBIS effectively created new, additional, graduate-level jobs or whether the interns were simply recruited to existing vacancies.

Value for money and sustainability

The ORBIS programme collectively cost the tax payer and industry a total of approximately £16 000 for each intern to be paid to participate in a 26-week placement and receive 12 days of training, and to enable two existing members from the host company's staff to each partake in 6 days of training. The commercial return for each host company has not been calculated, but the value of the work conducted by the intern could reasonably be expected to significantly outweigh the costs they incurred while training and supervising the intern. The benefits derived from the interns' labour, the skills developed through the training by interns and their managers, improved graduate employability and networks formed through ORBIS are likely to be considerable. It should also be taken into account that keeping a recent graduate on a package of state unemployment benefits for 26 weeks would have cost the UK tax payer at least £2000 in addition to the opportunity cost of their economic inactivity.

Although further research is needed it would appear clear that internships in the biosciences offer a genuine return on investment for funders and industry. It may be argued that through, for example, the programmes offered by Reading and Surrey universities and ORBIS that the expertise and experience is available to deliver a nationwide, cost-effective and sustained internship programme for the commercial bioscience sector. Funders, industry and universities now need to urgently develop a sustainable funding formula to provide the quality and quantity of work placements required to help ensure the United Kingdom remains the location of choice for pharmaceutical and medical biotechnology companies.

CONCLUSIONS

UK-based life science firms face a range of competitive pressures; highly skilled human capital is a business-critical resource the United Kingdom must maintain and further

develop in order to remain a location of choice in this global industry. Although the United Kingdom is recognised for providing a pipeline of well-qualified graduates and postgraduates, a range of skills gaps have been identified in both new entrants to the profession and established sector professionals. One mechanism to close these gaps is work-based learning including undergraduate and graduate work placements.

This article describes the design, delivery and impact of the ORBIS Bioscience Graduate Internship Programme. The ORBIS programme highlights the latent demand from graduates and industry for well-managed and affordable placement programmes. The ORBIS programme satisfied its key aims of serving the commercial life science sector and recent graduates from the perspectives of delivering a commercial return on investment and increased employability, respectively. In addition the ORBIS programme showed the value of placements in terms of work-relevant learning when employers are properly engaged and training deployed to respond to commercial need. However, the pilot ORBIS programme also highlighted the need for internship programme providers to listen to its stakeholders to ensure that the offering does not present barriers to participation and carefully matches the developmental skills needs of both host companies and interns in all aspects of the programme's delivery (Table 2).

The ORBIS programme was funded by a government body as part of its response to the economic downturn. Given the competitive pressures facing the UK life science sector there is a strong case to be made to extend work placement funding as the economy recovers. Similar situations are likely to exist in other nations such as the United States and Germany, which host established bio-pharmaceutical sectors. However, as government funding is likely to be in short supply, employers must be consulted to find a sustainable funding solution for high-quality work placements focused on skills development. Considerable collaboration, and potentially nationwide

Table 2: A SWOT analysis of graduate internship programmes in the biosciences

Strengths:
- High demand from graduates
- Focused opportunity to develop technical and transferable skills in the workplace
- Improved graduate employability and workplace confidence/effectiveness
- Cost-effective mechanism for companies to access graduate labour

Weaknesses:
- Insufficient provision of internship places to meet demand
- Limited participation from doctoral-level postgraduates
- Poor engagement by employers with skills training programme
- Limited engagement by interns with mentoring programme

Opportunities:
- Developing future programmes specifically around key skills gaps, for example, *in vivo* sciences
- Creating a national clearing house to coordinate placement advertising and intern applications
- Using internships as a platform for career planning
- Creating an inter-company internship programme for mid-career and senior bio-pharmaceutical sector professionals to encourage skills renewal and inter-company collaboration

Threats:
- Developing a sustainable funding model
- Providing high-quality work-based learning opportunities, particularly lab-based projects
- Failing to develop the line management and learning support skills of host company supervisors
- Neglecting to engage in research and continued stakeholder dialogue to enable the design and delivery of programmes that meet the skills development needs of employers and graduates

coordination such as a placement clearing house, will be required to boost the numbers of funded placements to appropriate levels, increase cost effectiveness and encourage a focused dialogue on skills deficits. If this can be achieved the potential benefits to the community of more than 4000 UK life science firms are likely to be significant.

Furthermore the sector should consider how internship programmes could be developed and deployed to support mid-career graduate-level professionals to re-skill and up-skill, and perhaps to drive innovative collaborations between UK firms.

The data collected from the ORBIS programme are indicative but clearly far from definitive. Employers, internship programme providers and educationalists need to work more closely to establish how learning is optimised in the workplace, and conduct longitudinal analyses of the career destinations of their interns. These data will help to fine-tune work placement design and delivery, determine their impact, and provide a solid basis on which to engage funders, employers and interns. The United Kingdom's commercial life science sector will be heavily dependent on the skills developed by such programmes, if its future is to be a prosperous one.

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