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# STEM graduates in non-STEM jobs: Executive Summary

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# Executive Summary

This research set out to investigate why some STEM graduates do not work in occupations related to their degree. This question has arisen from previous research looking at the extent to which the supply of graduate-level STEM skills meets employer demand. While there is evidence of high demand from employers (of whom many report difficulties recruiting STEM graduates) and an apparent salary premium for many STEM qualified graduates who work in 'scientific' occupations[1], why is it that a significant proportion of STEM graduates do not enter these occupations? What factors are influencing STEM graduates' career decisions, especially to move 'away' from STEM careers? More knowledge of STEM student and graduate career decisions was felt to be needed to help current efforts to improve the supply of STEM-qualified entrants to the graduate labour market. The research was commissioned by the Department for Business, Innovation & Skills (BIS) and undertaken in 2009 and 2010.

## Defining STEM

The research question was not simple or straightforward. A particular issue is the definition of STEM (and thereby also "non-STEM"). While degree disciplines can be grouped relatively easily into a STEM cluster (subjects grouped as Science, Technology, Engineering and Mathematics), it is much more difficult to classify STEM employment in the absence of a generally accepted definition of what comprises either a STEM job or STEM skills. Neither Standard Occupational Classification (SOC) system codes or Standard Industrial Classification (SIC) codes are particularly valuable to do this, so it was necessary to develop a working definition of STEM and its scope for our research.

The degree subjects with which we were primarily concerned were Physical and Biological Sciences, Engineering and Technology, Mathematics and Computer Sciences, but we also included Subjects allied to Medicine (but excluding Nursing), Architecture/Building, Psychology and Geography within our STEM discipline scope as these other subjects include courses with a scientific focus. We developed our own STEM employment framework, consisting of:

- *A STEM Specialist* sector where employers seek core STEM competences in graduates, a *STEM Generalist* sector where STEM graduates might be suitable or preferred, and *non-STEM* employers where there is no overt demand for STEM graduates; and
- *STEM Core* jobs where a STEM degree and associated competences are directly

[1] Analysis by DIUS, now known as BIS, in *Demand for STEM skills* (BIS, 2009a)

relevant, *STEM-related* jobs where STEM competences are of relevance but applied more broadly, and *Unrelated* jobs where a STEM degree qualification has little or no apparent relevance.

Only by using the combination of both our sector and occupational role classifications, which could be represented as positioning in a 3 x 3 Sector/Occupational Matrix, could we fully understand how much any particular job was a 'STEM job' or a 'non-STEM job'.

## Student career decision-making

A second issue was that existing knowledge (from previous research) suggests that decisions to enter 'STEM jobs' at the point of, or after, graduation are often part of a longer process of career decision-making by individuals. So, aspects of career decisions at different stages in the 'journey' through higher education and into work, needed to be covered in our investigations, as well as career intentions at the transition between degree study and work and graduate employment outcomes. This meant exploring the reasons behind choosing to study STEM as a degree, development of career thinking from entry to university onwards, influences on certain career decisions taken (especially career 'direction', i.e. towards STEM jobs or not) and the factors that appeared to have the most impact on graduates' outcomes. We particularly wanted to assess the extent to which STEM graduates were making conscious decisions to follow paths towards or away from STEM-based occupations, or whether they drifted into them accidentally, or whether they wished to take up STEM careers but were prevented from doing so, by employers' recruitment requirements or for other reasons.

## Research methodology

We needed to see how graduates' decisions differed according to STEM subject and if other factors, such as type of higher education institution, qualification, ability, work experience or demography, might interact with this. An important requirement was therefore to generate sufficient data on STEM students and graduates to understand such potential differences. A mixed method approach was used in the research:

- Reviews of existing evidence drawn from other studies and data sources;
- A survey of STEM students on their career decision-making and intentions, focusing on final-year undergraduates but also taught masters and PhD students ( c.7,000 in total sample);
- Interviews, face-to-face and by telephone, with over 550 graduates now in early-career employment about their actual decisions to take up either STEM or non-STEM occupations and their employment experiences;
- Discussions with over 50 employers of their requirements and strategies in relation to recruitment of STEM graduates and how these might affect graduates'

decision-making and career outcomes.

## Key research findings

### A 'STEM job' or 'STEM career' is not a clear concept

- Employers and graduates tend not to think of 'STEM' but more about degree subject (groups). Students are anchored in their subject rather than in STEM, and consider career/occupational directions in relation to their degree subject, rather than in relation to STEM.
- This results in complexity for analysis and policy – a job like accountancy is seen as strongly degree-related by a Mathematics graduate but unrelated by an Engineering graduate, while a specialist IT role regarded as degree-related for a Computer Science graduate could be in any industrial sector. For a Sports Scientist, working at a local authority fitness centre would be degree-related, but neither the role nor that sector is likely to be regarded as being within or related to STEM in most policy discussions or analyses.
- The definitions used in any analysis of STEM employment are therefore crucial; the 'matrix' approach using both role and sector for any particular job was useful to tell how much it was a 'STEM job' or not, although subjectivity remained in classifying some roles.

### Do STEM students/graduates want a STEM career?

- The vast majority of final-year students, at undergraduate, masters and PhD level, report that they do want to pursue a career related to their degree subject, although that proportion varies somewhat with degree subject, and some are more definite about this than others. As many as two-thirds of those in more 'vocational' subjects like Engineering *definitely* want a degree-related career, but nearer to a half in other subjects. However, between a half and a third are not fully decided.
- Many of the undergraduates who want to pursue postgraduate study also wish to progress to degree-related occupations in the longer-term. Entering a postgraduate course is often a deliberate path towards a STEM career.
- Among those with career ideas, about half are considering a career in a STEM Specialist sector and/or in a STEM Core job function (i.e. the 'core' of STEM employment as we defined it). This varied considerably by subject, with the highest proportions in the more narrowly 'vocational' STEM subjects, but this partly reflects that degree-related STEM employment will be outside this 'core' for many subject disciplines within STEM (e.g. Mathematics, Geography).
- Only a very small minority report that they want to work in employment not related to their degree (11% might not or don't, and even fewer postgraduates),

but a larger and more significant proportion have only vague or no career plans. A substantial proportion of final-year students had not made job applications half way through their final year, and roughly a quarter expect to take time out or enter temporary work next, deferring any long-term career direction decision.

### Why choose a non-STEM career?

- The main reasons students seek a STEM degree-related job are aspirational, chiefly the potential for interesting work and to use their learning and specialist skills. There is no one dominant factor. Career-related and more pragmatic reasons, including expected earnings and job availability, are uppermost for a few but secondary for most that are considering entering a STEM career.
- The most likely reason students seek employment in a direction away from STEM is because other fields are seen to be of more interest, although more practical and career-related reasons are also significant for graduates considering 'leaving STEM'.
- Earnings (expected pay) is an important factor (somewhat more important for males) but not the main motivating factor either to choose STEM degree-related work or not to. Career prospects and earnings are seen as positive reasons both to enter STEM careers and not to, i.e. there are mixed perceptions about where earnings are best.
- In parallel with the student survey, most graduates interviewed had chosen their current job (whether in STEM or unrelated) because it offered interesting work, with starting salary and prospective earnings a main driver for only a minority of graduates, almost exclusively male.
- The profile and reputation of certain major employers, especially in our STEM Generalist and non-STEM sectors, with well-established and substantial graduate schemes, were attractive and powerful influences on 'undecided' graduates at the transition stage between university and work. For many strong STEM graduates this was considered to be the 'mainstream' career route – rather than into specialised STEM jobs – an impression reinforced by peers and some careers services.
- Although few students reported this as a reason for not staying in STEM, employers – especially in some STEM Specialist sectors – were much more likely to feel that STEM had a less attractive image (as employer or working environment) in the eyes of students. In some cases, they felt this perception arose from a lack of real knowledge about STEM employment and unrealistic expectations among many STEM graduates.
- Almost no students and very few graduates reported that rejection by STEM Specialist employers had led to a shift in their direction away from STEM work; if anything rejection from non-STEM corporate graduate schemes was more significant in their decision-making.

## Progressive development of career thinking

- Most students did not originally choose to study a STEM degree primarily for a career-related reason, but rather for interest/enjoyment in the subject or based on their aptitude. Of those that did cite career-related reasons, more thought a STEM degree kept career options open than thought it would accelerate them to a specific STEM occupation, even those studying a subject like Engineering.
- Most started university with few career ideas but developed and firmed them up during their degree study, the majority focusing towards a STEM degree-related direction. The profile and reputation of employers became more important with time, and some began to have some understanding of the graduate labour market.
- Different career routes were progressively adopted depending on degree subject and the firmness of career plans, and the firmness of plans also varied with subject.
- Those who were more career-motivated (i.e. had firmer career plans when starting the STEM degree, or at any later stage), were more likely to wish to enter a STEM occupation. The more 'decided' they were at any stage, the more likely they would seek a STEM career direction.
- Although partly related to career motivation, degree-related work experience had a strong influence on developing a career plan, mostly towards a STEM occupation.
- A substantial proportion of final-year students had not made job applications by the time of survey, nearly half way through the academic year. The majority of graduates who did had applied both to STEM Specialist employers for STEM jobs or graduate schemes *and* to more general graduate schemes with employers related to or outside STEM.
- Many STEM students and graduates did not use their university careers service, yet most felt they would have benefited from additional career support at some point, particularly before they went to university in order to understand better how different degree courses related to potential careers or occupations.
- In principle, most would study a similar degree if they had their time again, although perhaps a quarter would study a different course (and higher for some subjects).

## Complex and individual paths post-graduation

- Many graduates interviewed had still been undecided about career direction by the time they graduated and delayed job applications until after university. Those choosing to take time out or enter temporary work were amongst the least 'decided' and potentially the most likely to drift away from STEM.

- Graduates' eventual job destinations often did not correlate simply with their career thinking before graduation; significant numbers who had applied only for STEM jobs when finishing at university ended up outside STEM, while the reverse was also the case with some who had only applied for non-related jobs at that time ending up in STEM jobs.
- For a minority, particular individual circumstances became more important than strategic career-thinking, as they had to take into account their own personal responsibilities or the impact of potential decisions on personal relationships.
- For those that secured jobs after leaving university, quite complex and often very individual decision-making had taken place, as pragmatic and tactical considerations were combined with what remained of their prior aspirational thinking.
- Some graduates had changed jobs since graduation, due to redundancy or their own tactical choice for similar but higher quality employment. Others had taken until this time to recognise the true direction they wanted in their career; overall, these changes tended to result in shift away from STEM employment.

## STEM graduates doing non-STEM jobs

- STEM graduates were found working for employers' right across the economy, in both private and public sectors, in a wide variety of job roles, although most of the graduates interviewed worked for larger employers.
- Within the workplace, few graduates interviewed used their specific degree subject knowledge a great deal (even those in STEM Specialist work), although their degree subject was perceived as vitally important in gaining such jobs. On the other hand, almost all the graduates – irrespective of employment sector – used the general and broader skills learned while doing a STEM degree to a much greater extent.
- Some skills of high value to non-STEM employers were unique to STEM graduates, such as a particularly logical approach to solving problems, enabling some STEM graduates to progress faster in their careers than non-STEM graduate colleagues.
- Levels of satisfaction with current job and career progress were found to be very high amongst the graduates interviewed irrespective of employment sector, reflecting that many in the sample were in 'good' jobs with 'good' employers. Although many working outside STEM would like more degree-related work, as it might be more interesting, few considered it would be feasible to re-enter STEM occupations, largely due to the expected drop in earnings they thought would result. On the other hand, many did not want more degree-related work as they perceived it might be narrower than their current work.

## Employer perspectives

- The interviews with employers confirmed previous research (and the student and graduate survey findings) that a wide range of employers seek to recruit STEM graduates, and that classifying employers by type can be 'fuzzy' with overlaps in places, especially between our defined STEM Specialist and STEM Generalist employers.
- The employers using the most targeted approaches to securing the STEM skills they need tended to be STEM Specialist employers recruiting graduates for STEM Core jobs (usually into a graduate development programme). Some of these graduates would later move to STEM-related or unrelated jobs as they progressed with that employer. Many STEM Specialist employers also recruited STEM graduates directly into STEM-related or unrelated job functions too.
- STEM graduates could be recruited into a range of job roles or functions in STEM Generalist employers, from investment banking and accountancy to education, as well as commercial and specialised ('STEM Core') functions in non-STEM employers in both private and public sector. Although STEM degrees were frequently welcomed by these STEM Generalist employers, only in a few places was a particular need for a STEM degree qualification specified on entry.
- STEM Generalist (and also non-STEM) employers recruit STEM graduates for different reasons – some focused more on their numeracy and analytical skills, others their approaches to problem-solving, yet others their technical knowledge and skills. It was the ability to apply some STEM knowledge and derived employability skills more broadly which seemed most highly valued.
- The interviews confirmed much of the existing evidence on STEM recruitment problems. STEM Specialists mainly perceived deficiencies in some STEM graduates' technical ability and subject knowledge, and in some cases also in their lack of commercial awareness. STEM Generalist employers did not generally encounter recruitment difficulties.
- There was a wide and sometimes contrasting range of views held about specific STEM discipline deficiencies. All types of employers felt that some STEM graduates lacked some of the broader behavioural skills sought of graduates, such as particular team-working, communication and time management /organisational skills, as well as more commercially-related skills.
- Targeting certain universities or degree courses, or both, was seen as a necessary and valuable part of graduate recruitment strategies of most STEM firms, in order to deliver a sufficient supply of recruits of the calibre they required, and to compete with non-STEM employers. It did not necessarily mean that STEM students from other places were excluded, as any student could apply online, although potentially from a lower information base. Many employers were actively working with schools, especially, and selected universities, to try to

improve STEM students' (and potential STEM students') knowledge of STEM careers.

- The majority of STEM Specialist employers were concerned about potential, and some actual, shortfalls of STEM graduates to fill their core functions, arising from graduates preferring other employers and unrelated jobs. STEM Generalist and other employers, on the other hand, were more likely to see economic benefit in wider dispersion of STEM graduates across the economy. The two main reasons seen by employers as causes of an outflow of STEM graduates 'away' from specialised STEM jobs/careers were the perceived greater attractiveness of careers outside STEM (not least the perception of higher salaries) and the graduates' lack of real knowledge about working in STEM core functions.

## Overall conclusions

The research has given insights to many issues in the career decision-making of STEM students and graduates and their recruitment to a wide range of jobs and employers. It has been shown to be an area of greater complexity than often recognised; and there is not a clear or simple main reason why some STEM graduates are not in STEM jobs. It may result from many individual factors, but the most likely one reported is that students and graduates find other (non-STEM) work potentially to be more interesting, and/or that their chosen STEM degree turns out less interesting or enjoyable than expected so they actively seek a change of direction.

The decision on whether to apply for and enter STEM work is often more a matter of individual choice which takes in a number of push and pull factors, both personal and employment-related, over a period of time. Few students appear to be primarily motivated by pay in choosing a STEM or non-STEM career (despite the economic evidence that financial returns in STEM are better), or are turning away from seeking a STEM job because they have experienced rejection on the grounds of inadequate skills. Some can be influenced strongly away from the degree-related areas of work which they thought they might pursue by the pull of individual employers; for quite a number this is after they leave university as many delay job applications until after completing their degree.

Furthermore, it seems that, rather than them seeing STEM Specialist employers or STEM Core job functions as the expected or mainstream career option for STEM graduates like themselves, a good number (although not the majority) prefer corporate graduate schemes , the majority of which are outside STEM Specialist sectors. For many, and particularly those that have not done degree-related work experience, this is reinforced by their lack of knowledge or experience of what STEM Core jobs and careers are really like, or what the wider opportunities to use their skills and learning open to them might be in STEM-focused jobs, in STEM Specialist or Generalist sectors.

Increasing opportunities for STEM-degree related work experience would be beneficial in developing better understanding in these areas.

The research has called into question the widespread expectation that a STEM student should become a STEM worker/employee. This 'default' career direction is clearly not what many STEM students or graduates have in mind or are adhering to. The situation is more complex and career paths less simple and less predictable than generally thought. The research has also highlighted the fluidity of the students' and graduates' career decision-making (and lack of career thinking in many cases) which lies behind many of the observed individual outcomes. A number of policy messages arise from the research:

- Limitations need to be put on an expectation that choosing to study a STEM subject leads to entering a STEM job. This link has been an important part of the STEM pipeline model which has formed part of the Government's STEM skills strategy, and may require some rethinking.
- A wide range of job opportunities is open to STEM qualified students, and they can secure employment if they develop the appropriate academic and personal skills sought by employers. But there is insufficient awareness of the full range of opportunities available to them and employers' requirements. Furthermore, not enough get the opportunity to gain experience or knowledge of work in STEM which would be beneficial to them in understanding what STEM work entails and how STEM careers can develop. Many acknowledge they would have benefited from additional career support either before they went to or during their time at university.
- For employers, especially those in STEM Specialist sectors, the research confirms that many STEM graduates are attracted to other areas, often because of a lack of knowledge of what STEM work and careers look like but also because the graduates perceive other areas to be of more interest. It appears to be more a case of ignorance rather than decisions to go in other directions due to well-founded negative views. With so many students apparently undecided and without well-founded views, there is much potential to help STEM students firm up career ideas while at university and beyond (especially in the first year or so after graduating when many appear to 'drift away' from STEM). STEM employers need to make their case more visibly, both in terms of the attractiveness of the offer and career prospects but also the opportunities for interesting and rewarding work within STEM employment sectors..
- Employers in STEM specialist sectors are still reporting mismatches between their requirements and the skills offered by STEM student applicants, a problem highlighted by previous studies. Weaknesses in core discipline knowledge and understanding and a lack of high calibre applicants was widely commented upon, as well as for some, specific skills (in Mathematics, for example) and their

general employability. Though action has been taken by universities to align many STEM degree courses more to employer demand, it seems that more needs to be done by them to engage effectively with employers and take account of their needs in the curriculum.

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