Short form sustainability and impact final report

Title: Employer Engagement – enhancing HEI engagement with the Satellite Industry for workforce upskilling and informing policy makers

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NOTE: This document is to be read in conjunction with project Interim report. Please complete those questions that are relevant to your type of project and the outputs/results of your project.

Abstract:

The Satellite and Space Industry contributes significantly to the UK's Gross Domestic Product and represents a sector where the UK has an important world role both technologically and scientifically. The UK Space Industry's Space Innovation and Growth Strategy for 2010 to 2030 identifies education and training in STEM subjects as a key factor to support the growth predicted in this sector. Key employees generally have qualifications in the physical sciences, and like other employers of these graduates the broader Space Industry does not always find it easy to source suitably qualified personnel.

We have reviewed the current skill levels of graduates and apprentices entering the sector, and the destinations of graduates from key courses. These have been compared with the skills requirements that employers report, and deficits fed back to universities and professional development course providers. We will recommend how HEIs may contribute to improve the provision of the skilled workforce needed by employers, and also how those employers may engage proactively with HEI STEM departments in order to raise awareness of their own requirements and improve recruitment.

Discussion and Learning (Success):

Since the UK Space Innovation and Growth Strategy 2010-2030 was published and identified that training for the next generation of space engineers and scientists, was critical, many key Government agencies working in this area have raised their efforts to work with the education sector and to raise the profile of STEM subjects. This project was initiated in order to identify the particular skills that employers across the sector find that their recruits lack, and to identify good practices across Higher Education where organisations have successfully engaged with employers to improve the employability of their graduates.

The sector itself is quite complex, in that it includes companies that design, build and manage the spacecraft (Upstream) and those that use space derived data and provide services (Downstream), encompassing location

services (GPS navigation), Earth observation, including weather forecasting, and communications. The spectrum of organisations and their requirements is quite broad, but all require novel problem-solving skills.

We have talked to HEIs, and to employers and employees within the space sector. The requirements of upstream organisations are somewhat easier to quantify; these are a quality numerate first degree in a STEM subject – principally Maths, Engineering (particularly mechanical or electronic), Computer Science or Physics - with a more specialised Masters degree. Downstream organisations, which cover almost the full range of industry sectors from Agriculture to Telecommunications, often look for a more diverse skill set, often similar in the physical sciences, maths and engineering but also earth, marine and geographical/environmental sciences, increasingly with the addition of strong quantitative skills. Analysis of the employment destinations of undergraduates suggests that approximately 30% will go on to study for a Postgraduate degree, and up to 30% may be able to find employment loosely within the industry of choice; for masters students this figure almost doubles, with the remainder going on to further study, showing that employers strongly value the additional skills provided by a postgraduate taught degree. It is worth noting that in general a Doctorate did not confer any particular improvement in employability rates, with the majority of people with doctorates continuing in a research or public sector environment.

In 2010 NERC published the "Postgraduate Review of Skill needs in the Environment Sector". The study is currently being refreshed. That extensive study identified 224 different skills that were required by employers, of which 15 were defined as critical. Our study, which was not planned to be as extensive but to build on the NERC findings, has also identified some similar skill deficits (Modelling, Data Management and Architecture, Numeracy, Professional Communications, Fieldwork, Understanding Risk and Uncertainty); additionally, we found strong demand for languages and basic business skills (Time and Project Management, Balancing Budgets and a willingness to understand the business, whatever it is). Many employers also emphasised some critical areas which are less easy to address (Determination and a 'Can Do' attitude). Most universities are actively addressing the 'soft skill' deficits by developing what they are calling co-curricular courses (presentation, report writing and communications), assisting with work experience and providing elective courses such as languages. In general, we have found that employers are broadly satisfied with the technical knowledge with which graduates leave university, and that experience lies within their levels of expectation. There are some particular aspects that employers from different organisations emphasise:

- Understanding Scaleability issues, and the difference between point and averaged data
- Uncertainty and risk in environmental data
- Catastrophe modelling
- Practical experience (field work) so that they can recognise errors in the data and understand natural processes
- Understanding of simple statistics
- Introduction to 'the business sector' (provided by larger companies during induction programmes but perhaps scope here for KTNs providing for SMEs)
- Understanding the principles and basic programming for natural scientists
- Understanding the relative benefits and shortcomings of different types of data

Some of the technical deficits can be and are rectified through further study options, such as Masters degrees, or short courses (often repackaged MSc modules) provided by a number of HEIs for students once they are in employment. There are a few areas where training is provided through workshops or short courses in particular subject areas, for example Data Assimilation in Meteorology which could be offered to other users but would require a 'rebranding' or change in 'techno-speak' – in the oil industry Data Assimilation is referred to as History Matching and the insurance industry uses similar techniques under other names. In the past data suppliers have provided introductory workshops on the use of various data types, but reductions in profit margins, and the proliferation of different data types marketed by sole providers have made such generic introductory 'courses' unviable, and the expectation is that undergraduates will have been introduced to the basics whilst still at university. Research from the USA (NASA, in press) has supported our findings, which indicate that downstream employers, where growth is anticipated in this sector, are increasingly looking for quantitative experience of Earth observation data analysis (e.g. processing radar data, extraction of soil moisture information). This is an area where experience traditionally resides

within the research community and use within industry has been far more qualitative. Sector-specific short courses (e.g. for insurance, agriculture, food security) will be essential to address these shortcomings for long-term development of space data services.

We have not considered the place of Apprenticeships (or planned Higher Level Apprenticeships) in any depth, noting that there is a report in preparation to address this topic for the space sector. Engineering Apprenticeships are well established within large engineering organisations (EADS Astrium, Serco) but smaller organisations find it hard to support the training aspects required. Many of these organisations are at the extreme high technology end of the sector and voiced concerns about young apprentices having the right attitude to work or maturity to react responsibly both in a lab or workshop, or in front of clients. Higher Level Apprenticeships are in place within the Telecommunications sector, and they work well when partnered with quality Further Education Colleges.

Upstream employers mentioned the importance of chartered status and accreditation by, for example, the Institute of Mechanical Engineers or other learned organisations. This route for continuing professional development has been in place for engineers for many years, and is now being developed for 'Chartered Scientists' supported by organisations such as the Institute of Physics, Institute of Environmental Science and the Royal Meteorological Society. Outside the engineering community, though, this marque is not clearly understood and will take time to be appreciated. It is also worth noting that many of the employers interviewed recruit from global sources, or for co-organisations elsewhere, where chartered status has different connotations. Two employers who recruit internationally (EADS Astrium, BMT Argoss) noted that these international employees came with a more independent, free thinking attitude than those who had been educated through the British system. This might be driven by their relative (older) age , however neither thought this to be the case . Short courses appear to serve the Upstream sector well, and there are close links between key universities (Leicester, Surrey and Southampton in particular) and the industry.

A number of downstream employers commented that graduates in pertinent science subjects weren't aware that they could seek specialist employment within their industry (for instance across the Financial Sector). In many of these cases the employer teams and their graduate requirements are too small to expend much time and effort participating in graduate fairs, however there is a clear opportunity for inviting these professionals to talk to students. Exposure to employers whilst at university comes in a number of forms and clearly makes a difference to employment prospects. Several employers commented that they have used dissertations, work experience and internships as an informal selection process, helping them to identify good candidates for employment and saving on recruitment costs (BMT Argoss, Arup, EADS Astrium). Employers can usefully provide both undergraduate and master dissertation topics where they have close links to the university or course (e.g. Meteorology, Reading University and the Met Office) and industrial partners may teach specialist subject modules (e.g. Space Systems Engineering, Southampton University and EADS Astrium). Such approaches are rarely rejected and can be of mutual benefit – providing students with 'real world' experience, companies with a useful piece of research that they have little time to do themselves and course directors with a broader range of topics.

We have found that the links between the upstream space sector and universities are quite close. There is a clear recognition by employers that if they want to employ the brightest and best, and to do so they need to ensure that they are well known and seen as an employer of choice. Almost all employers report that they're looking for a good first degree backed up by a more specialist Masters qualification, which gives the student more of an insight into the particular business sector. Some employers, e.g. EADS Astrium, are actively targeting particular universities and developing relationships with departments and course directors. They encourage recent recruits to act as 'campus ambassadors' not only providing a conduit for ideas and new research but more importantly as an early 'heads up' on the best recruits for the future. BMT Argoss have similarly developed close relationships with departments and regularly lecture, review research proposals and provide dissertation topics and internships (work experience). They note that the recruitment process begins long before a job offer is received. None of those looking for engineers or

scientists described problems finding good recruits, and generally they do not put a large effort into advertising as applicants come through online media. However, one of the HEI's interviewed (Leicester University) commented that they had recently lost two excellent post doctoral researchers to industry, following something of a bidding war between two potential employers. One respondent from Arup noted that he found the applicants who admitted having found their website independently rather than having been directed to it by search engines like monster.co.uk were more committed to the company and the jobs they might offer. However, finding applied computer science or systems engineering graduates was more difficult, as few have any experience of the data architectures or the large datasets and high performance algorithms common in Earth observation data centres.

The downstream sector tends to have more difficulties. The range of skills they are looking for can be broader, they may not necessarily be known as a 'space' employer (which lends a certain amount of cachet) and the organisations are frequently SME's, meaning that there is less slack in the system to support raw graduates. It is notable that several companies commented that they seemed to be 'invisible' and were only approached through secondary sources (e.g. monster.co.uk) This seems to be an area where they need to work on their own profiles. Many of these organisations report that they favour recruiting graduates who have already been working elsewhere for 2-3 years, a comment which causes concern since this is the part of the sector where most of the growth is predicted to happen and this could be a limit to growth. The key disincentive to employing those straight from university was described as an unprofessional attitude to work and the working environment and a lack of knowledge of the context of the work. The growing culture of work experience and internships should defuse this negative impression, and can serve as an informal 'probation' for the right candidates, but as these are often unpaid this will have a bias on the wealth of the candidates who will be attracted to the sector.

The larger employers (EADS Astrium, Logica, Serco, Severn Trent) have their own Graduate Training Programmes, through which recruits will travel over a period of 2-3 years. During this time they will be inducted into the company, have regular review meetings, complete appropriate training courses either internally or externally, and possibly rotate through different departments within the organisation. Smaller organisations find it harder to provide this type of support to recent recruits, but recognise the benefits that the training confers when provided by others to the new graduate This probably informs their inclination towards recruits who are at least 2 years post graduation. There is probably a need to organise a work experience programme across the sector to give graduates the necessary experience of the downstream sector, which is largely lacking in the UK at present.

Outputs:

There is a clear mutual benefit to course directors and prospective employers building good relationships:

- Work experience / reduction in recruitment costs
- Dissertation topics / possible small pieces of research
- Jobs
- Skills feedback loop to enhance courses further
- Early identification of the brightest and best for recruitment
- Lectures by individuals from employer organisations who are outside the 'norm' e.g. Guy Carpenter Analytics or Arup Geotechnics to Hydrology students, Severn Trent to RFI students

We intend to continue the dialogue with the respondents most of whom have asked for further feedback, as they would like to learn from the best practice of others. Following a successful presentation to teachers at the Farnborough Air Show on July 11th, a number of new employers in the sector have approached us, and we intend initiate links with them in the next few weeks.

The outcomes of this study will be presented to the Space Leadership Council in September, when Prof Gurney has been invited to discuss the report. This is chaired by David Willetts, Minister for Science and Space. It is also intended that a paper derived from these results will be presented at the HE STEM conference in September.

The team at Reading University are already using information derived from the study to inform short course planning for Reading's involvement with the International Space Innovation Centre at Harwell.

Sustainability and Impact:

Approaches to Sustainability	**Examples**	**In relation to your project**
Continuance (finding alternative sources of funding)	Potential for institutions to provide continuation funding. Networks / communities being sustained through inclusion in future funding bids	We are working with the International Space Innovation Centre at Harwell to develop short courses, which will support the growth predicted in the space sector
Embedding (within institutional activity)	Identification of institutional strategies the project might inform. Accessing institutional funding. Uptake within own/other HEIs – for example natural embedding of the activity within the curriculum. Influencing of work of organisations external to HE sector.	We hope that other Institutions will be encouraged to build on their own links with industry, and that industry will conversely see these links as supportive and beneficial in the longer term
Mainstreaming (changes in working practices)	Staff development. Curriculum enhancement. Influencing senior managers.	
Legacy (passing on important elements of the project)	Dissemination activities. Evidence of impact of activities both within the lead HEI and more broadly.	The preliminary outcomes have already been presented to educators at the Farnborough Air Show and the final report will be presented to the Space Leadership Council and the HE STEM conference in September.

References:

1. A UK Space Innovation and Growth Strategy 2010 to 2030 – Space IGS
2. Space Technology – Opportunities for physicists – IOP/Careers 2012
3. Analysis of postgraduate provision at UK Universities, 1994 Group Research Report January 2010.
4. Environment Research Funders Forum : Skills Needs in the Environment Sector – NERC 2010