CRAC

Evaluation of a scheme to develop pilot engineering and computing conversion Masters courses

March 2019

Report to the Office for Students
By the Careers Research & Advisory Centre (CRAC)

Written by Robin Mellors-Bourne and Keith Williams

Careers Research & Advisory Centre (CRAC)

Careers Research & Advisory Centre (CRAC) Ltd
22 Signet Court
Cambridge CB5 8LA

Contact: Robin Mellors-Bourne
Director, Research & Intelligence

robin.mellors-bourne@crac.org.uk
Tel: 01223 460277
www.crac.org.uk
www.vitae.ac.uk

The Careers Research & Advisory Centre (CRAC) is a registered charity (no. 313164) which provides research, expertise and innovation to all those who support lifelong career development and career-related learning

Contents

1 Executive summary

Background

In 2015 the Department for Business, Innovation & Skills and the Higher Education Funding Council for England (HEFCE), augmented by the Department for Culture, Media and Sport, made funds available to English higher education (HE) institutions to develop pilot conversion courses at Masters level in engineering, data science, cybersecurity and computing. The aim was to explore whether conversion courses at this level could contribute to increasing the number and diversity of highly-skilled graduates entering careers in engineering- and computing-related sectors. There were 28 successful bids which together proposed development of 45 conversion MSc courses, either as new provision (in most cases) or enhancement of existing provision. Funding was essentially catalytic with institutions making additional contributions to development costs.

CRAC has carried out an evaluation of the institutions' activities under this funding. A genuine summative evaluation would aim to assess the extent to which these conversion courses delivered an increase in the number and diversity of graduates successfully pursuing technical or professional careers in these areas but would require longer-term measures beyond the timeframe of the research. However, in the limited timeframe available it has proven possible to provide a range of early insights into potential outcomes from the scheme. Formative evaluation work was also conducted to support the institutions' development work and share with others the learning and experiences that were emerging. This document is the final report of the evaluation study.

Overall findings

The engineering- and computing-related pilot conversion courses scheme has been at least partially successful in terms of achieving a range of its intended outputs and there are some signals aligned with potential intended longer-term outcomes:

- All but one of the funded institutions that proposed to do so have developed, validated and made available new MSc conversion courses on engineering, computing or data science themes (between them 41 new courses), while others that sought funding to broaden intakes to existing MSc provision have achieved that to some extent;
- A total of 31 new courses are actively being delivered to enrolled students in the 2018/19 year – 21 in engineering, six in computing and four in data science;
- A total of 833 students are recorded to have enrolled in this provision to date, of which over 500 have studied data science courses, just over 230 engineering courses and almost 90 other computing-related courses. The total for engineering includes an estimate of additional conversion students enrolled in pre-existing MSc provision as a result of enhancement activity funded through the scheme;
- The number of students starting these courses in 2018/19 was 363, the highest of the three years spanned by this evaluation, suggesting that there continues to be some growth in student participation;
- Two thirds of the students enrolled have been conversion students, i.e. had first degrees that we considered were not cognate in relation to the MSc course discipline. Using definitions developed for this research, their first degrees ranged from 'Near-STEM'

subjects (such as physics or maths) to 'Non-STEM' subjects, with a range of mixes in different cohorts;

- 60% of the students to date have been of UK domicile, which is higher than the proportion in most existing UK provision in these disciplines. Even when one particularly large course, comprising mostly UK domiciles studying part-time, is excluded, the proportion remains significantly higher than the norm;
- There was no evidence that the diversity (in terms of gender or ethnicity) of students on the new courses was substantially different to that of typical cohorts of existing UK provision in these disciplines;
- In all, over one third were mature students (over 30 years old), with evidence that many were returning to HE study to up-skill or re-skill, some of whom studied part-time while in employment. This was the case for three quarters of those studying data science or other computing-related courses (i.e. they were 'returners' rather than having progressed directly after a first degree), whereas over half of those studying an engineering conversion course did so immediately after their first degree. Very few of either group (<5%) had been unemployed before the course;
- Average cohort sizes for data science courses have grown very strongly while for engineering and other computing topics, including cybersecurity, cohorts have been very modest in size and in many cases have not yet reached financial sustainability (although this may be congruent with the slow growth pattern of many new MSc courses);
- Based on the available evidence to date, the vast majority of enrolled students are progressing to the end of their course, successfully completing and obtaining their degrees;
- It is too early for robust assessment of long-term outcomes of the scheme, in terms of impact on entry to engineering/computing careers. However, on the basis of students' anticipated next steps after completion, up to 90% of participants indicated an intention that was aligned with the broad purpose of the funding scheme (and most of those who did not were still undecided about their next step). These intentions were largely borne out in the very modest number of responses from graduates who had completed their course;
- A range of course delivery approaches (including both full-time and part-time models) have been deployed, mostly using a combination of newly developed and existing modules along with provision of some additional support for conversion students. A number of new flexible learning resources developed to support students from varying backgrounds are being used not only in teaching of the new courses as they evolve, but also in some cases to enhance other pre-existing provision;
- Overall, this constitutes evidence to suggest it is feasible for non-cognate graduates to attain an engineering or computing MSc degree through a conversion course, although significant demand for such provision, so far, has only been proven in data science, based on the recruitment strategies employed (which in many cases included some bespoke marketing activity funded through the scheme that would not necessarily be sustained). Arguably, conversion to engineering and computing has always been possible for individual graduates, based on anecdotal evidence, but this project has provided more formalisation of the concept.

Broadly, we infer that much of this new provision could become sustainable in future years, subject to sustained effort to promote the courses leading to further growth in enrolments. Mixed cohorts, comprising both cognate and conversion students, and UK and international students, are likely to be required for financial sustainability.

Several of the data science courses developed have achieved large numbers of students very quickly, thought in large part to be due to current perceptions of very healthy career prospects for those qualified in this area. This success suggests that graduates are basing decisions to undertake further study on perceptions of labour market potential. Many used a new conversion course to re-skill or up-skill from existing employment.

A range of additional outcomes also ensued from the development work funded by the project, including a rise in the level of awareness within some institutions of the concept of conversion. This has resulted in some widening of intake to existing MSc provision and additional conversion-style provision being postulated in other disciplines. Conceptually, conversion appears to be feasible based on teaching that is either bespoke to conversion students or comprises an introductory module to underpin study of existing MSc teaching, together with additional support on a personalised basis.

Institutions are beginning to use of some of the new modules created more widely, along with the more personalised approaches to learning and student support developed, in their other programmes. Much MSc provision involves sharing modules between different courses, so there is scope for the new modules and content to be used widely.

Emerging issues

Aside from the data science courses, which have exceeded student enrolment expectations, the majority of new engineering- and computing-related courses have not secured the number of students projected in funding proposals. This was partly due to delays in the timing of course launches, as around half of the institutions were unable to develop new provision and have it validated quickly enough for marketing and launch for 2016/17 delivery. To some extent this related to some mismatch between the timing of scheme funding and the conventional cycle of course development and launch, in addition to over-optimism.

Most institutions are now in the second or third cycle of delivery so there has now been time for implementation of the full range of conventional marketing activities. On this basis, the slow growth of the new courses could reflect very modest demand from graduates for conversion courses in engineering and some areas of computing, or a lack of awareness of this type of provision, or lack of perception of a strong labour market, unlike in data science. More generally, anecdotal evidence from institutions suggested that it could also reflect low awareness of the idea that a postgraduate conversion course could enable career change or the up-skilling needed to enter a chosen career.

Course leaders report that most conversion students progress well and that high proportions of the cohorts to date have successfully completed their courses and graduated. There is preliminary evidence that completion rates and academic performance of conversion students may, on average, be as high or higher than typically experienced amongst cognate students at MSc level, as conversion students tend to be very highly motivated. Mixed cohorts (both cognate and conversion students) appear to offer beneficial opportunities to leverage peer-to-peer support amongst students.

While this provides evidence that 'conversion' of non-cognate graduates can result in them achieving MSc qualifications in the desired engineering and computing subject areas, there is as yet little evidence for longer-term outcomes which take time to accrue. Feedback from graduates from the courses and course leaders suggests that many of the graduates to date have obtained or are seeking the types of occupational role envisaged by the funders, in the engineering and computing sectors. However, a longer-term view would be needed to monitor their future career trajectories and, for example, whether they are able to acquire professional recognition such as Chartered Engineer (or equivalent) status.

2 Context and introduction

2.1 Background

Irrespective of their political hue, UK governments have for several decades persistently sought expansion in the number of people who study science, technology, engineering and maths (STEM) subjects in higher education (HE). This is principally to satisfy an evolving labour market that is believed progressively will require higher levels of skills and serve industrial sectors that are increasingly knowledge- and technology-focused. Recent growth in participation in HE in the UK has resulted in an increased number of STEM graduates emerging from education but they do not all enter STEM industries or occupations as their skills are also valuable in other sectors.[1] Despite that growth in the number of STEM graduates in the UK, policies seek further increases.

Employers and professional bodies in engineering continue to report skills shortages in the UK engineering sector, including at high skill levels. Engineering UK, for example, considers that a substantial proportion of the estimated 2.6 million job openings in engineering predicted in the decade 2014-2024 will require graduate-level skills, but that the current rate of supply of engineering graduates is insufficient to fill this need.[2] It predicts annual shortfalls of tens of thousands of STEM graduates per year, to satisfy new and replacement demand for labour within engineering and related sectors. Paradoxically, this is not always necessarily evident at the point of graduate recruitment, at least into larger engineering firms, where applications are reported to remain healthy and competitive.[3]

Engineering UK's broad view of an overall skills shortfall was endorsed in the current government's Industrial Strategy[4] and 2018 was designated 'The year of engineering' in a campaign to promote engineering in all its respects. At a more specific level, trends of supply and demand vary within different sectors and sub-sectors in engineering and other STEM-related industries. Some sectors can experience rapid surges in demand as a result of sudden maturation or deployment of a particular technology and/or growth in a particular market. The Industrial Strategy recognised cybersecurity, artificial intelligence and data science as three aspects of the information technology (IT) sector that are currently experiencing rapid growth. It seeks an increase in the extent and level of computing skills so that the UK can take advantage of that growth; amongst the recommendations were new policies to develop higher level digital skills, including changes to educational curricula.[5]

To date, one of the main strategies in response to graduate-level skill shortages has been to try to increase the number of people leaving secondary education with the STEM qualifications that enable progression to HE to read a first degree in a STEM subject (who will become the graduates capable of transition into STEM employment). However, increasingly, it is realised that fulfilment of the demand for high-level skills in engineering or IT/computing, as examples, will require not only more new engineering or computing/IT graduates to enter from education but also other new entrants to these sectors. The potential

[1] *STEM graduates in non-STEM jobs*, BIS Research Paper 30, 2011
[2] *Engineering 2017 – The state of engineering*, Engineering UK, 2017
[3] *Engineering employer graduate recruitment practice: Investigating barriers to diversity*, Royal Academy of Engineering (in press)
[4] *Industrial Strategy: Building a Britain fit for the future*. HM Government, 2017
[5] Tech experts to provide National Centre for Computing Education, Department for Education, 2018 https://www.gov.uk/government/news/tech-experts-to-provide-national-centre-for-computing-education

for intersectoral mobility is therefore increasingly visible in policy, i.e. the movement of existing STEM graduates – working in other sectors or not currently in the labour market – into these target sectors. In many cases, this will require some re-skilling and/or up-skilling of graduates who are existing employees or returners to work. A National Retraining Scheme has been proposed to trial approaches to up-skill adults, which has a focus on the digital and construction sectors, while STEM skills feature prominently in pilot projects under the 'Returners Fund' which seeks to bring skilled people back into the labour market.[6]

One such pathway which could increase the total flow of graduates into the engineering- and computing-related sectors could be through 'conversion' courses at postgraduate (PG) level, which could provide an entry mechanism for those who studied first degrees in other disciplines. Such students could be recent first-degree graduates who have not yet entered the labour market long-term, who recognise that their career prospects could be better if they had an engineering or computing PG qualification rather than just their current first degree. Alternatively, they could be graduates seeking a return to HE study after a period in the labour market as a strategy to re-skill to upgrade their career or to change sector.

A further angle of interest in such a pathway is diversity. The under-representation of women in engineering has been an issue of concern to the sector for decades. As highlighted by former Department for Business, Innovation and Skills (BIS)[7] Chief Scientist John Perkins,[8] widening the gender and ethnicity profile of entrants to engineering occupations would be beneficial in trying to increase the total flow of skills. The same applies to IT/computing. It has been noted that the gender profile of PG engineering courses is somewhat more balanced (roughly one in three or four are women) than for undergraduate courses (where around one in eight of students are female).

Recent research has revealed that employment outcomes for UK engineering first-degree graduates of ethnic minority background are weaker than for comparable white graduates, and that this differential appears to be greater for engineering graduates than across all graduates as a whole.[9] There is also concern to increase the proportion of entrants from less advantaged socio-economic backgrounds.[10] It is possible that an additional PG route into the engineering or IT/computing labour force could contribute positively to efforts to diversify these sectors.

2.2 Engineering and computing conversion masters pilots scheme

In December 2014, the Government's Science and Innovation Strategy invited the Higher Education Funding Council for England (HEFCE)[11] to support HE institutions to develop and pilot PG engineering conversion courses for non-engineering graduates. Subsequent research identified certain engineering sub-sectors where an enhanced supply of graduates through specific conversion courses would be particularly welcome, including agricultural

---

[6] *Industrial Strategy:* op cit.

[7] Subsequently the Department for Business, Energy & Industrial Strategy

[8] *Professor John Perkins' Review of Engineering Skills*, BIS, 2013

[9] *Employment outcomes of engineering graduates: key factors and diversity characteristics*, CRAC report for Royal Academy of Engineering, 2016

[10] Royal Academy of Engineering Graduate Engineering Engagement Programme: https://www.raeng.org.uk/policy/diversity-in-engineering/employers/graduate-engineering-engagement-programme

[11] HEFCE, which commissioned this study, was replaced by the Office for Students in 2018

engineering, additive manufacturing and civil engineering.[12] It confirmed that some conversion MSc courses already existed in engineering which were targeting graduates from maths and physics – degree disciplines from which graduates might most readily 'convert' – but proposed that additional provision could support a wider range of STEM graduates to convert to engineering.

Funding was made available to HE institutions by BIS and HEFCE in autumn 2015 to support development of pilot conversion courses in engineering, augmented by Department for Culture, Media and Sport (DCMS) funds to extend this to data science, cybersecurity and software engineering. The focus for this specific data science theme was the computing and analytical science that underpins 'big data' – an area of very rapid growth and high demand for skills, highlighted in the Industrial Strategy, across a multitude of industry sectors.

A total of 28 bids to the fund were successful, mostly from individual HE institutions but in a few cases from institutional collaborations. Between them they proposed development of 45 conversion MSc courses, either as wholly new provision (in most cases) or enhancement of existing provision. The funding was essentially catalytic (generally around £50,000 per project) so most institutions contributed significantly themselves to development costs.

CRAC was appointed in 2016 to conduct an evaluation of institutions' development and provision of proposed conversion courses, and to provide some initial assessment of the extent to which this approach might contribute to increasing the number and range of highly skilled graduates in careers in engineering- and computing-related areas. In order to accommodate both recent graduates emerging from HE and potentially the re-skilling or up-skilling of graduates already in employment, institutions were encouraged to consider a range of delivery approaches and modes, including full-time (FT), part-time (PT) and distance learning. Informed by the development trajectories of many participating institutions, the duration of our evaluation project was subsequently extended by a year, to end on 31 December 2018, from its originally anticipated period (summer 2016 to December 2017). This document is the final report of our evaluation work.

[12] *Transition to Engineering,* HEFCE, 2015

3 Evaluation aims and methodology

In our original proposal to HEFCE for this evaluation project, we recognised that there would be benefit in both formative and summative aspects to the work. A very simple logic model for impacts of the scheme identifies that from the project inputs (essentially the funding that allowed courses to be designed and developed), there were a range of outputs (relating to the courses that were developed and provided by the institutions and the students participating on them) and potential longer-term project outcomes (more graduates working in engineering- or computing-related occupations and careers as a result of their participation on the courses). The main aims of the study were:

- In relation to project outputs:
    - To understand how institutions developed and delivered courses under the scheme and the educational approaches they took to develop the desired skills and knowledge;
    - To capture and share effective educational innovation and practice across the scheme;
    - To understand how institutions marketed the courses and which types of graduate they targeted, and how well it worked in terms of recruiting participants onto the new courses;
    - To observe how the conversion courses worked in practice, from the point of view of course leaders and students;
    - To assess the 'success' of the courses in terms of the number of student enrolments (i.e. participants in this new provision);
    - To identify the profile of participants on the new courses (to assess the potential contribution of these courses to widening access to engineering- and computing-and related careers, including 'returners' to study from later career stages).
- In relation to outcomes of the scheme (that were potentially observable within the timeframe of the evaluation):
    - To understand whether students successfully completed their courses and obtained the resultant qualifications:
    - To obtain any insights available into participants' subsequent career-related decisions and employment outcomes;
    - To assess the extent to which institutions would sustain this provision beyond the period of funding of the scheme;
    - To make some initial predictions of the potential impact of PG conversion courses in terms of a response to skills gaps or shortages in the relevant sectors, and/or suggest how this might be monitored in the longer term.
- In terms of formative benefits:

- To highlight any other impacts observed within the operation of the scheme including the potential for related developments;
- To provide recommendations for the HE sector and institutions about future provision of conversion courses, and how they might be developed, targeted, marketed and delivered.

Three main sources of information were available to the evaluation project: the proposal documents and progress reports submitted by the institutions to HEFCE in relation to their participation in the scheme; the institutions themselves (through course leaders and other staff involved in developing the courses); and participants on the conversion courses. The research methodology selected was based around these three potential sources but was also specifically designed to maximise opportunities for institutions to share their learning during the scheme.

Desk research was undertaken initially to study the proposals submitted by the institutions to HEFCE for funding under the scheme, to understand the approach they planned to undertake, their target market and the outcomes they had projected (in terms of courses they intended to develop and subsequently numbers and types of student participating on them).

The institutions were split into three groups, each of which was allocated to a member of our research team. During summer 2016, our researchers visited each institution to conduct detailed interviews and discussions with course leaders and other staff involved. This provided us with greater insight into their plans and, especially, more understanding of the approaches they were taking in practice and the context within which they were taking place, as well as the progress being made. These visits were followed by periodic planned contact by telephone or Skype, across the lifetime of the evaluation (roughly 2.5 years). Information was also drawn from monitoring forms and final reports completed by institutions submitted to HEFCE in December 2016 and autumn 2017, respectively. We also requested specific information about student enrolments on an annual basis. It was notable that the alacrity with which some course leaders engaged with us waned somewhat over time, particularly beyond the period of HEFCE funding. In some cases, institutions engaged consultants to lead the project design and implementation, so termination of their contracts at the end of the funding resulted in a lack of continuity of contact with potential key informants. We do not believe that this reflected any lack of enthusiasm in developing the new course provision, but more that they were already expending a lot of personal time and effort running the courses (and providing additional support to some students) and struggled to prioritise the additional tasks we asked of them. We were interested to note one senior HE staff member’s comment that the amount of monitoring and information that we were seeking from them in relation to income of £50,000 was more than they had to divulge for monitoring of other grants in excess of a million pounds in value.

Two workshops were run in London with representatives of the funded institutions, co-developed by CRAC and HEFCE and facilitated by the research team. The first, held in June 2016, focused on institutions’ rationales for involvement and their development of pilot courses, including student targeting and marketing, and how they were approaching content and pedagogy. The second, held in November 2016, focused on early experiences of delivery to participants and practical challenges. This was another opportunity to share insights from marketing and development strategies, from both those who had launched courses and those who were yet to do so at that point.

The workshops were very well attended, with 20 institutions represented (through 29 staff) at the first and 25 institutions (32 staff) at the second. The workshop programmes were based on facilitated, thematic round-table discussions. Discussion points were then synthesised into summary outputs which were circulated to participants and those unable to attend.

Although institutional contacts were asked to report certain characteristics of the students who enrolled on their pilot courses, this provided less complete information than we had originally envisaged. Course leaders in many cases did not have ready access to some details about their students, as these were retained centrally within their institutions – within the function which presumably generates data returns to the Higher Education Statistics Agency (HESA), and/or the admissions or marketing departments. In particular, key information for this project was the discipline of a student's first degree but this was not available at department level and would need to be retrieved from individuals' application forms, which are held in admissions departments. The extent and depth of information about students we gained from this type of reporting was therefore somewhat variable, although comprised a key aspect of our monitoring of participation.

In addition, we wanted to investigate independently with the students who they were, their motivations and, where possible, at a later stage their experiences and outcomes. Online surveys for students (referred to here as 'participants') were undertaken annually in October 2016, 2017 and 2018, targeting students who enrolled on newly launched courses (or subsequent delivery) in those academic years. In addition, further surveys were conducted in October 2017 and 2018 which specifically targeted students who were completing their courses and/or had just graduated ('completers'), to gain any insights possible into their experiences, outcomes and next steps, to assess potential future career impacts at an individual level. Response numbers to the surveys were in all cases modest, not least because the total number of students that could be surveyed was very modest, especially in the first year of delivery. This had a knock-on effect in that responses to the completers surveys were inherently relatively few, as these surveys could only be conducted with students who had undertaken FT courses at institutions which had launched their courses early in the project. For data protection reasons, we did not have direct access to students' contact details and so were totally reliant on course leaders to send out survey invitations on our behalf, which was dependent on their level of engagement with us (which, as noted above, in many cases dropped somewhat beyond over time) as well as being subject to approval from those guarding such data in the institutions.

Nonetheless, these surveys did provide a range of quantitative, semi-quantitative and qualitative information from students, which was valuable in obtaining a rounded view of participation in these early years of course provision, and provided early indications of genuine outcomes for at least a few individuals.

4 Institutions' approaches and models

4.1 Approaches to conversion and course development

Institutions' approaches to developing and delivering engineering- or computing/data-related conversion courses were varied. We investigated these by studying their proposals to HEFCE for funding, their reports to HEFCE during the project and our periodic discussions with course leaders and other staff involved. The approach taken by most was to attempt to match 'conventional' engineering/computing MSc output by additional learning activity and support, while a very small number of institutions instead considered what was possible within the study volume of a course and defined a different level of output that would fulfil skills demands.

There are no defined syllabi for Masters degrees in engineering but the design of programmes is subject to a range of constraints. Two such constraints are the broad specification for a Masters programme of 150 credit points of learning at Level 7[13], of which up to 30 points may be at a lower level, and the benchmark expectations of engineering professional bodies relating to subject knowledge and professional competence. The UK formulation of internationally agreed professional standards is defined in the requirements for recognition at Chartered Engineer level. The two major academic routes to such recognition are currently:

- An approved integrated Masters (MEng) programme designed to provide integrated academic and professional development comprising 360 credit points at undergraduate level and 120 credit points at postgraduate level;
- A 360-point first degree in engineering followed by an MSc in engineering. There is flexibility in this route for recognition of a range of first degrees, most commonly including physics and other physical sciences with significant mathematical content.

Whilst the detail of permissible (acceptable) routes to professional recognition is complex it is important to recognise that Masters-level study is an integral requirement and not an alternative to study of engineering at undergraduate level.

Thus, the challenge facing programme designers within the pilot conversion course scheme was in balancing institutional and professional output expectations with potential student entry characteristics. Adherence to a specific established Masters output would inevitably constrain the extent of conversion that was achievable within the study span of a Masters programme.

As described in the next chapter in relation to the characteristics of enrolled students, we considered student type in terms of the 'distance' of their first degree from the engineering or computing/data focus of the conversion course (which we considered as core STEM subjects). Thus, students' first-degree subjects could range from 'Near-STEM' disciplines (such as maths or physics) through 'Far-STEM' disciplines like chemistry or a biological science out to 'Non-STEM' disciplines such as business or a social science.

For students from a Far-STEM or Non-STEM background, achievement of the standards expected of Chartered Engineers would be extremely challenging whereas conversion to a

[13] National Qualifications Framework Level 7: https://www.gov.uk/what-different-qualification-levels-mean/list-of-qualification-levels

lower, but potentially nonetheless industrially relevant, level of engineering qualification could be much more feasible.

Constraints of time and resource resulted in the majority of projects adopting an approach based on reverse engineering from the benchmark Masters output definitions. In practice this meant restricting potential applicants to those who had first degrees in the Near-STEM domain. A much smaller number of institutions designed their programmes around the output behaviours that they believed were practically achievable by those from Far-STEM or Non-STEM backgrounds, which could fall short of what professional engineering institutions would feel they could recognise.

These constraints are less severe in the data sciences domain, where the knowledge base and professional practice are both in rapid evolution.

With that context, we considered the approaches of the institutions in two dimensions. One was the extent to which institutions developed new teaching and learning, content and materials, or used pre-existing content and teaching modules. Approaches varied from those which essentially used only pre-existing content to those which developed new courses using entirely new, bespoke content, which they devised and developed utilising the scheme's funding. The level of funding available would in most cases not have been sufficient on its own to generate entirely new and innovative provision, so many institutions committed additional resources and investment themselves. It is likely that the requirement to do so impacted to some extent on the approach they took, as they will have sought to develop materials with the potential for value not only for these specific new courses but more widely in their provision.

The second dimension was the nature of the students (in terms of first-degree subject) that they targeted, i.e. the 'distance' of the first degree from the engineering or computing/data focus of the conversion course as described above. A cognate first degree would plot as zero in terms of this distance. When it came to implementation of their new courses, some institutions were essentially more ambitious in trying to target a wide range of students including those who were much more 'distant' in terms of first-degree subject, while others were more conservative in restricting their targets to disciplines closer to engineering or computing, such as physics. It should be stressed that this discussion is based on the original targeting as expressed in institutions' proposals, because in reality most achieved cohorts including at least some cognate students.

Figure 1 illustrates where proposed courses were located using these two dimensions. Its vertical axis indicates the 'distance from core STEM' (in terms of first degree background) of the students being targeted by each course. Strategies ranged from a more conservative focus on 'Near-STEM' subjects, plotted at the lower end of the y-axis, upwards through 'Far-STEM' subjects and most ambitiously to 'Non-STEM' subjects at the top. Where a range of student backgrounds was specifically proposed, we represented this with a single, average position. The horizontal axis represents the spectrum of approaches, from the use entirely of an existing course, or existing modules and content, at the left-hand end, to new courses entirely composed of new content on the extreme right. Each institution's main approach is plotted schematically as a single point, although judgements had to be made about where specifically to plot each one, as many institutions targeted a range of graduates and also a range of approaches.

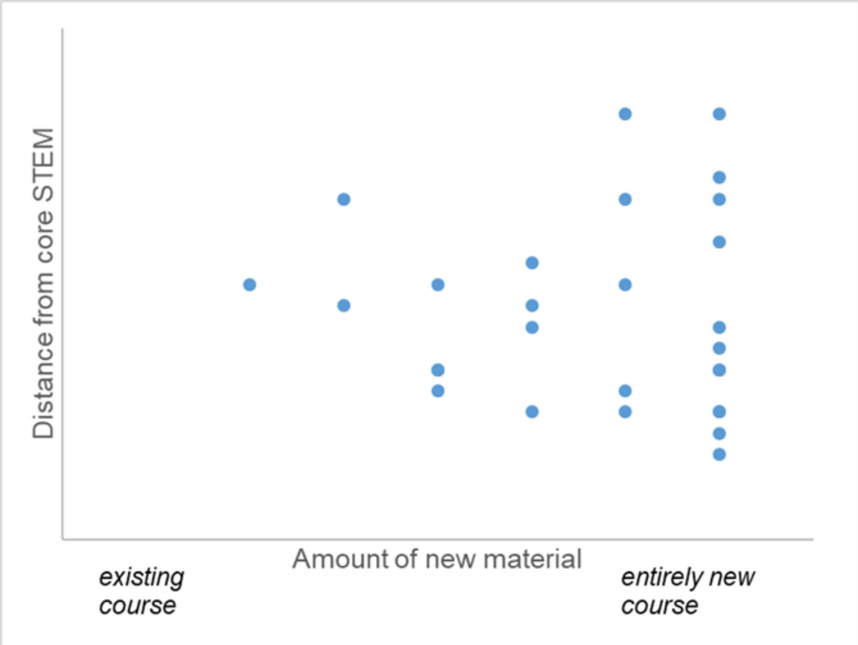


Figure 4.1 Schematic of course/content and targeting approaches taken by institutions

The depiction is similar to analysis of a new product proposition using an Ansoff Matrix, which traditionally considers product development strategies in terms of novelty of the product and whether the market is existing or new. Conventional wisdom is that the most ambitious business development strategy is for a new product in a new market, which is generally the top right segment of the Ansoff matrix. In the context of this project, that would be developing an entirely new course which targeted Non-STEM graduates.

The chart demonstrates that a wide range of strategies was proposed. Many proposals for new courses were based on development of entirely new content and material. Of these, some were ambitiously targeted at a wide range of graduates, while others were more cautious in their targeting of students in terms of discipline. All proposals were written on the basis of targeting UK graduates rather than international in domicile.

Perhaps most popular as an approach were those institutions which proposed a new course (or more than one) which leveraged modules and content already in place for teaching of existing MSc provision but added new modules or content. These institutions devised and developed bespoke, new modules to provide the underpinning engineering or computing background that conversion students would need in order to study the existing modules. In some cases, some existing undergraduate level content was included, as the requirement for Masters level study is 150 credits at Level 7, allowing for up to 30 credits at a lower level. All provision included a project and dissertation.

Additional new content intended to facilitate ‘conversion’ could take the form of one or more introductory, bridging or conversion modules, taught either at the start of the course or, in a few cases, as a pre-course module. In some cases, such a pre-course module was a non-assessed part of the study programme. Some institutions devising computing-related courses labelled such a pre-course module as a ‘bootcamp’ – for example, as a means to develop the necessary programming skills.

Certain institutions proposed new courses that comprised new pathways for students but that were entirely made up of existing modules or teaching. One identified two potential routes that could be appropriate for either 'Near-STEM' or 'Far-STEM' students, respectively, while another offered bespoke pathways depending on individual student background. These pathways included both undergraduate modules as well as Masters-level modules from existing provision to deliver the learning needed by a conversion student. This approach, which avoided development of substantive new content, was relatively rare, as most institutions preferred an approach of developing at least some bespoke new content.

At the left-hand end of the chart, a small number of institutions utilised the scheme funding either entirely or mainly to adjust its marketing and selection processes to widen the range of students attracted to and/or enrolling on existing MSc courses. Their strategy was to widen the 'funnel' to their existing MSc provision by attracting conversion students in addition to the flow of cognate students to their courses.

In practice, the most common models were a combination of several of these approaches, i.e. development of one or more specific new conversion or bridging modules for conversion students together with some extent of new marketing or recruitment to attract such students.

One factor underpinning the strategy adopted by institutions was the extent of existing engineering- or computing-related MSc provision. Those with more extensive pre-existing provision had more opportunity to preface existing modules with an introductory or conversion module, or devise a new conversion pathway, whereas those with little or no existing relevant MSc provision had to develop all content anew. All institutions acknowledged, to some extent, in their proposals, that they would have to provide more substantive and personalised support for conversion students than cognate students, and some underpinned this with additional staff capacity within their proposed models.

In almost all cases, the proposals stated that courses would be offered on both FT and PT modes, with a handful of exceptions where only a single mode was envisaged. Full-time provision was anticipated in most cases to be of a year's duration (potentially plus additional time to undertake a project), with a few exceptions where a two-year FT course was devised. A variety of models, including flexible delivery and elements of distance learning, were postulated for PT students, as many institutions anticipated that they would need their course to appeal to those who remained in full-time employment. All models could be considered to be blended, as is almost invariably the position for UK taught PG courses.

4.2 Case studies

A selection of case studies follows to illustrate the range of approaches taken. These include some information about enrolments, participants and outcomes, which are considered in more summative fashion in the next chapters.

Case study 1: Data Science, Birkbeck, University of London

Birkbeck specialises in educating mature PT students, most of whom work while they study. Its Department of Computer Science and Information Systems developed a new MSc Data Science course through the conversion pilots fund, to complement an existing conversion MSc in Computer Science. The new two-year PT course was structured as four compulsory modules covering fundamentals of software engineering design and development, plus applied modules on data science and analytics, all at Level 7. Although some are shared with other courses, new material on data science was developed. Students use Python and R programming languages, in line with employers' reported needs. A new pre-course online module was developed for applicants to provide a feeder and widen access, which included maths, probability and statistics. Birkbeck already offers several study skills workshops to help students move and/or return to PG study and develop or refresh maths skills.

Most module content is delivered through face-to-face lectures and labs in the evenings, supplemented by material on a virtual learning environment (VLE). Industry speakers contribute inspiration, motivation and insight through guest lectures, case studies for use in teaching and supervision of student projects. Engaging employers sufficiently was expected to be challenging and funding was used to hire a part-time employer liaison officer.

The new course targeted graduates in and around London considering a career change into IT and/or a wider skillset including data science. Entry requirements are a good first degree in any subject (other than computer science) together with demonstrable aptitude for computing languages – this is tested during the application process. A bespoke marketing campaign, highlighting career prospects, was run using traditional media and online, utilising existing links with employers and targeting Birkbeck's own non-computing graduates. Four new videos were commissioned, promoting the subject and its prospects but also reassuring non-computer science graduates that they could engage with the course and achieve a recognised qualification. The videos proved to be very popular, with one being served to over 100,000 people, and were therefore cost-effective.

The new MSc was approved by the college in February 2016 and 110 applications led to 34 students enrolled (exceeding the target of 16) for 2016/17 start, 26 of whom were UK-domiciled. Practically, all first-year modules were pre-existing, enabling time to develop the new content for use in the second year of the programme. Since then, a new programming module and a data analytics module have been introduced into the first year for the second cohort, to give earlier exposure to data science topics.

Enrolments have easily exceeded recruitment targets: 88 new students (almost 80 from the UK) enrolled in September 2017 and 93 a year later. Such is the popularity that Birkbeck has introduced a FT version in parallel, with a further 34 students. Around half of all students have first degrees in STEM subjects, but significant proportions have economics, business and management, and also arts and humanities, backgrounds. A small number of students have been sponsored by employers, including the Office for National Statistics.

The first cohort has now completed and are graduating successfully, with around 80% completing in two years (better than is typical for a PT course). Informally, course staff reported that on average conversion students have done better projects than cognate students, which may reflect their higher motivation as they see the course as a stepping stone to a better career.

Case study 2: Data science, University of Salford

Salford's new Data Science programme was designed to expand access to data sciences as there is worldwide demand for staff capable of working in the expanding realm of 'big data'. Its existing provision of data-focused conversion programmes focused on those from either computing or business degrees. The opportunity was taken to develop a teaching strategy designed for intakes of graduates from a mix of disciplines provided they had mathematical underpinning, an enquiring mind and an analytical approach to problem-solving. The aim is to enable them to become effective data science practitioners in business.

Programme design was assisted by Salford's close collaboration with SAS, a US-based data analytics software specialist which has 24,000 employees worldwide. SAS offers professional certifications related to the use of their software products (analogous to Microsoft or CISCO certifications) which have established acceptance by employers. Salford is classified as a SAS Academy and has access to SAS proprietary teaching materials. The connection also enables Salford to gain insights into skills requirements of employers that use SAS products. There were established arrangements for students studying appropriate modules at Salford to be awarded SAS Certification, on achievement of a certain score in Salford's assessment. This was planned to continue on the conversion programme, providing both academic and industry certifications.

An initial two-week intensive session brings students to a common starting point, with formative assessment providing diagnostics for likely future support needs.

Validation and development of the course followed a tight schedule but use of SAS proprietary materials helped the development team move sufficiently quickly. 21 students enrolled in September 2016, which exceeded expectations in both number and subject diversity. The students were drawn from 13 subject areas (including from biomedical science and pharmaceutical science, areas of strong potential for big data) with a maximum of three students from any single discipline. Initial marketing efforts focused on graduating students at Salford, using presentations to students negotiated with other departments. Existing industrial links were also exploited. Demand was such that a second intake of 32 students entered in January 2017, again with three quarters from the UK. The number of companies working with Salford and providing live projects for students expanded from 19 to 44 that year.

Strong recruitment has continued with 24 more students starting in September 2017, 54 in September 2018 and sufficient demand for another start of 30+ in January 2019. Application numbers are the highest of any Salford Masters programme, and it is second on the basis of confirmed enrolments. The course received the Salford Vice-Chancellor's Distinguished Teaching Award for excellence and innovation in a 'real-world' student experience with evidence of cross-departmental, interdisciplinary working, undertaken in partnership with external stakeholders.

The new Data Science programme has significantly exceeded its student number targets and, through its association with an industry standard software provider and involvement of a large number of employers, is clearly meeting the needs of private and public sector organisations interested in increasing their data science/analytics capacity.

Case study 3: Cybersecurity, University of Chester

The University of Chester acquired the Thornton Science Park (between Chester and Ellesmere Port) and developed it as the base from 2014 for an expansion of its STEM provision alongside companies engaged in research and innovation activity on the site. The university's recent strategy, following consolidation of undergraduate provision, is for a future focus on apprenticeship-based programmes and expanded Masters provision.

Chester recruited new staff, including the project lead, to enable the introduction of cybersecurity-related programmes, in order to leverage experience of cybersecurity in the public and private sectors. An undergraduate programme was launched in 2015 and, using the conversion pilots funding, the new Masters programme was designed and validated to a tight schedule for launch in October 2016.

Industry experience is that computer science graduates do not necessarily have the skills needed for cybersecurity work, with its blend of human and organisational factors. It is not as mathematically demanding, so a cybersecurity programme should be accessible to students from a broad range of disciplines. The aim is to enhance the computing capacities of non-cognate graduates and the human factors dimensions of cognate graduates. The assumption in entry requirements is that students must have the capability to undertake some form of technical task using skills developed in their prior education. Previous coding experience is not necessary and additional introductory materials have been developed to enable students to attain a common starting point. To provide flexibility, the programme is available in FT and PT modes.

The team established industrial links through active engagement with the North Wales Cyber Security Cluster, which specialises in the nuclear industry. The industries of NE Wales and the Chester/Warrington economic area are intimately linked with the university's strong aerospace, automotive, chemical and optoelectronics specialisms. These industry links provide projects and placement opportunities spanning diverse business and industry sectors.

Teaching input from the university's Institute of Policing had been planned, as an integral component of initial delivery of the programme, but staffing pressures at the institute forced the use of alternative module materials in the first two presentations of the programme. The short lead-in time to first delivery also rendered impossible the commissioning and use of a virtualised server network, although this was remedied midway through the year so that students had access to this network both on- and off-campus.

Recruitment has met expectations in terms of student numbers and diversity, including diversity of degree discipline. The first delivery in 2016/17 attracted seven UK students, with 12 new students enrolling in 2017/18 and a further 16 in the cohort which started in September 2018 (half of the latter being part-time students). Throughout, the majority have been of UK domicile and around half have had first degrees unrelated to computer science.

Case study 4: Computing MSc courses, Southampton Solent University

Southampton Solent has been delivering computing-related undergraduate degrees for over 20 years but only had a single Applied Computing MSc course prior to the scheme. One of its rationales for participation was to increase MSc-level provision in strategic areas. It also recognised that there were few ‘conversion’ opportunities on the south coast, and Solent has a mission to provide HE that is vocationally relevant to local needs. It also has a strong ethos of flexible provision and wide diversity of participation in its programmes.

Three new course titles were proposed although this evolved to four in practice. All were launched in autumn 2016 and all have run every year since: Computer Engineering; Cyber Security Engineering; Digital Design; and Data Analytics Engineering.

The courses aimed to appeal both to employed professionals wanting to upskill or change career and new or recent graduates from Solent itself or resident in the region. The development team were conscious that some degree subjects, including psychology and business, generate large numbers of graduates but have weaker graduate employment outcomes. Solent has experience of teaching computing- and data-focused first degrees to students from very diverse backgrounds, and/or with little or no prior knowledge/experience of technology, so extending this approach to Masters level seemed logical.

The delivery model is a ‘pick and mix’ approach so students attend existing provision at Levels 4-6 for up to 30 credits to gain the necessary basics and study newly created Level 7 modules (and some shared with the Applied Computing MSc) for the remainder. All the courses have core elements to build skills in areas like object-oriented programming, databases and systems architecture, while each course also encompasses specialist elements, and all have professional practice and project management elements too.

The approach entails bespoke mixes of content per student, necessitating understanding of the student’s strengths to enable them to fast-track through the undergraduate-level content, although initial contact time can be quite substantial. Throughout, there is a focus on applications and minimising the extent of background theoretical content. With courses open to students of all backgrounds, it is important to be able to assess aptitude for study in these disciplines during the application process. This is assisted by diagnostic evaluations using the university’s VLE and also apps, which both assess and encourage prospective applicants – including some gamification to encourage interest and stimulate demand.

Despite the short time available in 2016, the team developed four new courses and obtained university approval in time for launch that autumn. Opportunities for marketing that summer were limited due to the short time available, although their funding allowed for some bespoke campaigns to employers and recent graduates. As a result, each course only had one to two students that year, but Solent was keen to pilot the courses on this basis. As the courses became embedded into the institution’s promotional cycle, enrolments grew substantially, with a total of 27 students (4+ for each course) starting in autumn 2017. The numbers in the most recent year (starting in autumn 2018) were slightly more modest at 17 in total. Most participants to date have studied on a FT basis, despite Solent’s aspirations for flexible delivery, although there have been some PT students on all of the courses. Students’ backgrounds have been very mixed, right across the subject spectrum, including some students without a first degree. Most have been from the UK but the most recent cohort includes small numbers of both cognate and international students too.

Case study 5: Medical Engineering Design, Keele University

Keele has a longstanding background in the engineering of medical devices and more recently in sustainable engineering. The university does not formally have an engineering department but has demonstrable strength in depth in relation to the engineering associated with these two specialist areas. Project leader Peter Ogrodnik, based in the School of Medicine, had a clear vision of the objectives of a conversion scheme and also the roles that its graduates might fulfil. The approach is based on Keele's experience of working at the interface between medical and engineering professionals and of active involvement in the formation and management of university spin-out companies.

The strategy formulated aims to enable graduates from a disparate range of disciplines to make the transition to fulfil graduate-level functions in engineering but not to enable them to undertake the analytical roles undertaken by Chartered Engineers. Practically, this means the programme should prepare its students to act as intermediaries between medical professionals and analytical engineers, conceptualising and developing design briefs based on medical requirements and then overseeing the transfer to analytical engineers for realisation. The approach to programme design focused on building from the input capabilities of graduates with 'Far-STEM' backgrounds (typically biomedical sciences, pharmacy or product design) rather than trying to reverse engineer from the output knowledge and behaviours required of Chartered Engineers.

Professional accreditation issues were explored with both the Institute of Engineering Designers (IED) and the Institution of Mechanical Engineers. It was believed that most students completing the programme would be prepared to IEng level but that a minority would reach CEng level. At the time of development, the IED was exploring additional levels of professional accreditation below full Chartership, which could be appropriate in terms of accrediting Registered Product Designer qualifications.

Whilst 15 credit modules are the norm at Keele, the programme includes 30 point modules in core subjects of engineering design and engineering applications, which offer more flexibility in implementing project-based teaching strategies. As the programme aimed to recruit from a broad subject base, an optional 15 credit Level 6 package was also created to serve the needs of students from biomedical or other biosciences or similar backgrounds.

The programme launched for the academic year 2017/18 following marketing in relevant journals as well as postgraduate recruitment fairs and websites. A small cohort of four students was achieved, studying full-time and evenly split between 'Near-STEM' and 'Far-STEM' backgrounds. Links with medical industries provided a source of projects for all students, who additionally undertook a study visit to Germany. All students from this cohort gained relevant employment on completion of the course.

In the latest year, a further cohort of three students enrolled, one from a medical background, one from biomedical science and one from product design. Thus, although the cohort is again small, it is achieving its aims in terms of a genuine conversion course.

Case study 6: Robotics and Autonomous Systems, University of Sussex

Sussex was in the process of developing a Computing Robotics Electronics and Mechatronics Centre, part-funded with a STEM teaching capital investment, when the conversion course pilots scheme was announced. The new fund was an opportunity to develop an MSc that used the facilities and staff expertise in the centre, complementing existing MSc provision (which was dominantly pursued by international students). The aim was to provide non-engineering graduates with knowledge and skills they could utilise in employment developing or applying devices or systems for robotics, automation or smart systems with autonomous capability, or ubiquitous and wearable computing. Sussex has strong links to engineering companies utilising these devices/systems in different sectors.

Existing MSc provision is to a mix of MEng, BEng and BSc/MSc engineering students from different countries, who vary widely in their depth and range of knowledge. With that experience, the team chose to construct the new course from 10 brand new modules, plus an existing management module, and focus on highly practical and application content. It would launch initially as a one-year FT course, potentially followed by PT options.

To check aptitude and motivation, all applicants are interviewed during recruitment (locally or by Skype if overseas), unlike for many other MSc programmes. Enrolled students also have to pass a two-week pre-course introduction module (not assessed as part of the MSc) to check their grasp of what the course is about and whether they will cope. They can leave at this point, without cost. The module is mostly practical robotics work but also to re-awaken their maths; practically it can be accommodated as the first fortnight of other MSc provision tends only to deliver taster content because many international students arrive late. Delivery style ensures a lot of staff-student interaction, with each student allocated an Academic Advisor. Where a suitable company-based project can be identified, the students complete their project within that company, potentially enhancing their employability.

The course was validated in July 2016 although preliminary marketing had started in spring 2016, including a strong, bespoke online campaign. This targeted graduates in STEM subjects (initially maths, physics, chemistry, biology or agricultural engineering) with an interest in robotics, although other graduates with logical/analytical skills are considered.

In 2016/17, the course launched with six students (four from the UK). They displayed excellent participation and involvement, which led to very good results – only one student failed a single module. Peer support was also noted, with students helping their peers in areas where they had more personal experience, such as programming or prototyping. For 2017/18, 14 new students enrolled (11 full-time). Almost all have successfully completed and, notably, several students obtained internships and long-term jobs during or after the course, as hoped.

After the first two years in which almost all students were converters, the 14 students in the new 2018/19 cohort are now more mixed with some cognate international students included. At this size the course is just about self-sustaining. Sussex is monitoring the position and considering introduction of an additional robotics course specifically for engineers. The course leader reflects that those 'nearer to STEM' do find content and the teaching style more familiar, regardless of how much work they do. However, conversion students are highly motivated, tend to work very hard, and often get the higher marks. "*I'm proud of my conversion people – they have by far exceeded my expectations*".

Case study 7: Food Processing Engineering, Teesside & Sheffield Hallam Universities

This project originated as a collaboration between Teesside University and the Department of Chemical Engineering at Sheffield Hallam University (SHU) and was designed to address the challenges faced by the food industry in recruiting appropriately qualified engineers. The two universities had complementary specialisms that enabled them to collaborate effectively in development of a common core of new MSc programmes but allow for differentiation in subject specialisms and marketing, to serve the needs of this large and diverse sector. Teesside's strengths lay in food safety and hygiene, already offering Food Science and Biotechnology MSc, while SHU's strengths lay in its 'centre of excellence' in Food Engineering. Both identified target populations for their respective (independent) marketing activities: Teesside focused on graduates of science-based programmes, such as Forensic Science, while SHU targeted those with physics, maths or engineering degrees seeking a more distinct specialism. Additional funding for the collaborative venture was provided by industry and the Local Enterprise Partnership (LEP), while existing industry links at local and national levels were supportive of the development.

The institutions worked together on a joint curriculum but there were significant differences in their approach, requiring totally separate approval and validation processes. For example, in detail, there were differing norms for module size: 20 or 30 credits at Teesside in contrast with the 15 credit point norm at SHU.

With their larger module sizes, Teesside was able to integrate conversion aspects within each module, reflecting the view that students registering for these modules would be highly motivated and rise to the challenge of adjusting to new concepts. They also planned a blended learning approach making extensive use of online materials to enable flexible study patterns both on-campus and by distance learning students. The content of these materials was developed by subject experts and transposed to online formats using in house expertise in e-learning. Where appropriate, these materials were made available for use within the SHU programme too.

At SHU, the programme developed was planned to achieve a degree of integration with a more general engineering conversion programme also funded through the pilots scheme. It focused on developing support materials and services for students seeking conversion into mechanical and electrical engineering subject strands; these materials (with concentration on engineering principles and maths) were well suited for the induction to the SHU Food Processing programme with its engineering-based specialism. Subsequent to launch, management of the new Food Processing programme has been integrated with that of the more general engineering conversion MSc programme.

The two courses were both launched for the 2016/17 academic year and have recruited students in small numbers each year (around four students per year, per course) since then, although a larger cohort of 15 was achieved at Teesside in 2018/19 primarily of international students. The nature of the UK students enrolled has to some extent reflected the respective targeting of the two institutions, although many have been students with a first engineering degree looking to move to a different specialist area.

This project has enabled the successful development of two related but distinct programmes that address the full spectrum of the food processing industry, embracing food safety, processing techniques and supply chain management factors.

Case study 8: Automatic Control & Systems Engineering, University of Sheffield

This case study demonstrates a different approach to the majority of projects, as it focused on broadening the intake to Sheffield's existing MSc provision, although development of a new Data Analytics course was included in the overall package of activity within the initiative. Increasing diversity in engineering has been a longstanding interest and concern at Sheffield with previous scholarship initiatives demonstrating the feasibility of conversion. An earlier 'women into engineering' initiative enabled students without previous engineering education to graduate in chemical or bio-engineering or computer science. Given the marketing focus of the project, this case study takes a student journey perspective, in relation to Sheffield's Automatic Control & Systems Engineering (ACSE) MSc programme in particular.

The core thesis is that students have little prior knowledge of the nature of specialist subjects such as materials engineering. This problem also exists at school level where students have little exposure to engineering, and through the school curriculum are more conditioned to regard chemistry or physics as more 'natural' choices for HE study. At graduate level, there is similar reluctance to break from familiar subjects despite anecdotal evidence of successful transitions and sector needs for these specialist skills.

Sheffield's marketing strategy focuses on final-year undergraduates in science subjects such as chemistry, physics and maths. Slots in lectures are used to introduce the possibilities of conversion, supported by fliers presenting case studies illuminating alumni experiences. The case studies exemplify projects students worked on, their impact and the high earnings that professional engineers can expect. Students are offered the prospect of industrial mentors during their MSc programme, to enhance their experience. An industry-related project which is integral to the MSc programme is regarded as a strong motivator.

Students are supported from the point at which they express interest in a conversion course. The course directors speak with all prospective students to help steer them to the most appropriate offering, which supports students but also filters them. A programme of webinars and alumni insight sessions helps to maintain interest. On acceptance of a place, students gain VLE access to course-specific material and preparatory work, prior to the formal start. This strong emphasis on nurturing students continues into the induction week, with resources being sent in advance. Conversion students are monitored distinctly in learning records but there is no segregation of groups during teaching. Tutors are aware of the additional challenges facing conversion students and resources available to support them.

For the ACSE programme, modifications were made to support conversion students: additional pre-arrival VLE-based material focuses on maths, online tutorials and an introduction to MATLAB, while on-course enhancements include quizzes and additional tutorial support during the first six weeks which are particularly challenging for conversion students. These approaches have been extended now to a wider range of engineering MSc programmes, including Materials Science & Engineering and Bioengineering programmes.

Data on enrolments are somewhat challenging to interpret as some conversion students were being admitted prior to the scheme, but figures suggest up to 16 additional MSc conversion students were attracted in 2017/18 and 45 additional in 2018/19 across several engineering programmes. Sheffield has also noted that the programmes have attracted a higher proportion of female students (29%) than the average faculty PG-taught population (24%); also, 44% of those with a non-engineering background were female.

5 Outputs – courses and participation

5.1 Courses launched

In their proposals for funding within the scheme, 25 of the 28 institutions[14] had proposed to launch at least one of their intended new pilot conversion courses (or an enhancement of an existing course) in the autumn of 2016, anticipating an intake for the 2016/17 academic year. The remainder all proposed launch of their courses the following year.

Table 5.1 summarises the position for each institution and its course/s in terms of launch (i.e. approval and availability, and/or active provision) or enhancement of each course, across the years covered by the evaluation.

In practice, 11 institutions launched a total of 20 new pilot courses in autumn 2016 and a further three reported that they had enhanced existing engineering courses. Of the new courses launched, four were focused on data science and four others computing-related, while the remaining 12 were engineering-focused. One further institution launched a taster module for undergraduates, as a pre-cursor to its planned new MSc course launch in 2017.

This picture had changed significantly by autumn 2017. All 27 institutions[15] had developed and made available at least one new course (or had enhanced an existing course, if that had been the intention). The total of 41 courses comprised 31 essentially engineering-related courses, while four were data-focused and six were computing-related (including three on cybersecurity). However, five of the institutions did not successfully recruit eligible students to this new provision although these courses were available for delivery; thus, seven of the 31 engineering courses received no students that year. In contrast, all the new computing-focused and data sciences courses had enrolments.

By autumn 2018, the position had changed slightly again, with a total of 37 courses being available of which 31 had successfully enrolled a new student cohort. Within that total picture, while some additional institutions had achieved enrolments for the first time to their engineering courses for 2018/19 delivery, two others had chosen to withdraw availability of a particular new engineering course. Our understanding is that three institutions remain that are yet to enrol any students on new courses developed through the scheme. The overall situation is likely to remain somewhat dynamic, as some courses evolve towards long-term sustainability but institutions may withdraw others where they are not sustainable and/or merge provision in response to market demand. One institution reported that in addition to its on-campus course, it had also launched a parallel transnational education (TNE) course through a partner college in the West Indies (which had received 15 enrolments in 2018).

Table 5.1 (overleaf) New MSc courses and enhanced MSc provision within the scheme (tick: course active; A: course available; C: course now ceased; –: no current information)

[14] The term ‘institutions’ (considered to be 28 in the scheme) will be used for brevity, although there were a few partnerships involving more than one institution within the 28 projects receiving funding.

[15] One institution withdrew from the scheme after failing to recruit students to its new course in 2016.

Institution	Course title	2016	2017	2018
Anglia Ruskin University	Additive Manufacturing		✓	✓
Aston University	Computer Science		✓	✓
Birkbeck, Univ. of London	Data Science	✓	✓	✓
University of Chester	Cybersecurity	✓	✓	✓
Coventry University	Digital Technology for Engineering		A	✓
University of Derby	Advanced Materials & Additive Manufact. Eng.	✓	-	-
University of Greenwich	Cybersecurity		✓	✓
Harper-Adams University	Automotive Engineering (off Highway)		✓	A
	Agricultural Engineering (Mobile Machinery)		✓	A
University of Hertfordshire	General Transition Masters in Engineering		✓	✓
University of Hull, working with 3 colleges	Chemical & Energy Engineering	✓	✓	C
	Energy Engineering	✓	✓	✓
Keele University	Medical Engineering Design		✓	✓
University of Kent, with University of Bath	Advanced Digital Systems Eng. (IC design)		A	C
	Adv. Dig. Systems Eng. (Embedded Comms)		✓	✓
Queen Mary, University of London	Biomedical Engineering	✓	✓	✓
	Electrical and Electronic Engineering	✓	✓	✓
	Sustainable Energy Engineering	✓	✓	✓
	Mechanical Engineering	✓	A	✓
Middlesex University	Mechatronic Systems Engineering		A	-
University of Salford	Data Science	✓	✓	✓
University of Sheffield	Data Analytics	✓	✓	✓
Sheffield Hallam University	Mechanical Engineering	✓	✓	A
	Electrical and Electronic Engineering	✓	A	C
	Food Processing Engineering	✓	✓	✓
Southampton Solent University	Computer Engineering	✓	✓	✓
	Data Analytics Engineering	✓	✓	✓
	Digital Design	✓	✓	✓
	Cyber Security Engineering	✓	✓	✓
University of Staffordshire	Industrial Engineering		A	A
University of Sunderland	Manufacturing Engineering		✓	✓
University of Sussex	Robotics and Autonomous Systems	✓	✓	✓
Teesside University	Food Processing Engineering	✓	✓	✓
Univ. of West of England	Building Services Engineering		A	A
University of Westminster	Elec. Eng. for Sustainable Transport Systems		A	A
Enhanced activity				
Univ. Kent with Univ. Bath	Conversion to existing eng. MSc course/s	✓	✓	✓
University of Sheffield	Conversion to existing eng. MSc course/s	✓	✓	✓
Univ. of Southampton	Conversion to existing eng. MSc course/s		✓	✓
University of Exeter	Conversion to existing eng. MSc course/s	✓	✓	✓
Manchester Metropolitan	3 new engineering courses, cognate only		✓	✓

Viewed overall, a number of institutions launched new courses in line with the timescale they predicted in their funding proposals, but these were the exceptions. The overall pattern, of course development, availability and delivery lagged significantly in comparison with what had been projected in institutions' proposals. The second of the two workshops we held with course leaders and other staff was particularly useful in understanding the reasons for this lag, much of which related to a lack of alignment between the timing of the project funding and the cycle for course development and approval within universities (see Section 7.1).

5.2 Enrolments

5.2.1 Enrolment information

In their original project proposals, institutions had between them projected to have around 450 students enrolled on their new courses that started delivery in 2016/17, growing to around 800 (more) new entrants in 2017/18. Projected student numbers had been sought by HEFCE on a full-time equivalent (FTE) basis, but it was not clear in all proposals that projections were stated on this basis. For simplicity, however, all our reporting here of enrolment data is on a headcount basis (not FTE).

A further cautionary note in relation to our reporting of enrolments relates to 'eligibility'. For new course provision, we report all enrolments, whether they were conversion students or cognate (in terms of their first degree). On the other hand, where institutions essentially used the funding to widen the range of students enrolling on their existing MSc provision, we attempted to record only "additional" students that resulted from the enhancement activity. This was based upon institutions providing that specific information or, where they provided information on all enrolments, our assumption was that all conversion students were additional.

5.2.2 Enrolments and cohort sizes

Table 5.2 summarises the enrolment information we managed to record, by year and broad subject focus of course. Overall, it shows that there has been growth in numbers achieved since the first course launched in autumn 2016, albeit somewhat unevenly, and that there has also some evolution in the mean number of enrolments per course (i.e. of cohort sizes).

The total number of enrolments to the 20 courses launched in autumn 2016 was 128 students, of which 43 were part-time. A further six students were identified as conversion students who enrolled onto pre-existing MSc courses which could have resulted from enhancement activity funded under this scheme, bringing the total to 134 students.

Of the 128 students on new courses, 82 were on data science (72) or computing-related (10) courses, and 46 on engineering-related courses. The largest cohorts were for data science courses at Birkbeck (34 students) and Salford (21 students), which were notably larger than the modest numbers being achieved on all other courses, none of which exceeded 10 students.

The total number of new starters during 2017 (which included new cohorts at Salford in both January and autumn 2017) was 336 students, calculated on the same basis, on 34 active courses. Within that total, 203 were on data science courses, 37 on computing-related courses and 96 on engineering-focused courses. Large numbers of enrolments were being recorded on the data science courses at Birkbeck, Salford (split across two cohorts) and

Sheffield, contributing to a high mean cohort size for data science of over 50 students. In contrast, mean cohort sizes within other computing-related courses and on the engineering courses remained small at around five students.

During 2018, the total number of new enrolments was slightly higher again than in 2017, at 363 students. This slight growth was entirely within the data science courses, while enrolments to the other types of courses did not grow further.

Overall, during the evaluation project's duration, a total of 833 new students were recorded, of which over 500 have studied data science, just over 230 engineering-related courses and just under 90 other computing-related provision.

Course focus	Start year	Courses		Enrolments		
		Number	% of total	Number	% of total	Mean per course
Data science						
	2016	4	20%	72	56%	18
	2017	4	12%	203	60%	51
	2018	4	13%	236	65%	59
	Total			**511**		
Other computing						
	2016	4	20%	10	8%	3
	2017	6	18%	37	11%	6
	2018	6	19%	38	10%	6
	Total			**85**		
Engineering						
	2016	12	60%	52	36%	4
	2017	24	71%	96	29%	4
	2018	21	68%	89	25%	4
	Total			**237**		
Total						
	2016	20		134		7
	2017	34		336		10
	2018	31		363		12
	Total			**833**		

Table 5.2 Numbers of active courses and total enrolments, by year and broad subject focus

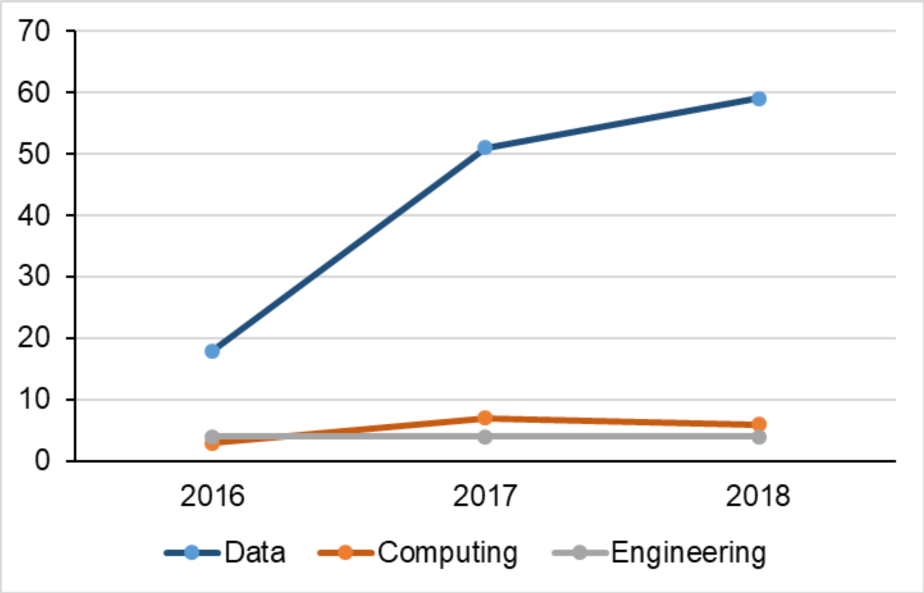


Figure 5.1 Mean cohort sizes by year and broad subject focus

Overall, significant growth was seen between 2016 and 2017 in all three broad subject areas, with total student numbers tripling for data science and computing and doubling in engineering. However, much of the growth in engineering was due to a doubling of the number of courses in that period, and Figure 5.2 shows that for engineering and computing provision, cohort sizes did not grow during this time, in sharp contrast to the position for the data science courses.

The success of the new data science course at Birkbeck, especially, has impacted heavily on the total student numbers recorded within the scheme's projects, with a cohort of 88 achieved in 2017 (which caused some challenges in teaching). In response, Birkbeck introduced a FT variant to run alongside the PT course, which enrolled 34 students in addition to the 93 new students on the part-time course in autumn 2018. Salford's data science courses achieved 30 students on each of two intakes during 2017, and over 50 in the autumn 2018 intake, while Sheffield achieved 27 students in 2017 and 45 in 2018. Achievement of these numbers of students, so quickly, is considered exceptional for new MSc provision in the UK, at least to our understanding.

5.2.3 Mode of study

We analysed in some detail the mode of study of students across the pilot conversion MSc courses. Figure 5.2 shows that, in data science, there has been roughly a balance overall between FT and PT provision, with the dominantly PT cohorts at Birkbeck countered by the mainly FT provision by the other institutions providing courses in this discipline. If Birkbeck is excluded, 90% of the data science students starting course in 2018/19 were on a FT basis.

Within engineering, by contrast to the overall position for data science, the proportion of students studying on a PT basis has been very low, at under one in 10 of all students. For the rather modest total number of other computing-related course enrolments, the position is between these two, with around one out of five students being part-time.

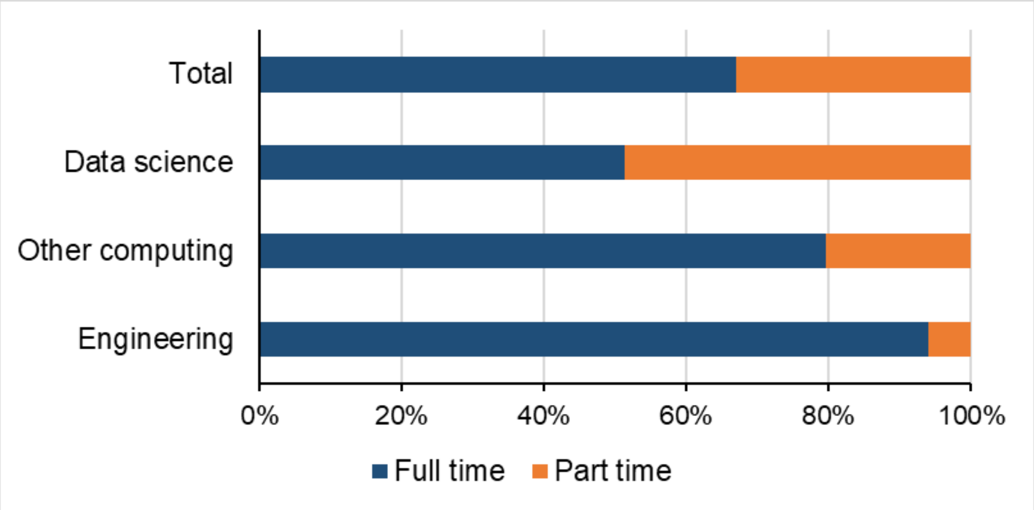


Figure 5.2 Mode of study by broad subject focus of courses (*N*=833)

5.3 Course participants

5.3.1 Personal characteristics

Data and information obtained during the evaluation enabled a number of key characteristics of participants to be investigated. Some aspects were revealed through the enrolments data provided by institutions (domicile, gender and subject of first degree), although not all course leaders were able to provide such detail about enrolled students (as noted in Chapter 3).[16] Survey responses provided another view of these same issues, although based on fewer students than enrolment data, and also provided a partial view of the ages and ethnicity of UK students. To maximise sample sizes and enable comparisons by subject, most results are presented here for participation on an accumulated basis, i.e. across up to three years of provision.

In terms of their domicile, overall, 60% of all participants (where domicile was known) were of UK domicile, with just over 10% from other EU countries and just under 30% from the rest of the world (RoW). The proportion of UK students was somewhat higher for the data science courses (65%), partly accounted for by the dominantly UK profile of students on Birkbeck's PT course cohorts. For the engineering courses, just under half of known enrolments were of UK domicile, around 10% from other EU countries and over 40% from countries in the rest of the world.

Placed in context, these proportions of UK students are markedly higher than have typically been reported in recent years for taught PG courses in engineering and computing in the UK, within which UK-domiciled students have recently made up 31% of engineering and 44% of computing students.[17]

[16] This appeared to be a practical issue of local recording, rather than due to data confidentiality regulations.
[17] *Engineering 2018 – The state of engineering*, Engineering UK, 2018

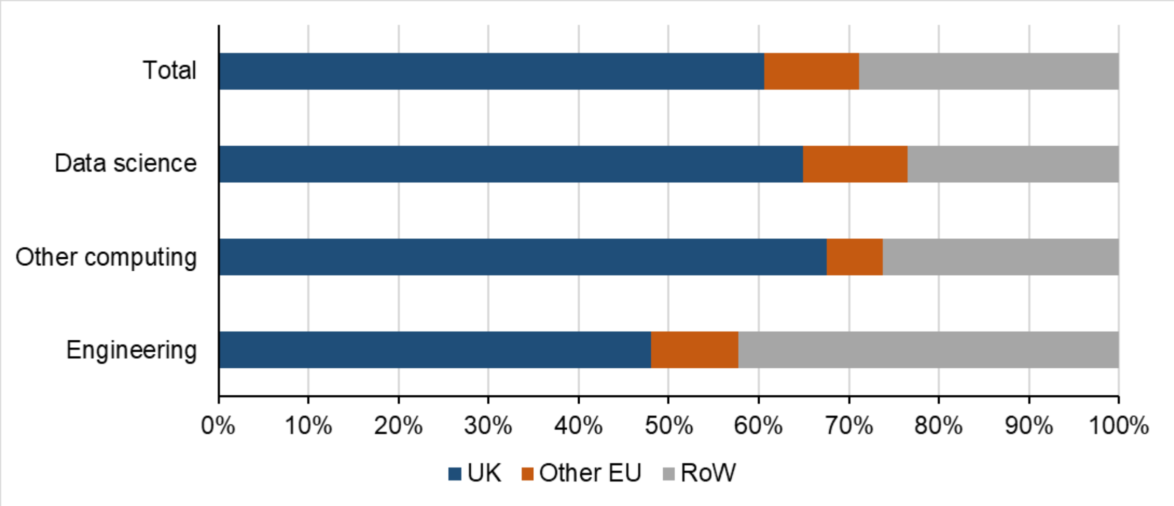


Figure 5.3 Domicile of enrolled students, by broad subject focus (cumulative basis across all years of provision, *N*=764)

There has been some shift in the profile of students by domicile over time but analysis of how it is changing needs to be treated with some caution as new courses were launched in different years and many have not been delivered for three years (i.e. in many cases 2018 was only their second year of delivery). However, with that caveat, Figure 5.4 shows that in 2018 there was a marked decrease in the proportion of UK students (and consequent increase in the proportion of international students) especially on the engineering and data science courses. This presumably reflects that by this time information about most courses had become fully incorporated into institutions' mainstream promotional and marketing activity, resulting in higher numbers of applicants from overseas. In contrast, marketing of courses that launched in 2016 was largely bespoke and in the absence of that 'mainstream' effort.

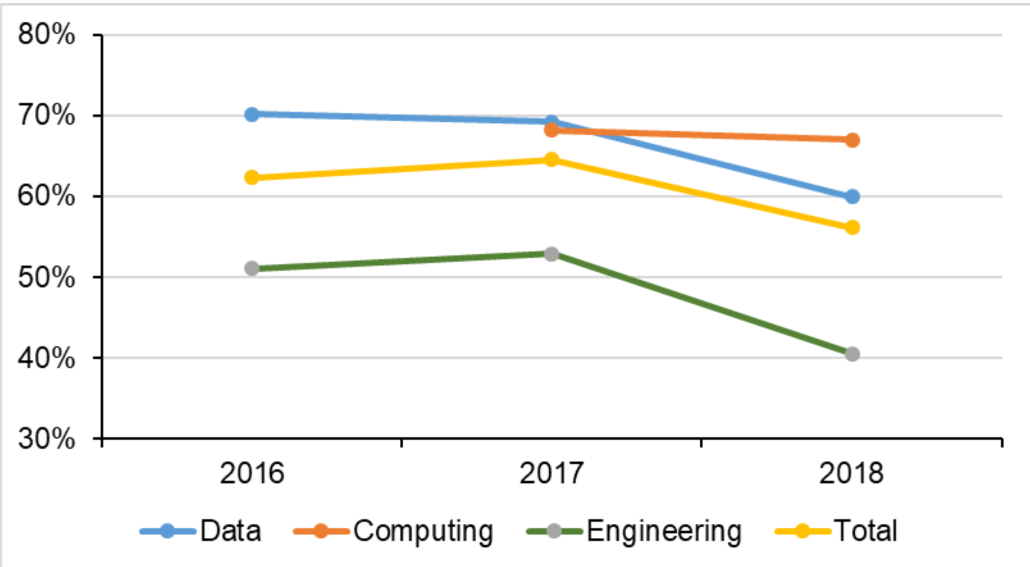


Figure 5.4 Proportion of enrolled students of UK domicile, by broad subject focus and year of course enrolment (*N*=764)

Some additional insight was available from survey responses. These showed that up to half of the international students who started in 2016 and 2017 had studied their first degree in the UK (and, in turn, up to half of these had done so at the same university as the Masters course, so had been recruited 'locally'). On the basis of the limited data obtained from 2018 starters, there was some evidence to suggest that a lower proportion of the international students had studied in the UK (or at the same institution) previously, which presumably again reflects that a more mainstream application and recruitment process was underway.

A further aspect within these trends could be seen across participants irrespective of domicile. Survey data suggested that, overall, almost one third of all respondents on courses starting in 2016 had studied their first degree at the same institution as the MSc. Amongst respondents who were 2017 or 2018 starters, this had fallen to around one quarter. This decrease is likely to reflect, again, the early focus by institutions on promoting the new course/s to their own students and graduates, in many cases using funding through the scheme, which has progressively become a less important element of their marketing strategies over time.

By gender, overall, 28% of participants were female, viewed cumulatively across up to three years of provision. This proportion was slightly lower amongst the engineering courses (24%) and slightly higher amongst the data and computing courses (at around 30%). These are remarkably similar proportions to those recorded recently for all taught postgraduate courses in the UK in the broad areas of engineering (24% females) and computing (29%).[18] While there were some anecdotal reports suggesting a relatively high proportion of females amongst the engineering conversion students, this did not emerge in the overall picture.

The age of participants is also of interest as one of the rationales for development of this type of provision was to enable mature (and/or employed) graduates to study a conversion course to re-skill and potentially change sector or occupation, or to upskill. Age was requested in the surveys and provided by some respondents, as shown in Table 5.3. This suggests that around 40% of starters were aged 25 years or younger, which would be those studying immediately or shortly after a first degree. The proportion aged 31 years or over, at just over one third, should reflect those who are 'returners' to HE study after some years in the workplace. In fact this is quite similar to the overall proportion (38%) of engineering and physical science taught postgraduates of UK domicile aged 35 or over, as reported in a recent study.[19]

Although the survey response sample size was rather modest, there was some evidence to suggest that more of the data science students were older, with nearly 45% aged 31 or over, while this age group comprised under a quarter of those studying engineering courses.

There was also some evidence to suggest that a higher proportion of more recent starters have been younger, which would again be concomitant with more 'maturity' of the courses – in the sense that they are attracting proportionally more mainstream applicants over time.

[18] *Engineering 2018 – The state of engineering*, Engineering UK, 2018
[19] *Mature entrants' transitions to postgraduate taught study*, Department for Business, Innovation & Skills, 2016

	2016		2017		2018		Total	
	Number	%	Number	%	Number	%	Number	%
25 yrs or under	29	40%	36	39%	19	58%	84	42%
26-30 yrs	19	26%	16	17%	7	21%	42	21%
31-55 yrs	24	33%	41	44%	7	21%	72	36%
N	*72*		*93*		*33*		*198*	

Table 5.3 Age profile of conversion course participants, where known (*N*=198)

Around one in four of the UK-domiciled survey respondents reported that they were of Black or Minority Ethnic (BAME) origin, based on survey responses. This is broadly similar to the overall ethnicity profile reported for taught PG engineering courses in the UK (27% of UK-domiciled being of BAME origin). These figures do, however, reflect that the rate of participation in engineering courses at this level is higher amongst the BAME population than amongst the non-BAME population.[20] It should be noted that the analysis here was of a very restricted number of responses (*N*=103) as the question only applied to UK domiciles.

Taken together, this series of information about the characteristics of participants on the conversion courses to date suggests they are quite similar in profile to the overall profile of all those who study taught postgraduate engineering or similar courses across the UK, rather than displaying a more diverse profile. One aspect of their profile that does, however, appear to be different is their domicile, as a higher proportion of the conversion course students have to date been of UK domicile, than in other provision at this level (even if the large, UK-majority cohorts at Birkbeck are excluded). This is entirely in line with the original intention of development of conversion MSc course provision, i.e. that it should be targeted primarily at UK graduates.

5.3.2 Subject of first degree

The subject that a student had read for their first degree was anticipated to be a key metric of our study, to assess the success of MSc provision specifically intended as conversion courses (i.e. designed for those with a non-cognate degree). In order to provide a measure of the extent to which conversion was taking place, a scale extending from 'cognate' to 'Non-STEM' was used to categorise students' first degrees (Table 5.4).

Within this analysis, 'cognate' was taken to mean a prior engineering degree or computing degree subject, for those on engineering- and computing-related MSc courses, respectively. 'Near-STEM' was used for those with a physics or maths first degree, and also for a computing first degree in the case of the engineering MSc students and vice versa. 'Far-STEM', on the other hand, characterised a STEM subject that was more 'distant' from either engineering or computing, such as (for example) a biological science or psychology. All other subjects were labelled 'Non-STEM'. Enrolled students were classified on this basis by

[20] *Employment outcomes of engineering graduates: Key factors and diversity characteristics*, Royal Academy of Engineering, 2016

the institutions as part of their reporting of enrolment data (in most cases)[21] although specific first-degree subjects were also captured within survey responses.

Course focus	Start year	Cognate	Near-STEM	Far-STEM	Non-STEM	No first degree	*N*
Data science							
	2016	25%	27%	12%	35%	0%	51
	2017	30%	31%	18%	21%	1%	188
	2018	39%	28%	9%	24%	0%	89
	Total	**32%**	**30%**	**14%**	**24%**	**1%**	328
Other computing							
	2016						
	2017	28%	26%	12%	28%	7%	43
	2018	50%	6%	8%	33%	3%	36
	Total	**41%**	**15%**	**9%**	**30%**	**5%**	79
Engineering							
	2016	35%	41%	7%	15%	2%	54
	2017	30%	41%	21%	7%	1%	96
	2018	35%	41%	7%	15%	2%	81
	Total	**32%**	**38%**	**21%**	**7%**	**1%**	231
Total							
	2016	33%	32%	9%	25%	1%	105
	2017	30%	33%	18%	18%	2%	327
	2018	33%	32%	9%	25%	1%	206
	Total	**33%**	**31%**	**16%**	**19%**	**1%**	638

Table 5.4 Enrolled students' subject discipline of first degree, by broad course focus and year of start, in terms of its 'distance' from the MSc course subject focus

As seen in Table 5.4, the overall pattern across the project was for around one third of students to be cognate and around one third to have had a 'Near-STEM' first degree, with the remaining one third a Far-STEM or Non-STEM degree (which would constitute substantial conversion). Analysed by broad MSc course focus, around 70% of the engineering students had a cognate or Near-STEM first degree and 30% a more 'distant' first degree subject. Amongst the data science and computing-related students, a higher proportion (40%) had Non-STEM or Far-STEM degrees, and fewer (60%) had cognate or Near-STEM first degrees.

Additionally, there was some apparent shift in this profile with time amongst the data and computing MSc students, of whom a rising proportion had a cognate degree subject in more recent provision. That trend was not evident in the engineering students, although a higher proportion of them had cognate degrees throughout. Such a shift could well result from courses becoming more mature in the PG market, i.e. attracting more mainstream applicants

[21] A few institutions were able to report specific first-degree subjects, which we classified ourselves. Insufficient data were available for computing courses starting in 2016.

in addition to the potential converters that institutions had primarily targeted during the project.

Another interesting aspect of these data is some difference in the range of first-degree subjects of those who were considered as conversion students. Broadly, those studying data- or computing-focused courses had a wider range of first-degree subjects than the engineering students. Amongst the former, over 40% had first degrees in 'Far-STEM' or 'Non-STEM' subjects, whereas this proportion was nearer to 20% amongst the engineering students. This trend could be evidence that significant 'conversion' (i.e. from a subject unrelated to either engineering or computing) was more popular and/or realistic to a computing- or data-focused MSc than to an engineering qualification at this level.

Table 5.4 also provides evidence that institutions enrolled significant numbers of cognate students onto their new courses even though they had been launched and promoted as conversion courses. In several instances, these have been the only (or the majority of) students that they have recruited. Certain institutions reported to us that they had effectively fallen back on recruitment only of cognate students after the initial year/s of a new course during which they had targeted potential converters but such enrolments had been very limited.

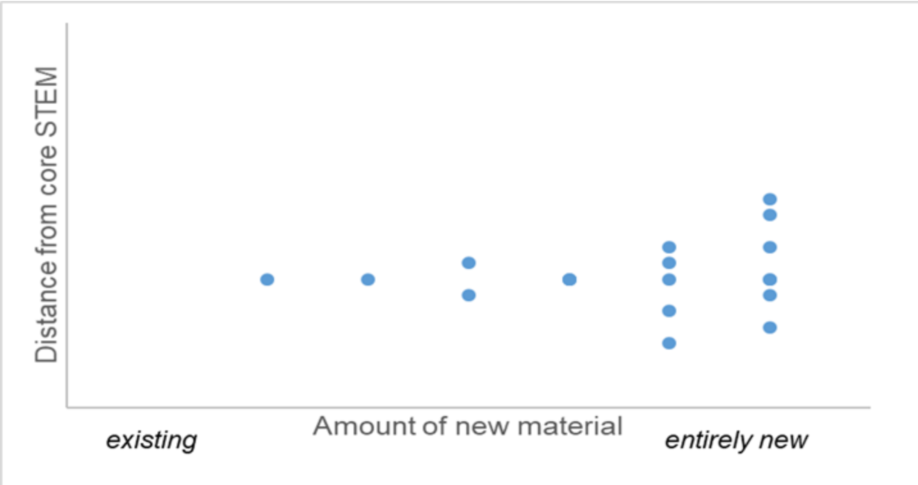
The enrolment data also suggest that quite a high proportion of the cognate students (although not all of them) have been from overseas. Given the relatively modest numbers of total enrolments on most courses (other than the large data science courses and some pre-existing courses with enhanced entry), many courses would not be sustainable if they only recruited conversion students. Rather it seems likely that it will be necessary for most providers to target and enrol a mixed cohort that includes overseas students or cognate students, and quite possibly both, as well as conversion students. There are some pedagogical implications if cohorts are mixed in this way, as highlighted in several case studies in Chapter 4.

This analysis does, however, beg the question of how to define conversion in terms of degree subject (or how to define cognate). Should those with a first degree in, for example, mechanical engineering only be considered to be converters if they pursue a Masters course that lies outside the engineering domain, or would studying a different engineering sub-discipline for MSc 'count' as conversion? It is, of course, common for engineering MSc courses to be more applied and specific than first-degree subjects. In our analysis, however, we considered that any engineering discipline first degree was cognate for an engineering Masters student, for simplicity. The same issues apply to those with computing/IT subject first degrees, with much of existing MSc provision more specialist in orientation and application than most first degrees.

It should also be pointed out that many existing MSc courses in engineering specialisms have traditionally recruited some graduates who have first degrees that are not only in other engineering sub-disciplines but also in 'nearby' subjects such as physics, in particular, so these have been already been operating to some extent as conversion courses.

Figure 5.5 attempts to show how the range of first degrees of enrolled students compares with the range of student types that was targeted in funding proposals. Figure 5.5(a), the upper chart, utilises the same axes as Figure 4.1 to plot the actual average 'type' of enrolled students, in terms of a single 'distance from core STEM'. This clearly involves a great deal of simplification in order to plot a cohort as a single point and does not represent how wide was the range of students enrolled. However, the narrower spread displayed in Figure 5.5(a) compared with the types of students targeted, shown in Figure 5.5(b), shows that for many institutions the 'average' student enrolled was closer to cognate than had originally been proposed. This is not surprising, because institutions' proposals and projections spoke only of conversion students, whereas in reality most recruited mixed cohorts.

(a)



(b)

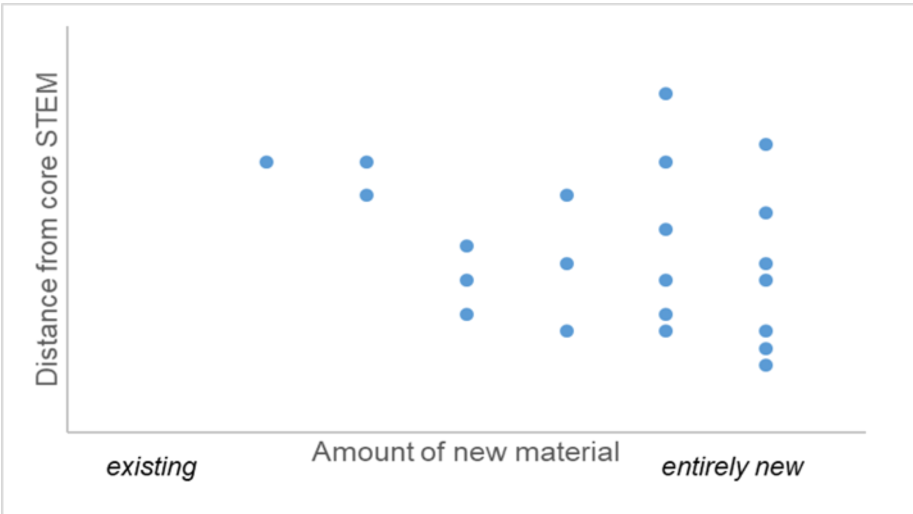


Figure 5.5 Schematic diagrams comparing average first-degree subject 'type' of students: (a) actually enrolled; and (b) targeted in proposals[22]

5.4 Student trajectories and rationales for participation

5.4.1 Prior circumstances

It was valuable to identify the prior employment circumstances of students to understand how studying the course fitted into their career trajectory. In Figure 5.6, results from all the surveys are combined (and those on both data science and other computing-related courses

[22] There are fewer data points in the upper chart due to limitations on data obtained.

considered together) to maximise group sizes. Overall, this suggests that approximately one third of participants had progressed to their course directly from a prior degree (in almost all cases a first degree) while around half had done so from a position of long-term employment.

A substantial difference was seen, however, between the two broad subject groupings. A much higher proportion (over half) of those studying an engineering course progressed immediately from their first degree, whereas this was the case for less than a quarter of those studying a computing-or data-related course. Most of the latter (almost 60%) had been in long-term employment previously. The proportions who identified that they had been unemployed before the course were low (less than 5%) for either group.

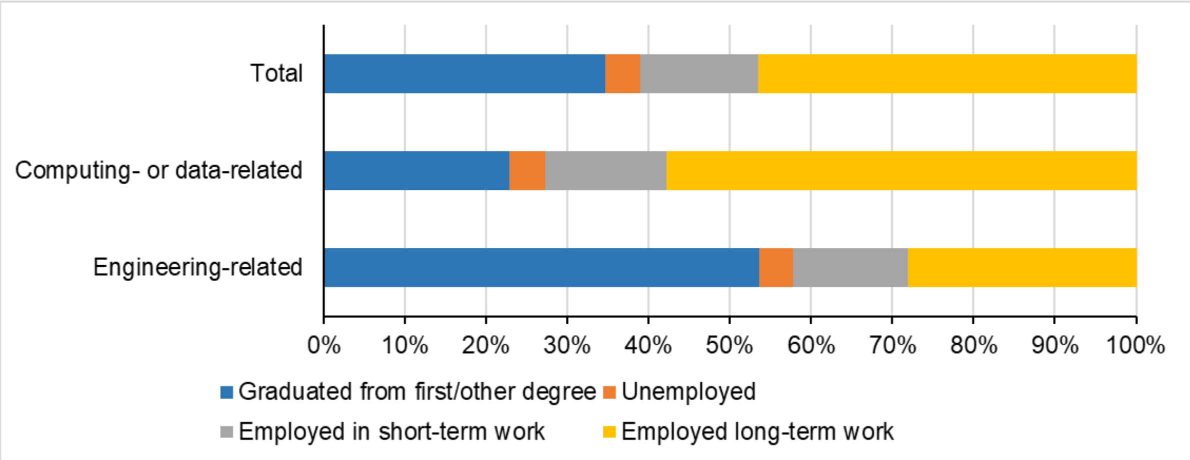


Figure 5.6 Survey respondents' circumstances prior to commencing conversion course (all surveys combined, *N*=185)

Those who had been in long-term employment prior to undertaking the course are of particular interest, as we infer these to have been employed in a 'career job'. Potentially they could have elected to study the course either to change career direction (i.e. to enter the computing or engineering sector, re-skilling from another sector) or to accelerate their progression if they were already working in one of these sectors (i.e. up-skilling). Undertaking a course within either of these trajectories could produce a valuable outcome in terms of increasing the supply of high-level skills into these sectors. For those who had been in short-term work or unemployed, the course was presumably an attempt to support entry to these labour markets in a more sustainable or longer-term career job. All of these trajectories could be seen as having the potential for what would be considered a positive outcome within the pilot conversion courses scheme.

Predictably, there was some correlation between those studying a course part-time and those who reported they were in long-term employment immediately before starting the course; most of these cases were those who were studying data or computing courses. Analysis of the type of job they were in suggested that in many cases a higher-level qualification in computing or data science/analytics would be relevant to their existing role and sector, which could potentially indicate an up-skilling rationale. There were also a few respondents where no such connection was clear, whom we inferred were seeking to change career direction completely.

Those who had previously been in long-term work but were now studying FT courses had been employed in a wider variety of occupations, some of which had no obvious connection with the MSc course subject. Again, it seems likely some of these graduates were studying in order to change career direction.

More analysis of respondents' reported motivations for study follows in the next section, but these data are already consistent with the ambitions of the conversion courses to provide opportunities for up-skilling in a current career (irrespective of first-degree subject) or for re-skilling in a potential change of career direction into these sectors.

5.4.2 Motivations

The rationale for participants to pursue an engineering- or computing-related conversion course was explored in our surveys from two angles – motivations for postgraduate study in general and motivations for selecting a conversion course in particular.

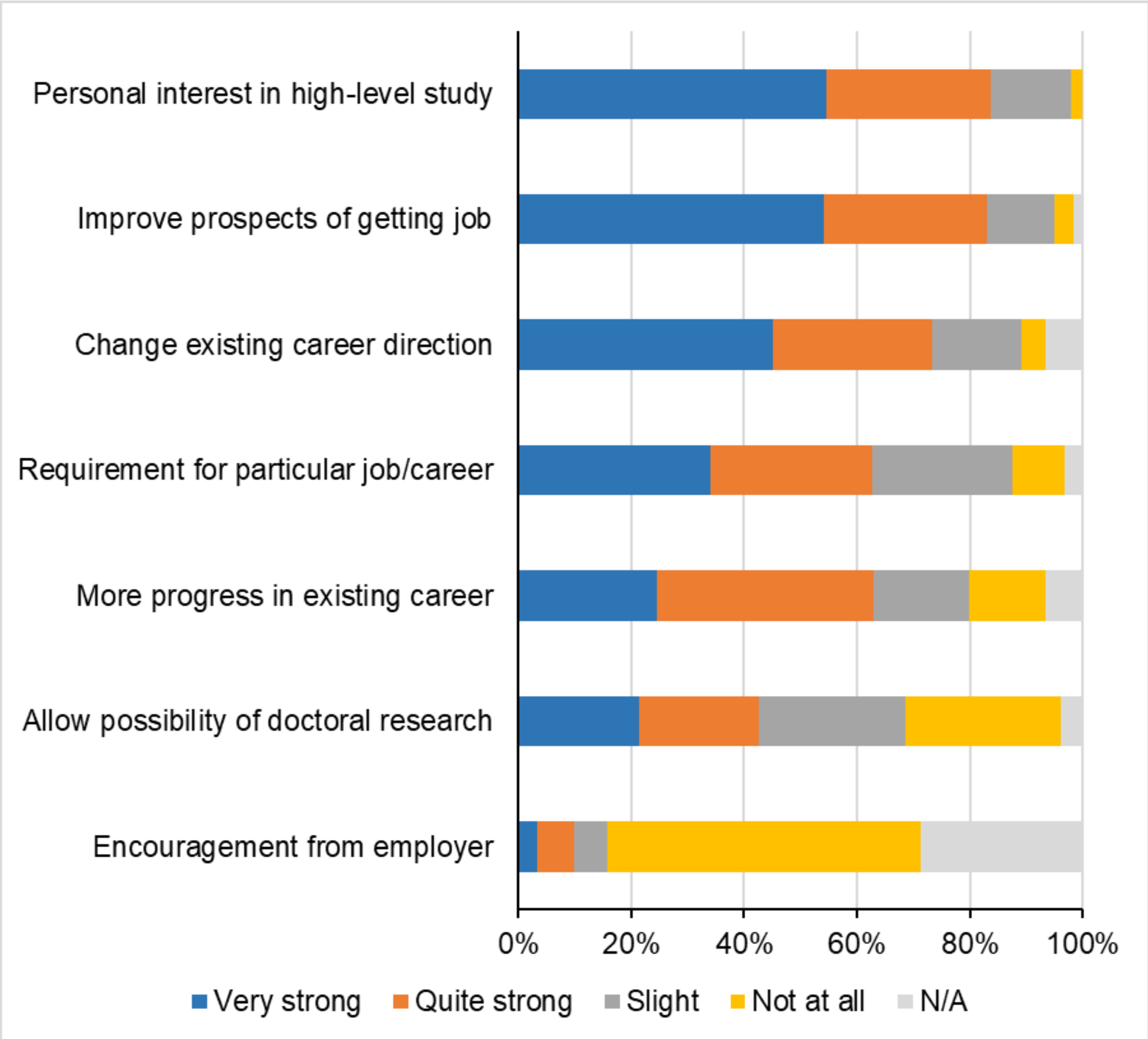


Figure 5.7 Strength of a range of possible motivations for respondents in electing to pursue postgraduate study (all surveys combined; *N*=185)

Figure 5.7 shows the extent to which respondents agreed with a range of potential motivations for pursuit of PG study in general. Personal interest in study at this level and a range of career- or employment-related motivations were dominant. Over 80% of respondents were very or quite strongly motivated by personal interest in high-level study and in improving their employment prospects. Almost three quarters were motivated very or quite strongly by the prospect of career change, while just under two thirds were motivated by a desire for greater career progress. A similar proportion reported the expectation that a PG degree was a requirement for a particular job or career direction. A smaller but significant proportion wanted the possibility of future doctoral study to be open to them.

These results are relatively similar to motivations previously reported for taught postgraduate study more generally[23] where personal interest was also the most common motivation, along with a series of career-related rationales. However, the issue of potential career change was less prominent in that more general study than the case here.

Survey respondents' motivations for selecting specifically an engineering or computing conversion course (as opposed to PG study more generally) are illustrated in Figure 5.8. In parallel with their motivations for PG study generally, personal interest in subject was uppermost in their minds, along with a series of career-related rationales. Around three quarters of respondents were very or quite strongly motivated to study a conversion course by its potential to enable entry to the engineering or computing sector, and two thirds by its potential to enable a career change. Over half cited a specific job or career requirement for the qualification and a similar proportion the potential for it to accelerate progression in their existing career, although only around one quarter saw these as very strong motivations. Only one in 10 were motivated by their employer to participate. Multiple motivations were held by most respondents, rather than their choice being driven by any unique rationale.

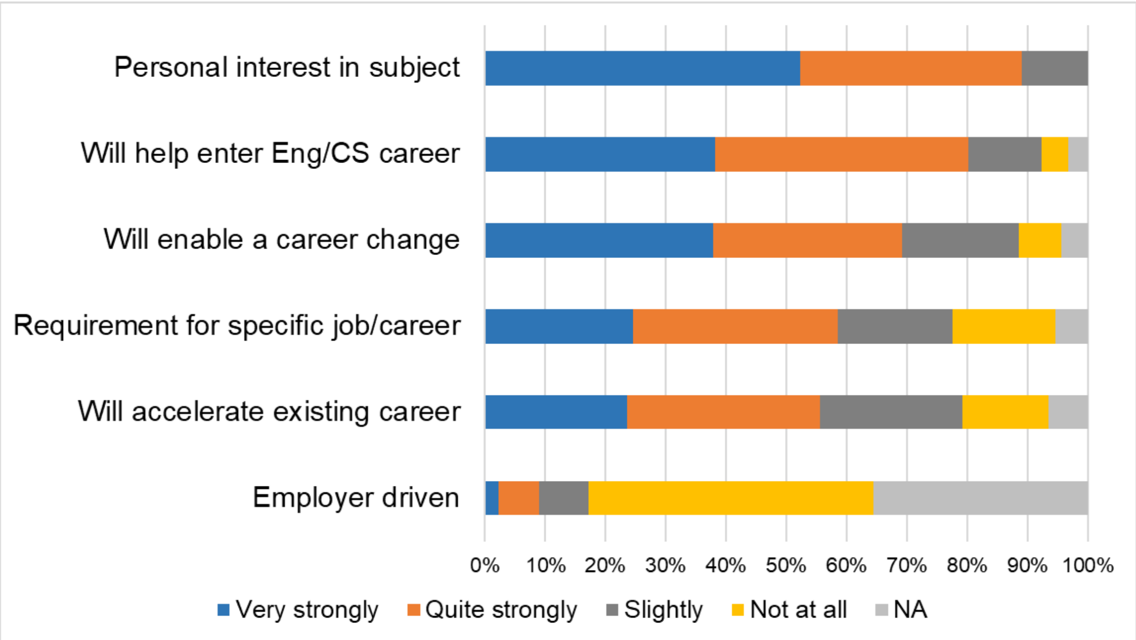


Figure 5.8 Strength of a range of possible motivations for respondents to study a conversion course in an engineering- or computing-related subject (all surveys combined; *N*=180)

[23] *Understanding how people choose to pursue taught postgraduate study*, HEFCE, 2014

In parallel with the reported rationales for PG study in general, more of the respondents studying computing- or data-related courses were very or quite strongly motivated to take the course by the potential for career change (over 75%) than amongst engineering students (under 60%). Potentially reinforcing this difference, somewhat more of them (62%) felt the qualification was a requirement for them to enter a specific job or career, than was the case for the engineering students (53%). The proportions seeing that the course would help them enter the engineering or computing sector, and/or accelerate progression within an existing direction, were similar in both groups, however.

We interpret that the somewhat higher proportions of those studying a computing- or data-related course who were strongly motivated by possible career change reflect that more of these students had already been working for some time, in comparison with the engineering students (of whom more were studying immediately after their first degree). Amongst the latter, more appeared to be seeing the course as a next step towards a pre-defined career aspiration. This interpretation was supported by other information in the survey which suggested that more of those studying computing- and data-related courses chose their specific university on grounds of its location (which would be expected as a higher proportion of them were studying part-time), compared with the engineering students (almost all of whom were studying full-time). Many of the computing- and data-related courses students also reported that anticipated employment outcomes from the course were a strong driver of their choice of institution, whereas engineering students appeared to be somewhat less strongly driven by those outcomes and more interested in the academic reputation of the institution and department.

The quantitative results from these closed survey questions were also strongly reinforced by respondents' open-ended contributions when asked about their long-term career aspiration when entering the course. These were overwhelmingly a range of technical and/or senior professional occupations or roles in engineering, computing or data science/analytics, and in many cases roles located in industries in these core sectors.

5.4.3 Impact of promotional activity

During the formative aspects of our evaluation, there was considerable discussion of the differing ways in which institutions promoted their new courses prior to launch, including strategies used by those who had allocated funding to bespoke promotional activity. Within that context, it was interesting to learn how students had found out about their course (i.e. the channel/s through which they had first heard about it).

Figure 5.9 shows that there has been some change with time in the balance of channels reported (noting that these were channels that had been effective for these particular students, rather than in general). Amongst the earliest cohorts (those who studied courses starting in 2016), almost half of the respondents reported having come across their course through a generic web search, while around 30% had seen it listed on a third-party website that aggregated PG opportunities from a range of universities. Around one in six had heard about the course through an email from the institution or department running the course (unsurprisingly, more than half of these were cases where the student had studied their first degree in that same institution).

The position in 2018, however, was somewhat different, with the most commonly reported channel being course listings on a third-party PG website. Meanwhile, the proportion reporting being attracted directly by the university itself was lower still than the one in six observed for the 2016 students. This shift presumably reflects the shift with time to standard institutional recruitment practices as the courses have bedded-in and become integrated with other PG provision. In particular, this will have resulted in the courses being listed on third-party aggregation sites, for which there had not been time for courses launched by institutions in 2016. These appear to be a crucial element of marketing of PG taught courses. In contrast, when courses were first being launched in 2016 or 2017, institutions had relied more upon very local and/or bespoke recruitment, some of which was funded through the scheme, although with hindsight many of these initiatives did not result in large numbers of enrolments (to what were at that point unproven courses).

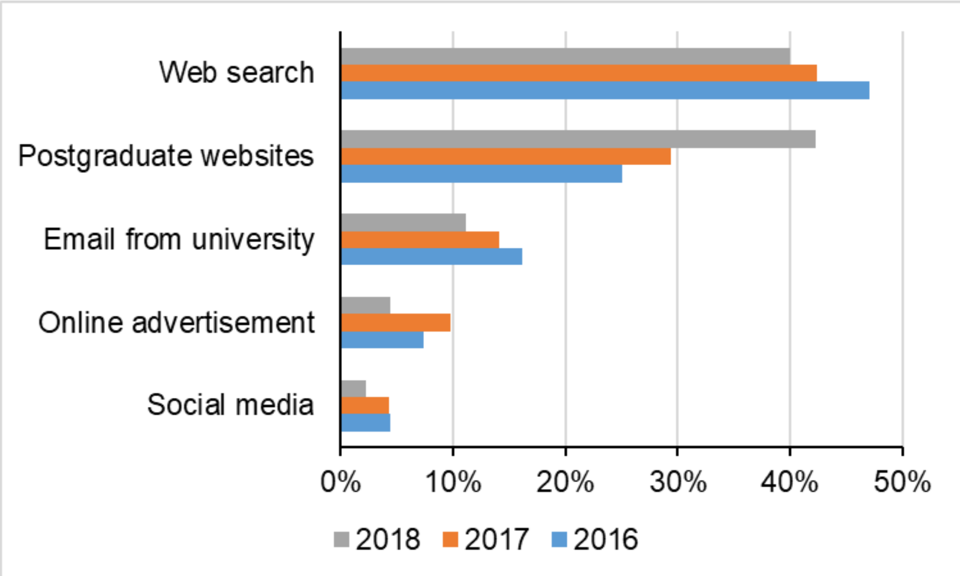


Figure 5.9 How respondents first heard about the conversion course on which they enrolled, by start year (*N*=175; multiple responses permitted)

Another point to be taken into account is that once a course has been delivered, marketing efforts for further years of delivery can take advantage of testimonials from previous students, although it is unlikely within the timescale observed that this can have included (many) cases where a graduate could cite long-term career benefit from taking the course. The inclusion of such testimonials within central institutional marketing (which third-party sites will direct users to access) should lend some weight to the perceived value of course information provided.[24]

Taken into consideration alongside the enrolment data, insights into the extent and type of marketing are of use to consider the potential sustainability of the conversion courses (i.e. whether sufficient enrolments are now being received on the basis of 'standard' institutional marketing rather than dedicated local marketing enabled by the scheme's funding). We noted during the early stage of the evaluation that HEFCE had deliberately not pursued any centralised promotion of courses, nor support through provision of scholarships, for example, in order to allow courses to grow organically and potentially reach sustainability without

[24] *Understanding how people choose to pursue taught postgraduate study*, HEFCE, 2014

central or national marketing support. The low reported impact of social media activity undertaken by institutions is also of note.

Most survey participants reported that, in general, they had been very satisfied with the course information that had been made available to them as applicants, with around three quarters saying they were fully satisfied with what was provided to them. Comments made by some of those who were less satisfied mostly related to issues of lack of information about practical delivery of a new course (which they now appreciated might have been launched hurriedly). Potentially more significant comments included the following, which all appear to relate to their understanding of the potential level of study involved, although it should be stressed that these were a small minority of the responses overall:

> *"Could have provided more detail about the content in terms of the scale of learning and how advanced it'd be."*

> *"The course handbook was available which was better than most courses. However I wanted to see level of work expected i.e. coursework and exam detail which was not available until enrolment."*

> *"It would have been great to know more detailed information about the specific maths required so I could brush up prior to starting the course."*

5.4.4 Funding participation

Analysis of the manner in which participants funded their course participation, based on survey responses, is reported here for UK-domiciled students as the core population of interest (although the results for other domiciles were, perhaps surprisingly, quite similar). Almost half of the UK respondents had taken out a postgraduate ('Masters') loan to cover their course fees (Figure 5.10). 40% of them reported that they were self-funding their fees (most were not receiving any external funding or a loan), while small proportions received help from their family and in around one in 10 cases their employer was paying the course fees. The latter correlates well with information from course leaders that, for example, a small but significant minority of students have obtained sponsorship from an employer.

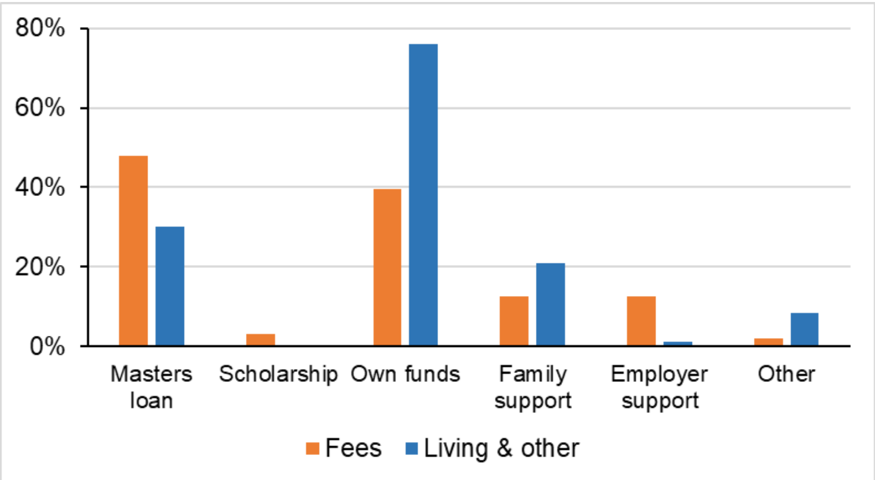
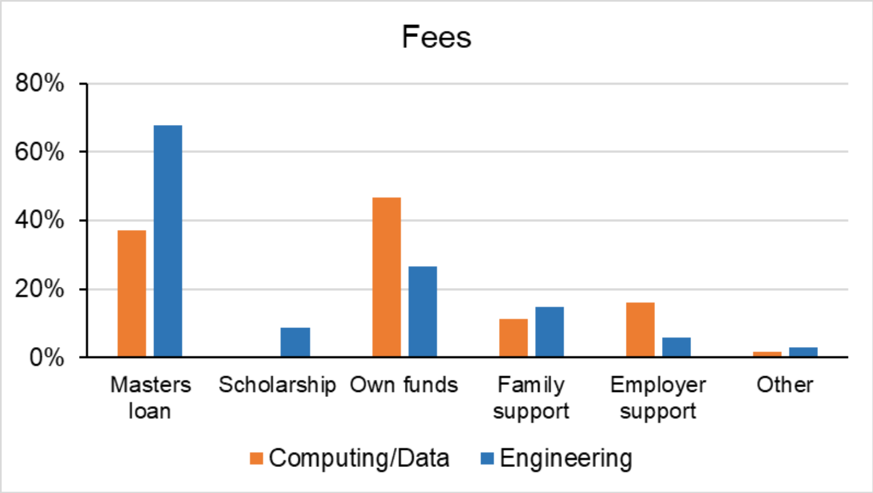


Figure 5.10 How UK-domiciled participants funded course fees and living and other costs (all surveys, *N*=96)

(a)



(b)

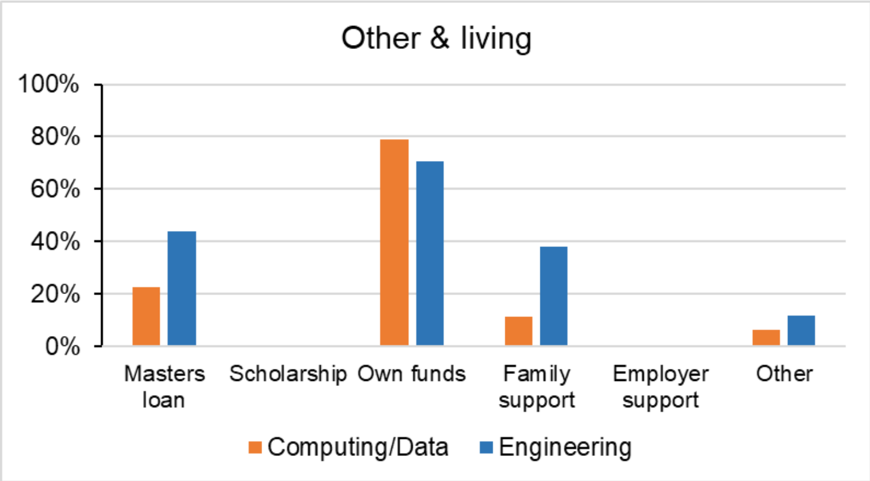


Figure 5.11 How UK-domiciled participants funded (a) their course fees; and (b) their living and other costs, by broad course subject focus (*N*=96)

When it came to their living and other costs, just over a quarter of UK-domiciled participants stated that their postgraduate loan contributed to these, while almost 80% reported that they were financing at least part of these costs themselves. However, it should be borne in mind that many of the part-time students were continuing to work in full-time employment while studying the course, so living costs may not have been a discrete issue for them.

Although the sub-sample sizes were very modest, analysis of funding information provided by UK-domiciled participants by course subject showed some apparent differences (Figure 5.11). More of the engineering students accessed a Masters loan, and fewer of them relied upon their own funds, to pay their course fees, compared with computing or data science students. Most of the few cases of employer support were for data science courses. These differences were less prominent in relation to funding of living and other costs, although a somewhat higher proportion of the engineering students obtained support from their family, presumably reflecting the earlier stage at which many of these students were undertaking the course, in comparison with the context of many of the data science students in particular, many of whom were already in long-term employment.

6 Experiences and outcomes

6.1 Students' experiences of the courses

6.1.1 Key challenges

Course participants were asked, when surveyed in the first term of their course, what they had expected to be the most challenging aspects of studying their conversion course. Figure 6.1 displays how challenging they had expected to find a range of aspects of PG study and particularly of a conversion course, showing those expectations separately for those on engineering- and computing- or data-related courses, respectively, as some of their responses were quite different.

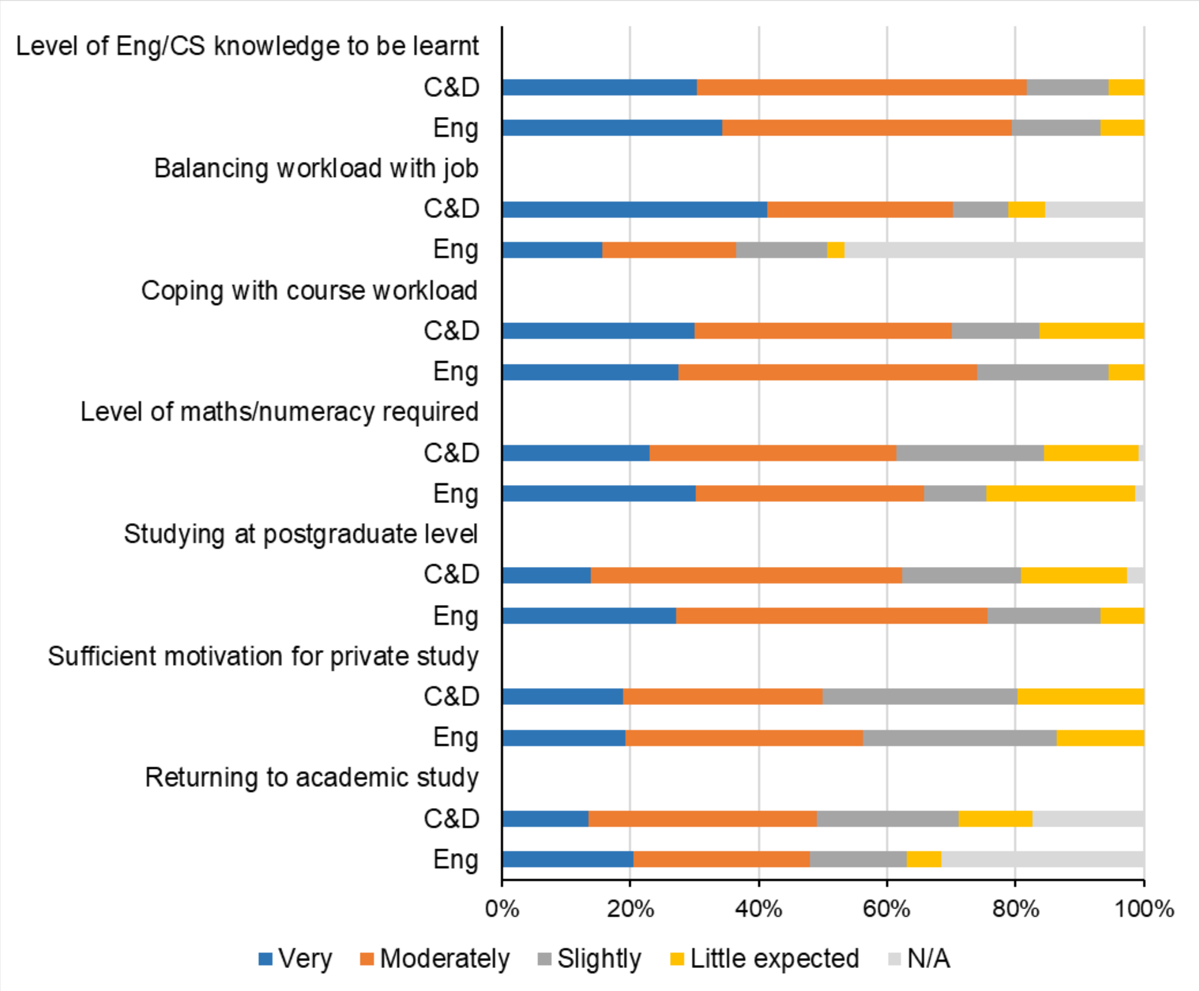


Figure 6.1 Survey respondents' expectations of how challenging they expected to find different aspects of study, by broad course subject focus (all surveys, *N*=190)

This appears to show that the most challenging aspect was expected to be learning the high-level of engineering or computing knowledge that would be needed, with around 30% expecting this to be very challenging (and around 80% at least moderately challenging). The specific issue of the level of numeracy or mathematical skill required was expected to be slightly less challenging than this, although at least moderately challenging for around 60% of participants.

More generic challenges of studying a PG course, such as coping with the workload, maintaining sufficient motivation for the extent of private study required, and simply being able to study at this high level, were all also seen as significant challenges. The PT study mode of many of the respondents on data science courses was reflected in the high proportions of those students expecting significant challenge in balancing their studies while holding down their job, whereas this was not an applicable issue for many of the engineering students. In the same way, the challenge of returning to academic study after time away was applicable to a higher proportion of the computing and data students, due to their more varied career trajectories.

Some comparative analysis was possible with survey responses from students in the process of completing their courses, who were able to report retrospectively on how challenging these issues had been for them in reality. For most of the challenges questioned, the results from ‘starters’ and ‘completers’ were, perhaps surprisingly, very similar, albeit on the basis of the small number of survey responses from those completing courses (*N*=29). Figure 6.2, however, shows the areas of challenge where starters’ expectations and completers’ reflections on levels of challenge experienced were different.

This analysis suggests that the level of numeracy or mathematical skill required (and the more general challenge of studying at PG level) turned out to be somewhat less challenging than had been anticipated. In relation to learning high-level engineering- or computing-related knowledge, however, this also appeared to be less challenging than feared overall, but the proportion who found it very challenging was actually higher (at around 40%) than the proportion who had expected it to be so (around 30%).

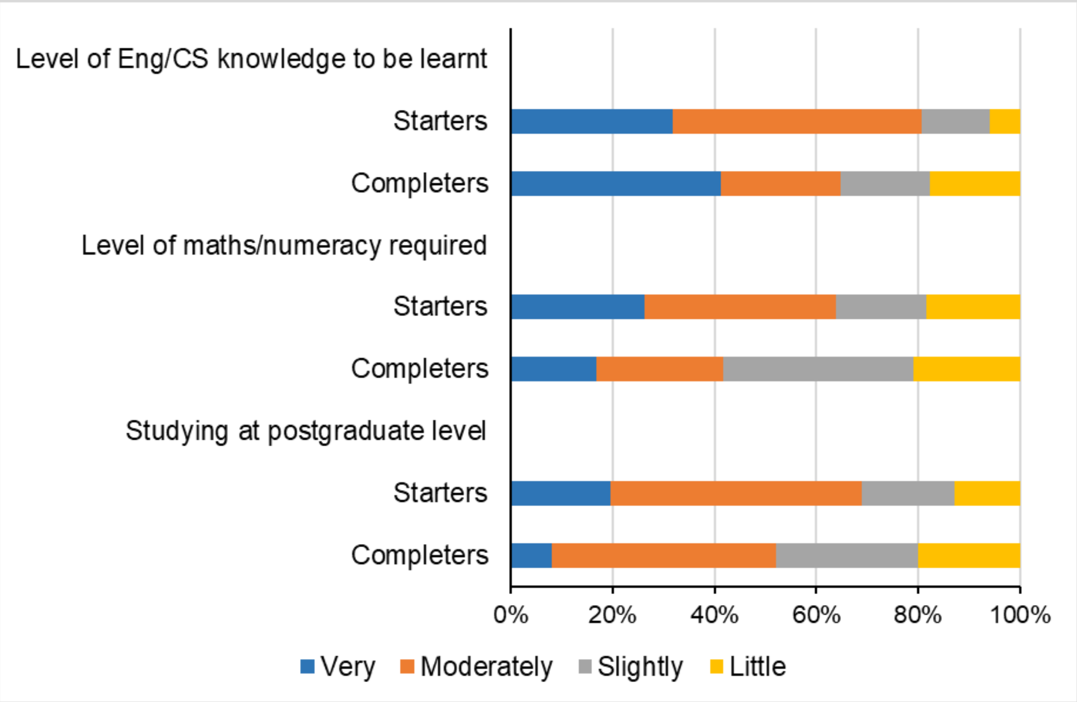


Figure 6.2 Survey respondents’ expectations (by starters, *N*=180) and experiences (by completers, *N*=29) of the extent of challenge of different aspects of study

Participants completing their courses were asked in the survey to describe what they felt had been the greatest challenge they had experienced personally. The most commonly reported of these were challenges relating to their research project and dissertation, although the range of issues included several that specifically related to conversion (as expected) as well as some more generic challenges of PG and especially PT study:

> *"[The required level of] self-study motivation for the dissertation."*
>
> *"Probably my dissertation and how much time it took out of my life to comfortably complete without pushing against the deadline. I had no social life and had to drop work down a day a week just to keep up the amount of work. The support I received from university during this time was incredible [though] and [I] was happy to work on the project."*
>
> *"Dealing with the level of assumed knowledge that the modules had. Out of my eight modules, two were designed for this course. [For the other] six modules that were not designed for this course I had limited or no information about how to catch up to the other people taking them."*
>
> *"The expectation of the level of engineering knowledge (like mechanical engineering concepts), and then the constant workload on top of feeling like I was starting at the beginning with some things."*
>
> *"The learning curve."*
>
> *"Relearning basic knowledge of maths required for studying MSc."*
>
> *"The technical content – a lot of work needed to be put in to understand things fully."*
>
> *"Some of the optional modules I chose out of interest in an unrelated field to what I had already done. This was ultimately a poor decision because many of the other students already had a background in the topic and this put me on the back foot. In hindsight I should select module options better calculating which work best for my skillset and previous experience."*
>
> *"Course looked well organised on the university website. However, it is […] difficult to understand what needs to be learnt and what the assessments are. I feel there is a lack of support and overall I have found that challenging."*
>
> *"Time management – working full time in a demanding role and also studying full time."*

6.1.2 Levels of satisfaction

Based on all survey responses (i.e. from respondents near the start of their courses as well as those in the process of completing), over three quarters of participants were very or quite satisfied with all the aspects of their course experienced to that point.[25] Satisfaction levels were relatively consistent and high across all the aspects questioned, although highest in relation to an initial conversion module where that was part of the course (or in some cases a pre-course bootcamp), and support from institutional staff. Interestingly, the aspect where the lowest proportion were very satisfied was the more 'routine' teaching of modules which,

[25] Responses from those for whom an option was not applicable were excluded, such as those who were yet to undertake project work

in many cases, would have included the teaching of pre-existing modules. Figure 6.3 summarises these results, on the basis of proportions of only those respondents who indicated that the issue was applicable to them.

We interpret these results to show that satisfaction was highest in relation to aspects of teaching and content that were bespoke to and/or had been developed for the new conversion course. It is highly likely that these were aspects of the course taught or overseen by those most closely associated with the proposal, who perhaps had the most invested in developing the concept of a conversion course. These responses, overall, appear to present quite a positive picture of course experiences at this early stage of their evolution, but a more robust assessment would require more students to have reached completion of their courses.

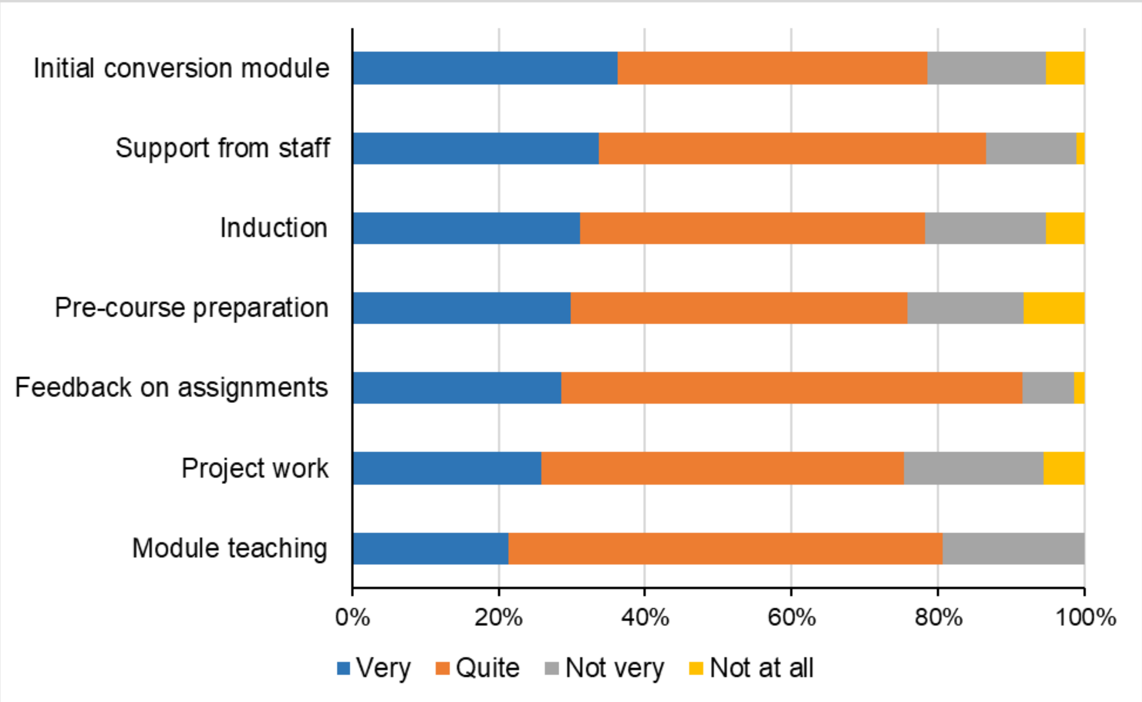


Figure 6.3 Extent of satisfaction reported by survey respondents (all surveys: *N* ranges from 70 to 180)

6.2 Student outcomes and next steps

6.2.1 Completions and graduations

Quantitative assessment of degree attainment was not possible within the timing of our evaluation due to the lag in launch of many courses and time taken for participants to complete and graduate (which is more than a year for FT students, due to project work extending well beyond the academic year, and over two years for PT students). Given the actual launch dates of many courses, the number of students that had graduated during the evaluation was as yet very small.

However, on the basis of dialogue with a selection of course leaders, we understand that the vast majority of students had successfully completed – or, in most cases, were fully expected to complete – their degrees. For example, of one cohort of 32 PT students scheduled to complete in early 2018, we learnt that 27 had done so successfully, while two others had deferred and three had failed. Course leaders' feedback was that rates of deferral, which are routinely quite high for PT Masters study, were if anything lower than seen on other courses. We therefore have reason to believe that most of the current students will complete successfully, or at least are projected to do so, although a longer duration of evaluation could potentially assess this more independently.

6.2.2 Next steps and anticipated career outcomes

Survey respondents were asked to state what they expected their next step to be after completing their course, although they could select more than one of several possible options (and many did so). Well over half indicated that they would seek to work in the engineering or computing sector in the long term, and around 30% would seek a technical engineering or computing role (mostly in the engineering or computing sector, but in some cases outside it). Where they specified work in another sector, this could be in a computing role. A small but significant proportion, particularly amongst the engineering students, aspired to higher level study, which could presumably be a doctorate; this was mostly but not exclusively amongst the international students. Up to one in five of those studying computing or data science courses anticipated that they would return to (or continue to work for) their previous employer. Figure 6.4 illustrates these results, for all students and also by broad subject focus.

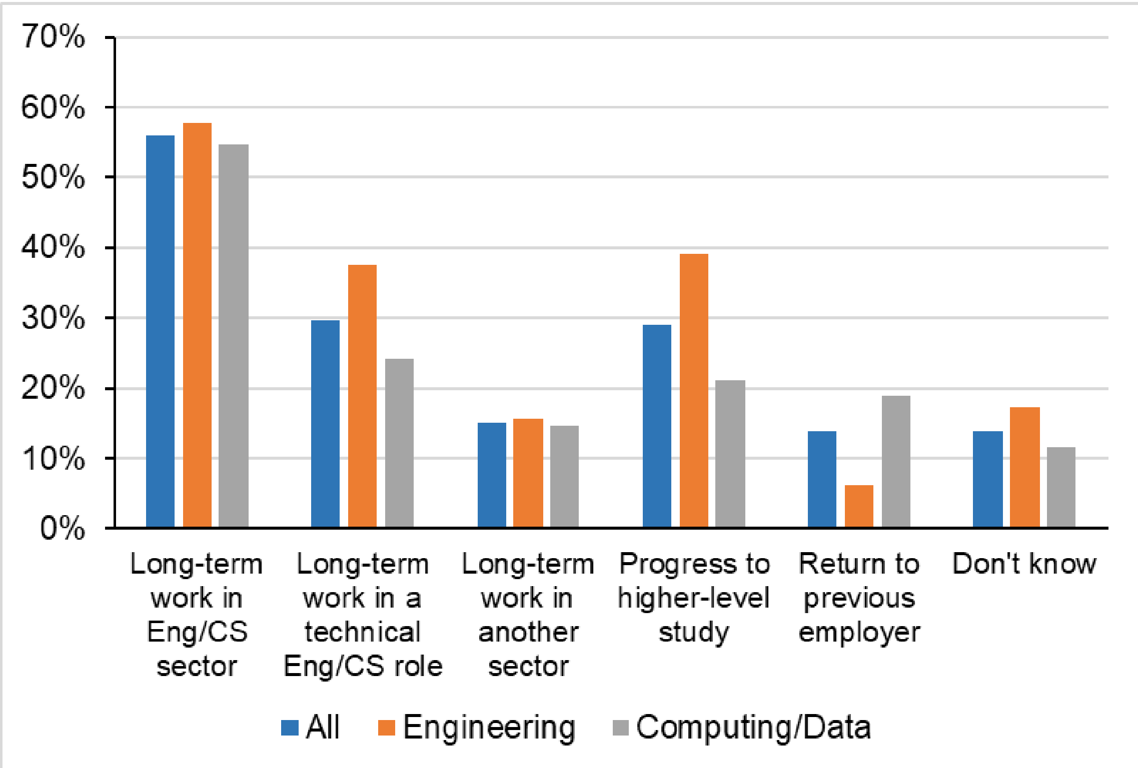


Figure 6.4 Survey respondents' expected next career step after graduation from their course (all surveys; *N*=159; multiple responses permitted)

We considered almost all of these potential next steps to be indicative of potential positive longer-term outcomes in relation to the aims of the pilot conversion course scheme. This means that up to 90% of these respondents, while they were students on one of the courses, at least, were indicating an intention that was aligned with the broad purpose of the funding scheme, and most of those who did not were still undecided about their next step.

The number of survey responses provided by participants who had fully completed their course was not sufficient to undertake robust analysis of this particular group in terms of their actual next steps. However, amongst their responses were many statements of very positive outcomes and circumstances, including the following:

> *"[I] now have a good knowledge and theory of cyber security. Lecturers [were] very helpful and knowledgeable and [are] still in touch."*
>
> *"An understanding of some of the more modern approaches in data science that I can incorporate into my work."*
>
> *"It has made me see the world through different eyes. I can relate a lot of the theories I learnt to [my] day-to-day activities and objects [at work]."*
>
> *"It has enabled me to change career direction."*
>
> *"A more in depth understanding of medical devices, in particular regulatory and quality-related areas which I believe really made me stand out on my CV and during interviews."*
>
> *"The grounded knowledge in computing science to comfortably make decisions based on my learning."*
>
> *"The effect and weight of having 'Masters of Data Analytics from the University of Salford' on my CV has got me many more job interviews."*

Respondents completing their course were invited to specify, if they knew it, an occupational aspiration 10 years from now. Their responses were very closely aligned with the aspirations that had been expressed by respondents who were students starting their courses, and the occupations defined included:

- Engineer / Chartered engineer
- Chief Information Security Officer
- Senior data analyst / scientist [*numerous occurrences*]
- Principal software engineer / architect
- Senior Product Developer and Consultant for Medical Devices
- Research and Development Engineer within Aerospace

Our dialogues with course leaders confirmed that many of the students completing a course (and/or newly graduated) were now successfully employed in engineering or computing roles and companies, having expressed a technical professional role as their career aspiration.

Within the data science students, in particular, where the employment market is strong, two course leaders reported that many of the students had received offers of either internships or open-ended positions with leading employers even before they had completed their course. In autumn 2018, the course leader at Salford reported that all their 2016/17 data science students were now in full-time employment, and that some had received multiple job offers.

What we do not know, which would have required significant in-depth research with individual participants, is the extent to these conversion students engaged with their HE careers advisory services, or other support, and whether this was more or less common than might be the case for 'average' Master's course students in these disciplines. Evidence suggested that the funded projects did not overtly include any bespoke careers support activity which could potentially enhance employment outcomes (noting that a significant proportion of participants were already in some form of employment).

Amongst the small number of graduate respondents who provided confirmed next step information (N=24), four (who had studied part-time, whilst being employed and in mid-career) had continued with or returned to their previous employer but all had now progressed to a more senior or technical role or were in the process of doing so. Seven others had successfully entered a different organisation and/or career sector and five were seeking such employment. Six were entering (or seeking to enter) PhD programmes in these fields – in one case this was a graduate who had previously been a school teacher who had received an offer for a PhD in a branch of engineering. Only two were in what could be termed subsistence employment and none were unemployed.

Within the survey responses from completers, 11 graduates reported that they had undertaken an industrial project as part of their course (which they indicated had been a 'live' or 'real' project with external industry). 10 of these reported that it had been very valuable practical project experience and six reported that they had the intention of seeking work at that specific company in the long-term.

6.3 Institutional reflections on teaching and learning

Course leaders reflected positively on a number of aspects of teaching their new conversion courses, as well as relating some of the expected challenges.

One reflection from several course leaders was that the motivation level of conversion students was particularly high, and potentially higher than typically seen for the average cognate student. Such high levels of motivation – which could arguably be necessary to have the confidence to undertake a conversion course in the first place – were thought to assist greatly in participating successfully in a Masters course. One course leader related his experience that conversion students performed very highly in a design module provided that they had previously had some form of hands-on background, whereas they tended to perform less strongly in mathematical tasks. In comparison, cognate students tended to do reasonably well, consistently across both, although did not always excel in either. He did note that many of their conversion students had high attainment in their prior degree, in another subject (several with a 1st class degree), so these students did have a track record of working hard. He also reflected that they also tended to ask more questions.

It was to be anticipated that students with STEM backgrounds that were closer to the engineering or computing subjects would find the new technical content facing them more familiar, than would conversion students, and also the style in which it was taught. This seemed to be the case both for students with the highest levels of motivation (and/or the hardest workers) and other students. However, there was a consistent observation that many conversion students tended to work very hard, reflecting their high motivation, as was required to succeed in study at this level, and as a result were amongst those obtaining high marks.

Many of the courses have been and are being delivered to mixed cohorts, which comprise both cognate and conversion students and a mix of UK-domiciled and international students (many of the latter being cognate students). The mix of students also varies as many of the conversion programmes share modules with other existing provision, which will have a different range of student backgrounds. Course leaders reflected that, typically, international MSc students tended to have quite a wide range of level and extent of prior knowledge as they had undertaken first degrees in a wide range of institutions and countries. As a result, MSc cohorts are already quite mixed even without the presence of conversion students. The addition of UK-domiciled students with non-cognate degrees simply extends this range and adds a further angle to the teaching of mixed cohorts.

In many cases, the range of backgrounds on conversion courses led to varying levels of additional support being required, which was provided by the course staff. However, course leaders also reflected that mixed cohorts had value in terms of their potential for peer-to-peer support. For example, cognate students were able to help other students in areas with which they were particularly familiar through their first degree. On the other hand, the presence of highly motivated, UK-domiciled conversion students could be beneficial for the whole cohort where it encountered new and challenging concepts and knowledge.

Overall, there was acceptance that conversion students did tend to require more support, which needed to be personalised, than UK-domiciled cognate students, at least. Course leaders understood that this was one of the areas in which ongoing investment of time would be needed if the course was to be sustained. In several cases, because the cohorts to date had been quite small, the course leader (or other closely involved staff) had been able to provide such additional support personally. If cohorts become large, the provision of support might well need to be broadened, because course leaders alone would not cope with that demand. In the early phase of development of these pilot courses, it has been only natural that course leaders have been very invested in the development and success of their venture, so they have been prepared to provide a lot of this support themselves, but more sustainable models of support provision will be needed in the longer term, as and when courses scale up. At the same time, it may be that some of the staff who are key innovators will move onto new initiatives.

6.4 Wider institutional benefits

There were also reports of some wider education-related impacts within the funded institutions, in the form of additional outputs and benefits from the development work beyond the new courses launched. Several course leaders reported that the project had raised the level of awareness, not only amongst students but also more generally in their institution, about the concept of conversion.

Some funded institutions, as noted, used the funding essentially to widen the range of students being considered eligible for some existing MSc provision and/or enrolling in that provision, through provision of limited additional learning to support converters and wider marketing. However, several institutions which used the funding to develop new provision also reported that conversion-style provision was now being postulated in other disciplines. This was leveraging their understanding that, conceptually, conversion does appear to be feasible for certain ranges of students – using customised teaching approaches to accommodate conversion students or through provision of an introductory module to underpin study of existing MSc teaching, together with additional support on an individualised basis. There is no reason, inherently, to doubt that the concept is transferable to subjects beyond engineering and computing.

Other commonly reported benefits to institutions were the wider use of some of the new modules created during development of a new course or conversion of existing content to other methods of delivery such as online. Newly created flexible learning resources which support students from varying backgrounds were being used not only in the teaching of the new courses as they evolve, but also in some cases to enhance other, pre-existing provision. Equally, effective approaches to provision of more personalised student support, reflecting different student backgrounds, could be applied to other programmes. Since much MSc provision practically takes the form of sharing of modules between different specific courses, the availability of new modules and content in topical areas will be very beneficial more widely. New learning resources developed under this funding scheme which are used in other provision are therefore an additional legacy of this scheme, including within institutions which had at the point of evaluation not enrolled any students to their new provision. In fact some of the institutions had deliberately pursued strategies towards these types of benefits. The University of Southampton, which introduced a new module to its existing MSc course in data science to widen access to it, also developed modular content to be embedded in a wide variety of courses across several of its schools, so that each of those courses had a discernible element on modern data science within that subject context. Another, Coventry University, developed a module specifically for final-year undergraduates as a generic taster of Masters provision including its potential new conversion courses. Arguably, given that many institutions considered the extent of funding to be very modest, it is not surprising that some will have had an eye on these more generic benefits, in the absence of knowledge of whether there would be strong demand for their new conversion courses.

7 Overall findings and issues

7.1 Key evaluation findings

Based on our evaluation work to autumn 2018, our overall conclusion is that the engineering- and computing-related conversion pilot courses scheme has been at least partially successful in terms of achieving a range of its aims that were measurable at this time. This includes certain measurable outputs and some signals that are aligned with intended longer-term outcomes:

- All but one of the funded institutions that proposed to do so have developed, validated and made available new MSc conversion courses on engineering, computing or data science themes (between them 41 new courses), while others that sought funding to broaden intakes to existing MSc provision have achieved that to some extent;
- A total of 31 new courses are actively being delivered to enrolled students in the 2018/19 year – 21 in engineering, six in computing and four in data science;
- A total of 833 students are recorded to have enrolled in this provision to date, of which over 500 have studied data science courses, just over 230 engineering courses and almost 90 other computing-related courses. The total for engineering includes an estimate of additional conversion students enrolled in pre-existing MSc provision as a result of enhancement activity funded through the scheme;
- The number of students starting these courses in 2018/19 was 363, the highest of the three years spanned by this evaluation, suggesting that there continues to be some growth in student participation;
- Two thirds of the students enrolled have been conversion students, i.e. had first degrees that we considered were not cognate in relation to the MSc course discipline. Their first degrees ranged from Near-STEM subjects (such as physics or maths) to Non-STEM subjects, with a range of mixes in different cohorts;
- 60% of the students to date have been of UK domicile, which is higher than the proportion in most existing UK provision in these disciplines. Even when one particularly large course, comprising mostly UK domiciles studying part-time, is excluded, the proportion remains significantly higher than the norm;
- There was no evidence that the diversity (in terms of gender or ethnicity) of students on the new courses has been substantially different to that of typical student cohorts in existing UK PG provision in these disciplines;
- In all, over one third were mature students (over 30 years old), with evidence that many were returning to HE study to up-skill or re-skill. Some of them studied part-time while in employment. This was the case for three quarters of those studying data science or computing-related courses (i.e. they were ‘returners’ rather than having progressed directly after a first degree), whereas over half of those studying an engineering conversion course did so immediately after their first degree). Very few of either group (<5%) had been unemployed before the course;
- Average cohort sizes for data science courses have grown very strongly while for engineering and other computing topics, including cybersecurity, cohorts have been very

modest in size and in many cases have not yet reached financial sustainability (although this may be congruent with the slow growth pattern of many new MSc courses);

- Based on the available evidence to date, the vast majority of enrolled students are progressing to the end of their course, successfully completing and obtaining their degrees;
- It is too early for robust assessment of long-term outcomes of the scheme in terms of impact on entry to engineering/computing careers. However, on the basis of students' anticipated next steps after completion, up to 90% of participants indicated an intention that was aligned with the broad purpose of the funding scheme (and most of those who did not were still undecided about their next step). These intentions were largely borne out in the very modest number of responses from graduates who had completed their course;
- A range of course delivery approaches (including both full-time and part-time models) have been deployed, mostly using a combination of newly developed and existing modules with provision of some additional support for conversion students. A number of new flexible learning resources developed to support students from varying backgrounds are being used not only in teaching of the new courses as they evolve, but also in some cases to enhance other pre-existing provision;
- Overall, this constitutes evidence to suggest it is feasible for non-cognate graduates to attain an engineering or computing MSc degree through a conversion course, although significant demand for such provision, so far, has only been proven in data science, based on the recruitment strategies employed (which in many cases included some bespoke marketing activity funded through the scheme that would not necessarily be sustained). Arguably, conversion to engineering and computing has always been possible for individual graduates, based on anecdotal evidence, but this project has provided some formalisation of the concept.

Broadly, we infer that much of this new provision could become sustainable in future years, subject to sustained effort to promote the courses and further growth in enrolments. Growth in the number of international students is likely, on the basis of experience of development of other MSc courses in these sorts of areas. Mixed cohorts, which comprise both cognate and conversion students, and UK and international students, are likely to be required for financial sustainability. Evidence suggests that teaching such mixed cohorts (meaning mixed in terms of prior degree subject and domicile) has some challenges but also offers significant benefits including potential for more peer-to-peer support.

Several of the data science courses developed through this scheme have achieved large numbers of students very quickly (in one case requiring more than one cohort per year and, at Birkbeck, introduction of a FT variant in addition to its PT course). This success is thought in part to reflect current perceptions of very healthy career prospects for those qualified in this area. It potentially demonstrates that graduates are aware of the exceptionally positive potential for future careers utilising this specialism, and are basing the decision to undertake further study through a conversion course as a strategy to re-skill or up-skill from existing employment, to take advantage of that labour market potential. However, it is likely that they also reflected local contexts; in some cases a newly created course and its marketing could have benefited not only from huge personal commitment and passion from an individual course leader, but within an institution with relatively little MSc provision it could gain high profile and institutional support. On the other hand, in a large university with a wide swathe of MSc provision, the funding from the scheme could be seen as minor income and lead to expectations of an outcome of only modest marginal or incremental growth to substantial existing programmes.

However, we believe that these large enrolments in data science were mostly driven more by the high profile of the topic (and perceived career potential), than exclusively by contextual factors or by the specific conversion attribute of these courses per se, but the findings endorse the proposition that conversion at this level is achievable. In other areas of computing and engineering, there appears currently to be weak demand for such provision from graduates.

In addition to these findings, we recorded a range of additional outputs and benefits from the development work funded through the scheme, beyond the new courses identified and students participating on them. Several course leaders reported that the project had raised the level of awareness amongst students and more general interest in their institution about the concept of conversion. This was resulting in wider intakes being considered eligible for some existing MSc provision, and enrolling in that provision, and additional conversion-style provision being postulated in other disciplines. Conceptually, conversion appeared to them to be feasible based on teaching that is either bespoke to conversion students or comprises an introductory module to underpin existing MSc teaching, together with additional support on a personalised basis. There seems little reason to doubt that the concept is transferable to many other subjects too.

Other commonly reported benefits to institutions were wider use of certain new modules or flexible learning resources created during development of a new course, conversion of existing content to other methods of delivery such as online, and development of approaches to more personalised student support reflecting different first-degree backgrounds could be applied to other programmes. As much MSc provision practically takes the form of sharing of modules between different specific courses, the availability of new modules and content in topical areas could have significant wider benefits.

7.2 Emerging issues

7.2.1 Projections, timing of course launches and marketing

While we highlight many of the successes achieved by institutions through the scheme funding, in the majority of cases the new engineering- and computing-related courses have not secured the number of students projected in their funding proposals. Reflecting on those proposals, it seems that there was almost universal optimism that student numbers would rise quickly to sustainability, on which basis all proposals were written. Subsequent dialogue with course leaders suggested that optimism was some way beyond their real-life experiences of launching MSc courses, as most reported to us that enrolments to new courses tended to be extremely modest for the first few years and only gradually built up to sustainability (which was typically 15-20 students per year). It could be that those writing proposals felt they had to model sustainability much more quickly in their bids, leading to that apparent optimism.

A related issue which was raised widely in our two formative workshops and in dialogues with institutional staff was the timing of the funding opportunity. They suggested that the timing of the call for proposals and the short duration of the funding did not align with the established 'cycle' for new course development and especially the time taken to obtain university approval (validation) for a new course, which was necessary before full marketing could be undertaken. In their proposals, almost all the institutions suggested that they could develop and launch their new courses in time for 2016/17 delivery, which was very ambitious and, with hindsight, unrealistic in many cases.

To their great credit, a dozen institutions did manage to develop new courses and achieve more rapid course validation by their university than was normally the case, enabling them to launch new provision on time in autumn 2016. However, many others missed that target and deferred first delivery to the following year. This clearly had a significant effect on the total number of students participating within the period of the pilot scheme, although it might not have a detrimental impact in the long term.

Amongst those that did manage to launch a new course in autumn 2016, many did not receive validation until the summer months. Full promotion of the course could not be undertaken until validation had been achieved, i.e. any promotions beforehand had to label the course as 'subject to validation'. Some institutions were not permitted to do any specific marketing of their course at all until after validation, although some undertook informal promotions in the meantime. Practically this also meant that details of these new courses were not included in institutional marketing activity for 2016/17 provision or incorporated in aggregated PG study databases.

The balance of promotional activity by institutions shifted as a result, and many directed their efforts mainly towards their own students and alumni that they could reach directly, in some cases with little use of their institutional centralised marketing team. Some institutions turned this into a positive, reporting particular success in recruitment where the course leader gave presentations during spring/summer lectures in subjects like psychology and business, where employment outcomes for graduates may not have been so strong. However, there is little doubt that this issue of timing impacted on total enrolment numbers in 2016/17, as well as the inability of many institutions to launch at all that autumn although they had proposed to do so.

Courses that started delivery in autumn 2017 were either a second cycle (for those that had launched in 2016/17) or first delivery in many cases. In either case, there will have been time for a full 'run up' in the sense that they could take advantage of the full range of marketing opportunities afforded by the institution across the conventional marketing cycle, as well as bespoke promotional activities undertaken by the department for which financial support had been secured. Overall, with the exception of the data science courses, enrolment numbers in the majority of cases remained modest. This pattern appears to have been repeated in 2018/19, which was the second cycle for courses launched in 2017/18 (and the third cycle for the earliest courses). On this basis, the slow growth of the new courses could reflect very modest demand from graduates for conversion courses in engineering and some areas of computing, or a lack of awareness of this type of provision, or lack of perception of a strong labour market, unlike in data science. It is possible that the greater acceleration of the data science courses reflects the strong linkage of those courses with employers, so that employment prospects are more immediately clear to prospective students. More generally, anecdotal evidence from institutions suggested that it could also reflect low awareness of the idea that a postgraduate conversion course could enable career change or the up-skilling needed to enter a chosen career.

7.2.2 Delivery experiences and the feasibility of conversion

The use of workshops in the early phase of this evaluation, to share approaches and experiences of development and marketing, worked well in terms of more formative aspects of evaluation. At the time of writing, relatively few of the total of about 830 students who have participated have completely finished their course and graduated (only those who studied a 2016/17 one-year course on a FT basis, as in practice the project extends course durations to beyond a year, even for a 'one-year' course). As a result, there has been little scope for retrospective assessment of the full delivery cycle including graduation, so we have had to rely on course leaders' insights into performance of students and reflections on course delivery. It has not been possible, for example, to compare the outcomes or study experiences of students benefiting from different delivery approaches or models. Equally, it is not yet possible to discern whether the learning acquired is genuinely sufficient to enable recognition for Chartered Engineer (or equivalent) status or a different status (see Section 7.2.3). To undertake evaluative work at that level of detail would require an even longer study and greater resourcing to attempt to collect more data with the level of detail required.

Overall, the scheme attracted proposals that predominantly offered a relatively conservative approach to the challenge of postgraduate conversion into engineering, through incremental change and adaptation of conventional approaches to engineering Masters programmes (and in some cases adaptation of existing provision). Many of these, in practice, targeted those with a first degree in a subject which was relatively 'close' to engineering, such as physics. There were examples of more ambitious approaches – developing all content from new and targeting a relatively wider range of students. There were also some more radical approaches that sought to develop the professional skills held by graduates of Far-STEM and Non-STEM programmes in order that they could fulfil valuable intermediary roles within the engineering sector, i.e. they did not seek to reach quite the same level of output. While the scheme does seem to have demonstrated what is feasible via (mostly) the more incremental approach, which might be expected given the relatively modest level of funding available, any future investment might focus on fewer but more ambitious and/or innovative programmes or approaches, perhaps with a tighter definition of more ambitious conversion in mind, such as focusing only on Far- and Non-STEM graduates but more flexible expectations of the output level of the programme.

What we can say at this point, however, is that on the basis of the approaches taken, we found no evidence to indicate that particular delivery approaches did not work. Course leaders report that most conversion students progress well and that high proportions of the cohorts to date have successfully completed their courses and graduated. There is preliminary evidence that completion rates and academic performance of conversion students may, on average, be as high or higher than typically experienced amongst cognate students at MSc level, as conversion students tend to be very highly motivated. Mixed cohorts (both cognate and conversion students) appear to offer beneficial opportunities to leverage peer-to-peer support amongst students.

These insights suggest that 'conversion' is feasible for at least some graduates on the basis of the delivery models proposed, at least to the point of acquisition of a Masters qualification, with some evidence that this enabled career progression of the sort envisaged. However, there is clearly no evidence of long-term benefits such as progression to Chartered status. Given the relatively limited numbers who have completed courses to date, these must be regarded as somewhat preliminary findings.

We suggest, however, that this does constitute preliminary evidence that, in broad concept, a conversion course is a feasible mechanism for non-cognate graduates to obtain an engineering or computing MSc qualification, through a range of models, although there is insufficient evidence yet to assess robustly whether this leads to long-term career success in these sectors, or for how wide a range of students it might be feasible. Feedback from graduates from the courses and course leaders suggests that many of the graduates to date have obtained or are seeking the types of occupational role envisaged by the funders in the engineering and computing sectors. However, a longer-term view would be needed to monitor their future career trajectories and, for example, whether they are able to acquire professional recognition such as Chartered Engineer (or equivalent) status.

That there has only been a relatively small total number of graduates emerging from the courses developed in the pilot schemes to date is not, we suggest, any failure in teaching or learning, but simply a reflection of both the slower than anticipated start of delivery by many institutions and also small numbers of students enrolling on courses other than in data science. It could be that once conversion becomes more widely understood, that demand might increase.

7.2.3 Accreditation

We felt it worth dedicating a short section to the issue of accreditation, because one of the aspirations of the scheme was that a conversion course could be an acceptable step within the progression of an individual to become a professional engineer with recognition through Chartered Engineer status (or an equivalent in computing).

Broadly, accreditation needs to be considered in two ways. First, there is the accreditation of courses by an appropriate professional body, such as one of the ‘Professional Engineering Institutions’ (PEIs). Course leaders intimated that, on the whole, it did not appear to be problematic for a university that was already providing accredited first degree and/or MSc courses to obtain accreditation of additional new provision in the form of a conversion course. There were several instances where such recognition, at provider level, had been obtained.

The more challenging area is recognition (accreditation) of individuals, i.e. the professional recognition conferred by a professional body through award of Chartered Engineer (CEng) or Incorporated Engineer (IEng) status. (For simplicity, this discussion is based on engineering, although the same issues may well apply to those seeking computing-based registration.) The entry point to CEng recognition, through the standard route, is a four-year integrated MEng degree or a BEng first degree plus evidence of appropriate additional higher-level study. A non-cognate first degree plus a conversion MSc delivers the same volume of study as the standard route. A number of PEIs were consulted by universities during course development and, in principle, appeared to confirm that they would be open to awarding CEng status to individuals who obtained an MSc through a conversion course from a recognised provider. Survey responses from course participants confirmed that around one in five respondents felt that eligibility for such professional recognition was very important and a further two in five that they would like to have the option to pursue it. These proportions were only a little lower for those on computing or data courses than engineers. Where they did express interest, this was almost exclusively at CEng level, while many of those studying computing or data courses would tend to seek industry or vendor qualifications.

The broad current position, as we understand it, is that while the PEIs would in principle accept a conversion MSc as a qualification for the Level 7 learning required, participants would not be able to access Chartered Engineer status through the standard route as they will not, by definition, have a first degree in engineering that the PEI accredits or recognises. Only the 'individual' or 'portfolio' route would therefore be open to conversion graduates, which is a less straightforward undertaking for an individual and is only conferred after several years of employment in a relevant role. We appreciate that this situation may change, but it seems likely that such change might require more substantial demand from conversion graduates than is currently anticipated based on this project.

7.3 Recommendations

- Institutions should continue to promote and deliver their new conversion course provision, and continuing efforts should be made to evaluate over time whether this provision can be made sustainable, and to what extent there is a long-term market for conversion courses, into engineering especially;
- Assessment of long-term career impact outcomes for participants, and any outcomes in terms of impact upon trends of entry to the engineering and computing labour markets, will need a longer time window than the duration of this study. Further assessment longitudinally of graduates completing conversion courses would be valuable to explore these longer-term outcomes of the scheme;
- Periodic further evaluation of relevant Masters provision, potentially in a sample of institutions including some funded here, would be valuable to explore the wider impacts of the early teaching experiences reported here, including the benefits of availability of conversion content and materials and new approaches to more personalised support;
- Institutions should consider other application areas for conversion, bearing in mind the needs in the economy for re- and up-skilling in the existing workforce, and opportunities to re-use some of the conversion content and approaches developed;
- If longer-term impact is proven, some national-level promotion of the potential for conversion, in the context of growing needs for re-skilling of the workforce and intersectoral mobility, could be valuable to increase awareness of the concept of conversion at Masters level;
- Given the relatively conservative approaches adopted by many institutions, a more tightly focused funding scheme which deliberately seeks development of more ambitious extents of conversion (i.e. only from Far- or Non-STEM subjects) could be valuable to test the conversion concept in more depth, although in itself it would not be likely to have a great scale of output in terms of numbers of graduates;
- It would be valuable to explore the extent to which there could be greater alignment between conversion Masters course approaches and Level 7 degree apprenticeship models. Much of the early provision of conversion courses has focused upon full-time delivery models, but institutions should consider more flexible modes of delivery (as many had intimated in their proposals that they would do following development of full-time provision);

- Institutions should consider how their careers advisory services and employability strategies could more prominently cater to and accommodate conversion course students to enhance the success of programmes and ultimate employment and career outcomes;
- If courses are sustained, monitoring of student diversity should be carried out and reported to assess whether they provide particular value to students from less-advantaged backgrounds (and whether courses should feature in institutional Access & Participation strategies);
- Any future conversion course development should be done in as close a partnership as possible with relevant employers to ensure relevance of content and to strengthen provider-employer links: this would support project-based conversion course work and/or other employer-led activities which themselves will improve the application of learning and thus potential outcomes, as well as providing more direct opportunities for students to pursue linkages to employment.

Abbreviations

BAME	Black, Asian and Minority Ethnic
BIS	Department for Business, Innovation and Skills
CEng	Chartered Engineer
DCMS	Department for Culture, Media and Sport
FT	Full time
FTE	Full-time equivalent
HE	Higher education
HEFCE	Higher Education Funding Council for England
HESA	Higher Education Statistics Agency
IED	Institute of Engineering Designers
IEng	Incorporated Engineer
IT	Information technology
LEP	Local Enterprise Partnership
PEI	Professional Engineering Institution
PG	Postgraduate
PT	Part time
RoW	Rest of the world
SHU	Sheffield Hallam University
STEM	Science, technology, engineering and maths
TNE	Transnational education
VLE	Virtual learning environment