The impact of doctoral careers

Final Report

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Dr Abigail Diamond, Dr Charlie Ball, Dr Tim Vorley, Tristram Hughes, Rachel Moreton, Peter Howe, Tej Nathwani
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<td>DLHE</td>
<td>Destinations of Leavers of Higher Education</td>
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<td>STEM</td>
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01. SUMMARY

This chapter provides a summary of some of the key findings from the Doctoral impact and career tracking study. With little known about the medium term career paths and destinations of doctoral graduates the study provides new insight into the impact they have when working outside of higher education. The research examines their current role and career history, value to employers, contribution to innovation and wider socio-economic impact.

Doctoral graduates’ value to employers

For those businesses that employ staff with PhDs, such is the value placed on their specialist knowledge, research skills and problem-solving ability, that three quarters of employers taking part in the research said their loss would have either a business critical or significant impact on operations. One in five employers said that doctoral graduates were business critical – without them their business could not function. This was particularly the case in the research and development and manufacturing and engineering sectors and in businesses that are built on science and technology.

Employers value doctoral graduates’ deep specialist subject knowledge, excellent research and analytical skills, their capacity for critical thinking, as well as their ability to bring fresh perspectives to problems or the organisation. These skills enable doctoral graduates to innovate, developing new or improved goods, services, processes and ways of working. This report provides examples of a multitude of ways in which doctoral graduates have contributed to innovation: from improved telecommunications products to the detection of cybercrime; from creating new flavours for the food industry to reducing the multiple births resulting from fertility treatment; and from an iPad app allowing users to explore exhibits in a museum to speeding up the assessment of financial claims.

Badge of quality

The evidence shows how doctoral graduates can boost the profile and credibility of an organisation, with the doctorate acting as a mark of quality and authority. When it is important for outputs to be innovative, rigorous or evidence based, having a PhD on board can help to provide this reassurance. Some employers in the study talked about winning new clients due to the expertise of doctoral graduates or gaining recognition through awards or high profile projects where doctoral graduates played a role.
Employers also reported that doctoral graduates help them to acquire new clients, markets and income streams, which contribute to improved profitability or sustainability. They also gave examples of how doctoral graduates help to increase productivity, make processes more efficient and generate savings, which in turn enhance competitiveness.

**Connecting ideas to industry**

Recent government analysis of UK innovation sets out the importance of ‘absorptive capacity’. This is a firm’s ability to identify, adapt and integrate new technologies and ideas. Doctoral graduates help to foster innovation by contributing to their employer’s absorptive capacity through collaboration and engagement with universities. 75 per cent of doctoral graduates responding to the survey stated that they had been engaged in collaborative projects, promoting knowledge exchange between universities and industry. Employers explained how doctoral graduates bring with them the cutting edge knowledge and ideas which can then be applied for commercial benefit.

**Raising the game of those they work alongside**

The benefits don’t just stop with the individual with the PhD. The research also demonstrates the different ways in which the skills and attitudes of doctoral graduates can ‘spillover’ to other employees. The vast majority of graduates responding to the research said they had been involved in improving the problem solving skills of others or helping them to think more creatively. This was corroborated by their employers, who described how doctoral graduates encourage, support and inspire those they work alongside to achieve more and better. Doctoral graduates ask questions, bring new ideas and knowledge to a company and offer fresh perspectives on old problems.

**Find out more**

The doctoral impact and career tracking study was commissioned by Research Councils UK (RCUK) and the higher education funding bodies for England and Wales (HEFCE and HEFCW). The aim was to explore the career paths and impact generated by doctoral graduates in the medium term, with a particular focus on those working outside of academia. The study surveyed 1,839 people who had graduated with a doctorate from a UK institution between 2003-04 and 2005-06 (four per cent of the total population of doctoral graduates for these years). The researchers also interviewed 268 of those who completed the survey and 96 employers of doctoral graduates.

Shorter briefings targeted at policy makers, employers and current and potential doctoral students can be found at [http://www.rcuk.ac.uk/skills/impact/](http://www.rcuk.ac.uk/skills/impact/)

Survey data from the study will be deposited with the UK Data Archive for other researchers to use. [http://www.data-archive.ac.uk/](http://www.data-archive.ac.uk/)
02. INTRODUCTION

This chapter sets out the project background, aims, scope and policy context for the study.

Project background

The doctoral impact and career tracking study was commissioned by Research Councils UK (RCUK) and the higher education funding bodies for England and Wales (HEFCE and HEFCW). These organisations provide public funding in postgraduate research and share an interest in demonstrating the impact of these investments.

AIMS AND OBJECTIVES

The project aims to address the following objectives, with a particular focus on career paths and impact of doctoral graduates outside academia:

— To understand the career pathways and destinations for doctoral graduates over a seven to nine year period after graduation
— To understand the economic, social and cultural impact of doctoral graduates, including views from both graduates and employers

It is hoped the study will help to inform:

— Investments in doctoral training
— Policies regarding research training and how it contributes to both excellence and impact
— Policies regarding the career pathways of researchers and how these might be influenced
— Researchers and those advising researchers about career options

PURPOSE

Economic theory suggests that obtaining higher levels of education will not only bring private benefits to the individual, such as a better salary or greater personal well-being, but can also generate significant benefits to wider society. Higher levels of education can allow individuals to develop a more creative and inquisitive mindset, which can then be used in employment and elsewhere to bring through new ideas and/or adapt new technologies. This is vital to the long-term economic growth prospects of an economy and enables new and more efficient products to enter the market, which we are all able to benefit from.
Additionally, these individuals may also pass on some of their knowledge to those they work with, boosting their creativity and productivity.

Previous research that considers the destinations and careers of doctoral graduates has often focused on the private benefits of doctoral study, such as job satisfaction and pay. Studies have also generally taken place within a few years of doctoral graduates completing their qualification, which can be too short a time scale in which to assess the impact. By considering doctoral careers and impact approximately seven to nine years after graduation, this study aims to go some way to address this knowledge gap and evidence the wider impact doctoral education can have on the individual and society.

**Project scope**

This study primarily focuses on the careers and impact of those who graduated with a doctorate in 2004/05. This is because there are already two sets of data on this cohort; the Destinations of Leavers of Higher Education (DLHE) survey carried out six months after graduation and the longitudinal Destinations of Leavers of Higher Education (L DLHE) survey carried out approximately three and a half years after graduation in 2008/09. This study therefore builds on previous research by Hunt et al (2010) examining the destinations and impact of doctoral graduates who qualified in 2004/05.

The study covers those who graduated from a UK higher education institution (HEI). This includes overseas doctoral graduates, although most respondents were UK and EU domiciled. Graduates of overseas HEIs are out of scope. The characteristics of research participants are explored in the following chapter. Although commissioned by RCUK and partners, the study encompasses all doctoral graduates regardless of how their studies were funded and is not restricted to research council funded graduates. Most doctoral graduates have a PhD and this is reflected in our survey participants, although we also collected data from a small number with an EngD or professional doctorates such as DClinPsy and DEd (3 per cent of respondents).

Identifying and making contact with this cohort of doctoral graduates eight years after graduation was particularly challenging and so to boost sample numbers for the research, we widened the scope to include doctoral graduates from one year either side (2003/04 and 2005/06).

**Policy context**

First introduced in the UK in 1917, the doctorate (commonly referred to as a PhD or DPhil), continues to be seen as the ultimate academic qualification and achievement (Green and Powell, 2005). The doctorate qualification is upheld as an internationally recognised qualification for academic researchers, and as the Advisory Board of the Research Councils stated, it is an important qualification for gaining entry into other labour markets (ABRC,
The Leitch Review of Skills (2006, p68) referred to higher level skills (such as PhDs) as key drivers of innovation and noted that they were “...critical to a high skills, high performance economy and increasingly in demand from high performance, global employers.” The number of people embarking on doctoral study in the UK has steadily risen since the 1980s. Between 1996/97 and 2009/10, the number of doctoral candidates increased by 27.6 per cent, from 18,635 to 23,780. Other nations have also experienced a big rise in the number of individuals obtaining a PhD. Growth is particularly evident in emerging economies such as China and India, where strong economic performance is raising the need and demand for higher level skills. Indeed China has overtaken the USA as the world’s largest producer of PhDs; however figures suggest that each professor in the country currently supervises almost six doctoral candidates, leading to concerns over the quality of the doctoral graduates that are being produced (Group of Eight, 2013). Brazil, another rapidly developing economy, doubled its number of doctoral graduates between 2000 and 2009. In India, the growing population and economy have led the government to commit an increasing amount of resources towards higher education and their ambition is to have up to 20,000 PhDs graduating every year by 2020 (Nature, 2011). India is not the only nation to set itself future targets, for example, Malaysia wants to achieve 60,000 PhD holders by 2023 (Group of Eight, 2013). This contrasts quite markedly to the situation in certain developed economies in the world. In Japan, doctoral graduates in science have struggled to obtain employment either in academia or industry, leading to a fall in the numbers entering such programmes. In the USA too there is concern regarding the over-supply of doctoral graduates, with individuals consequently unable to find jobs that suit their skills and qualifications (Nature, 2011).

At one time, the purpose of the PhD was to gain training for a career in academia. Yet the career pathways of PhD graduates have become increasingly diverse, particularly given the scarcity of academic roles available to an ever increasing pool of doctoral graduates. This has certainly been the case in more developed economies. Given such developments, debates about the nature and role of doctoral training have been the focus of a number of relevant government reviews in the UK and remain the subject of ongoing debate. In particular, the Roberts Review (2002) highlighted the need to consider the employability and career development needs of STEM (science, technology, engineering and mathematics) doctoral researchers in order to maximise the socio-economic impact of these highly skilled graduates. In the wake of Roberts, and as a result of its associated funding streams, there has been a concerted attempt by higher education institutions (HEIs) to develop enhanced transferable skills training with a view to better preparing doctoral graduates for employment in industry and the public sector, as well as academia. £120 million of funding has been invested by RCUK to address Roberts’ concerns with the development of research careers and researchers’ training in transferable skills. The RCUK commissioned Hodge Review (2011) found that this investment had enabled the UK to lead the way internationally in the development of transferable skills for researchers, but recommended that funding and initiatives need to continue to maintain and reinforce this progress. This research focuses on the mid-term destinations and career pathways taken by doctoral.
graduates working outside of academia and the extent to which their doctoral training has supported their career to date.

The current government has highlighted the importance it places on research and innovation in the UK. Indeed, in a period of austerity an additional fund of £600m has been provided to aid development and innovation in areas such as synthetic biology.\(^1\) With growing economies, such as China and Singapore increasingly investing in their own research facilities, the UK needs to continue to support these sectors in order to maintain the UK’s reputation as a leading research nation. The Warry Report (2006) considered ways in which RCUK could increase the economic impact of their funding, emphasising that research and innovation were of increasing importance to maintaining the UK’s knowledge base. The report argued that a strong supply of PhD graduates to industry is a fundamental part of maintaining the UK’s place in the global economy and that the output of highly educated people is perhaps the most effective method of knowledge transfer. The report made clear that given the increased scale of the investment from RCUK and other funding bodies in postgraduate research, there is a need to both understand and demonstrate the impact and value of doctoral training to individual graduates, employers and the wider economy and society.

Since publication of the Warry report others, such as that in 2010 by DTZ for EPSRC, have surveyed the extensive literature. A key finding of the extensive DTZ literature review was that PhD holders “…can drive higher levels of innovation, absorptive capacity, rapid return on investment, recruitment and training, and they have the potential to become future leaders in organisations.” However it also noted the difficulty of identifying wider impacts to the economy, the environment and society.

This current research project aims to better understand the impact of doctoral researchers through analysis of the views of graduates and their employers.

**Innovation**

One of the unique contributions this paper makes to the literature on doctoral graduates is an exploration of their involvement in and contribution to different types of innovative activity. Innovation takes place through a wide variety of business practices (Robson & Achur, 2012) and can be technological and non-technological. Technological innovation can involve introducing new or significantly improved products or processes. Non-technological innovation may involve bringing through changes in business structures, management or marketing practices. We were keen to ensure we gathered data on how doctoral graduates contribute to the full range of innovation. Drawing on Robson & Achur’s definition (2012)

\(^1\) https://www.gov.uk/government/speeches/eight-great-technologies
and developed the following definition of innovative activity, which we used in interviews with graduates and employers:

*Innovative activity includes developing new or improved goods, services, processes or practices. It can also include acquiring, adapting and transforming knowledge, ideas and technologies. Innovation might be pursued for economic ends (to create growth or income), to address social challenges, or both.*

Another way in which doctoral graduates may benefit organisations is through their capability to stimulate ‘absorptive capacity’ (DTZ, 2010). This is an organisation’s ability to identify, adapt and integrate new technologies and ideas. The degree to which doctoral graduates promote knowledge exchange and collaborative working, particularly with higher education institutions, might be an indicator of impact in this regard and is also considered in our study.

**This report**

In the next chapter (2) we describe our methodology for the research and provide information on the characteristics of survey respondents and interview participants. Chapters 3 looks at the current destinations of doctoral graduates and offers an insight into the different sectors and occupations graduates are currently working in. Chapter 4 concentrates on the various career paths individuals have taken since completing their doctorate. We then consider the benefits of study for the individual (Chapter 5) and the skills and attributes of doctoral graduates that are most valued by employers (Chapter 6). This is followed by a closer look at the extent to which doctoral graduates are able to innovate in the workplace, as well as the different types of innovative activity they are involved in (Chapter 7). Chapter 8 concentrates on the impact of doctoral graduates, both in the workplace and wider society.
03. METHOD
This chapter sets out the approach and methods used in the study. It provides information on respondents to the online survey and participants in the qualitative interviews.

Key information
We received a total of 1,839 valid responses to our survey from individuals who graduated with a doctorate between 2003-04 and 2005-06. This represents four per cent of the total population of doctoral graduates from these three years.

A slightly higher proportion of males (54 per cent) completed the survey compared to females (46 per cent). 76 per cent of respondents were domiciled in the UK at the time of commencing their doctoral study.

61 per cent of doctoral graduates were under the age of 40 at the time of completing the survey, but variations were found by domicile.

Physical sciences and engineering was the most common subject area studied by doctoral graduates responding to our survey (36 per cent). The proportions that had studied arts and humanities, social sciences, biological sciences and biomedical sciences were broadly similar at approximately 15 per cent for each discipline. This is broadly in line with the wider population of doctoral graduates.

The challenge of identifying doctoral graduates seven to nine years after graduation necessitated a flexible approach to sampling. The survey results should, where possible, be triangulated with other evidence.

In-depth follow-up interviews were conducted with 268 doctoral graduates and 96 employers of doctoral graduates. Of the employer interviews, 67 were the employers of doctoral graduate interviewees.

A purposive sampling methodology was adopted for the interviews, with greater focus on doctoral graduates and employers outside the higher education sector. The qualitative research data is therefore not representative of the wider population of doctoral graduates.
**Literature review**

To inform the research design and to provide context in terms of key debates and policy drivers, we conducted an initial review of literature. A systematic search and review was undertaken of public and academic literature that addressed similar research questions and/or provided insights into methods and indicators used to measure the impact of doctoral graduates. A paper was then produced for the project steering group reporting the findings. Rather than presenting a discreet literature review in this report, we have incorporated reference to relevant information throughout the report to contextualise our own research findings.

**Evaluation framework**

**LOGIC CHAIN AND INDICATORS**

An early task in the project was to develop a framework for the research. We adopted a logic chain approach. The logic chain seeks to summarise complex processes and factors that contribute to generating impact in such a way that makes it more manageable to measure and evaluate the key elements of that process. We set out a logic chain for this research on page 12. This shows how the inputs and activities of doctoral study might be expected to generate certain outputs, outcomes and ultimately lead to impact on individuals, organisations and wider economy and society. We continued to refine the logic chain throughout the study. For each of the outputs and outcomes in the logic chain, we then developed a set of indicators.

**CONTEXT AND PRECONDITIONS FOR IMPACT**

One drawback of the logic chain approach is that it presents the process as linear, whereas the reality is likely to be more complex and each of the elements will be affected by the wider context. Given the diversity of doctoral graduate subjects and roles, impact is likely to be generated in different ways and with different outcomes. The ability to create impact, as well as the magnitude and type of impact, is likely to be affected by the context in which doctoral graduates are working.

The extent to which the organisation in which the doctoral graduate is working allows and enables innovation is a key contextual factor in understanding the likelihood and limitations on graduates’ capacity to create impact, particularly through innovation. In Box 1 below, we suggest a number of preconditions that we can hypothesise may make a difference to the ability of doctoral graduates to create impact. Through the qualitative phase of the project we sought in particular to determine the extent to which doctoral graduates were working in roles, organisations and contexts that enable, or hinder, their ability to create impact.
Box 1: Possible preconditions for creating impact through innovation

- Ability to work independently / flexibility of the job description
- Freedom and encouragement to get involved in innovative projects
- Freedom and encouragement to seek and propose solutions to problems
- Ability to access and exchange knowledge
- Freedom to take risks / fail
- Organisation wide opportunities to develop good ideas
- Organisation wide opportunities to transform good ideas into practical applications
- Sponsorship from senior management for projects including allocation of funding and resources

ATTRIBUTION

In seeking to identify the impact to doctoral graduates it is necessary to understand to what extent this can be attributed to doctoral training and is also enabled and constrained by the role in which doctoral graduates are employed. While a doctoral graduate might be involved in an activity that adds value, it may not be their doctorate that makes the difference. Skills and knowledge acquired through work experience or professional training may have greater importance. The doctorate may not add significant additional value in comparison to someone, for example, who hold a Masters degree. Hence, the evaluation sought to gather evidence on the degree to which the ability to contribute to innovative and/or impactful activity is enabled or affected by having a doctoral degree. In particular, we looked to address whether the same contribution would have been achievable without the doctorate.
The impact of doctoral careers

**Inputs**
- Applications made for research degree study.
- UK higher education institutions work to attract the best potential researchers from all backgrounds.
- Specialist skills and knowledge are acquired by doctoral students during their research degree study.
- Doctoral study provides the knowledge, skills and attributes sought by employers.
- Career development and training in transferable skills is embedded as part of the preparation of PhD students for the job market.
- There is an effective exchange of skilled people between the research base and user communities.
- Opportunities are provided for PhD students to engage with external employers and access researcherspecific career advice and support.
- Doctoral study develops student's skills in abstract thinking.
- Doctoral study enables students to approach problemsolving in a creative and structured way.

**Activities**
- No. of doctoral graduates by discipline and subject area.
- No. of doctoral graduates undertaking additional training.
- No. of doctoral graduates in employment.
- Doctoral graduates' employment destinations by industry and sector.
- Extent of inter-sector mobility amongst doctoral graduates.
- Career pathways of doctoral graduates.
- Extent to which doctoral graduates meet organisations demand for skills and expertise.
- No. of doctoral graduates in management or leadership roles.
- No. of doctoral graduates working in research roles.
- No. of doctoral graduates working in education.
- Extent to which doctoral training enables graduates to solve problems.
- Extent to which doctoral training enables graduates to be creative.

**Outputs**
- Doctoral training enhances graduates' earning capacity.
- Doctoral training enables individuals to pursue their chosen career path and fulfil their ambitions.
- Completing a doctorate enhances graduates' quality of life.
- Employers place a higher value on the contribution of doctoral graduates.
- Doctoral graduates' roles allow them to draw upon their doctoral experience, use their research skills and exploit their expertise effectively.
- Doctoral graduates exhibit influence and leadership within their organisation, encouraging others to strive to excel and consequently raising productivity of those without a doctorate with whom they work.
- Doctoral graduates support others they work alongside to be more creative and/or productive.
- Skills developed by doctoral graduates during their research degree study enable them to contribute to innovation in their workplaces.
- Doctoral graduates introduce new methods, ways of organising, systems and products within the organization leading to changes in working practices, culture, service, quality, markets and products.
- Doctoral graduates contribute to the absorptive capacity of the organisations that employ them and enables new transformation or innovation in technologies and ideas.

**Outcomes**
- Individuals who have undertaken doctoral training are enabled to fulfill their ambitions, experience a high quality of life, and use their skills, knowledge and intellectual abilities to perform roles both within and outside employment, with a high level of professionalism, effectiveness, influence and impact.
- Employers of doctoral graduates are better able to access, develop and use ideas, technologies and processes, making them more productive and competitive both directly in terms of innovation, knowledge transfer, absorptive capacity and productivity benefits; and indirectly through influence on supply chain linkages, customer and partner relationships.
- Motivated and highly skilled individuals and productive and competitive organisations deliver wider economic, environmental and societal benefits which contribute to improved social wellbeing and enhance the long-term competitiveness of the UK.
Survey of doctoral graduates

Data on doctoral graduates' medium-term career destinations, employment outcomes, skills use and involvement in innovation was collected through an online survey of the target cohorts of doctoral graduates. The survey comprised mainly of pre-coded closed questions to produce quantitative data and a small number of open questions. Key questions were duplicated from the relevant DLHE and L DLHE questionnaires to allow for a longitudinal analysis of this data. New questions were added, in particular around innovation and impact, in order to gain greater insight about doctoral graduates in the workplace.

We also asked survey respondents for permission to link their data to their HESA (Higher Education Statistics Agency) records; this included student record and DLHE and L DLHE responses where available. 78 per cent of respondents agreed for their data to be linked and shared with CFE. This enabled us to validate the eligibility of respondents, that is, that they had indeed received a doctorate from a UK institution during the target years. We were also able to supplement our own survey data with key information collected by HESA, such as discipline, thus reducing the number of survey questions. We could also track individual responses to repeated questions across all three surveys, including those on salary and sector. This enabled us to conduct some longitudinal analysis of how doctoral graduate salaries had progressed over the past eight years, as well as explore whether there was any evidence for doctoral graduates moving in and out of the higher education sector.

To protect personal data, we have adopted the HESA rounding methodology for survey and linked data published in this report. Total frequencies have been rounded to the nearest five. Therefore numbers may not total due to rounding. Percentages and salaries are reported as precise figures.

PROFILE OF SURVEY RESPONDENTS

We received over 2,100 responses to the online survey. After cleaning and linking the data to HESA records, the total number of useable responses fell to 1,839. Over the three years considered in this study, this represents 4 per cent of the total doctoral population. The main reason for removing responses was because HESA data revealed respondents had been awarded their doctorate in a year that fell outside of the three year target. Some respondents had not completed a doctoral qualification and were also removed from our final analysis.

Once the survey was closed we analysed the responses to identify any significant differences between the three cohort years across a number of key variables. This included salary, employment type, as well as industry and occupation groups. For the majority of variables, we did not find significant differences.

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2 Those graduating with a doctorate from a UK institution in the academic years 2003-04, 2004-05 or 2005-06.
One exception to this was employment status. Employment rates were significantly higher amongst the 05-06 cohort, when compared to the 03-04 group. 91 per cent of the 05-06 cohort were employed at the time of the survey, compared to 86 per cent of the 03-04 respondents. However, there were no significant differences between the 05-06 and 04-05 cohorts in terms of employment levels. Additionally, there were a significantly higher proportion of biomedical scientists in the 04-05 group when compared to the 03-04 cohort. 16 per cent of our 04-05 cohort were biomedical scientists, compared to 11 per cent of the 03-04 group. Overall however, given the three cohorts did not appear to be too dissimilar; we proceeded by pooling the three cohorts together.

A slightly higher proportion of males (54 per cent) completed the survey compared to females (46 per cent). In comparison, across the actual population of doctoral graduates between 2003 and 2006, 57 per cent were male and 43 per cent were female. With regards to domicile at the time of commencing doctoral study, 76 per cent of respondents were from the UK and 10 per cent were from the EU. The remaining doctoral graduates were from outside the EU. Across the actual population however, the proportion of UK domiciled doctoral graduates was just over 60 per cent, with approximately one-quarter from outside the EU. The reason for the difference between our sample and the actual population is most likely our method of disseminating the survey.

The age profile of respondents at the time of the survey is provided in Figure 1 below. 61 per cent of doctoral graduates were under the age of 40; however this masks variations found by domicile. Almost two-thirds of individuals who were domiciled in the UK or EU at the time of starting their doctorate were under the age of 40 at the time of completing the survey, whereas the figure was just 39 per cent for those from outside the EU.

Figure 1: Age profile of survey respondents (base = 1810)
Over a third of our sample had completed a doctorate in a physical sciences and engineering discipline, as highlighted in Figure 2 below. Proportions in most other broad subject areas were fairly similar to one another. When comparing our sample to the actual population we found little disparity between the two sets of data. However, there is a slight difference in the methods used by us and HESA in terms of how the discipline categories are created. This was because we had more detailed information on the subject classification of an individual’s doctoral programme when compared to what was available from HESA. We followed the same method used for the analysis of the L DLHE survey results to construct the discipline categories (see Vitae 2010).

Figure 2: Doctoral discipline of graduate survey respondents (base = 1645)³

Identifying doctoral graduates seven to nine years after graduation was a challenge. Survey respondents were recruited through a variety of channels, including via higher education alumni offices, professional bodies and learned societies; the survey was also promoted through social media. The survey respondents were not sampled in a statistically random way and are not representative of the wider population on some variables. We advise that the findings are interpreted with a reasonable degree of caution and, where possible, are triangulated with other evidence.

EMPLOYMENT SECTOR AND OCCUPATION CATEGORIES USED IN THIS REPORT

Information provided by survey respondents on their job role and employment sector was coded using the Standard Occupational Classification (SOC) 2010 and Standard Industry Classification (SIC) 2007. The coding was used to group together occupations and employment sectors into the categories used throughout this report.

³ Environmental Sciences span a number of the disciplines – separate identification of this group of doctoral graduates is not possible using the current classifications used by HESA
We also refer to occupational clusters in the report. These are based on those developed by Vitae for their analysis of the L DLHE data (see Vitae, 2010) and are used to analyse the extent to which doctoral graduates are working in research roles in higher education and beyond. There are seven occupational clusters:

— **HE research**: research staff employed in higher education, for example, research associate, research fellow.

— **HE teaching**: teaching professionals working in higher education. This includes those with job titles such as lecturer, reader and professor, although we acknowledge that those in these positions will often have research responsibilities too.

— **HE other**: those employed in higher education, but in neither teaching nor research roles, for example, administrative roles.

— **Researchers elsewhere**: researchers working outside of higher education

— **Other teaching occupations**: all teaching professionals working outside of higher education

— **Other common doctoral occupations**: occupational groups which Vitae found contained a large volume of doctoral graduates in their analysis of the Labour Force Survey between 2005 and 2008. This cluster includes engineering and IT professionals, health professionals (for example, general practitioners and clinical psychologists), business, finance and statistical professionals (for example, economists and accountants) as well as corporate managers, directors and senior government officials.

— **Other occupations**: respondents working in occupations not covered by the clusters above.

A separate user guide to the survey data will be produced providing further information on how the categories and clusters were constructed.

**Qualitative research**

**DOCTORAL GRADUATE INTERVIEWS**

The online survey included a question inviting respondents to take part in a follow-up interview; 916 gave their consent. Semi-structured telephone interviews lasting approximately 30 minutes were carried out with a sample of 268 doctoral graduates. The objective of the interviews was to gather detailed accounts of the medium term career trajectories of doctoral graduates, their perspectives on the continued relevance of the knowledge and skills they acquired in the course of their PhD studies, their perceived impact on innovation in the workplace and the wider impacts on their employers, colleagues and themselves of the doctorate.

Our objective was to obtain qualitative understanding of the experiences and impact of a range of doctoral graduates in sectors and roles of interest, not to produce statistically representative data. Target minimum interviews were set for current activity, discipline, sector and occupation in order to achieve a range of perspectives. Targets were not necessarily intended to be proportionate to the wider population. Some occupations and sectors were over-represented, whilst others under-represented. For instance, we mainly
interviewed doctoral graduates who were employed in sectors outside HE. We cannot therefore assume that the findings from the qualitative research are representative of the wider population of doctoral graduates.

The employment sector and occupation of doctoral graduate interviewees are shown in Tables 1 and 2 below.

**Table 1: Occupation of doctoral graduate interviewees**

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Number of interviewees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business, finance, sales and marketing professionals</td>
<td>57</td>
</tr>
<tr>
<td>Culture and media occupations</td>
<td>10</td>
</tr>
<tr>
<td>Engineering professionals</td>
<td>11</td>
</tr>
<tr>
<td>Health professionals and associate professionals</td>
<td>10</td>
</tr>
<tr>
<td>IT professionals</td>
<td>14</td>
</tr>
<tr>
<td>Managerial Roles</td>
<td>60</td>
</tr>
<tr>
<td>Other professional, associate professional and technical occupations</td>
<td>19</td>
</tr>
<tr>
<td>Scientific research, analysis and development occupations</td>
<td>47</td>
</tr>
<tr>
<td>Teaching professionals</td>
<td>18</td>
</tr>
<tr>
<td>Other occupations</td>
<td>2</td>
</tr>
<tr>
<td>Did not say/unemployed/doing something else</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>268</td>
</tr>
</tbody>
</table>
Table 2: Employment sector of doctoral graduate interviewees

<table>
<thead>
<tr>
<th>Industry sector</th>
<th>Number of interviewees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education (Other)</td>
<td>18</td>
</tr>
<tr>
<td>Finance, business, IT and legal</td>
<td>37</td>
</tr>
<tr>
<td>Health and Social Work</td>
<td>19</td>
</tr>
<tr>
<td>Higher Education</td>
<td>40</td>
</tr>
<tr>
<td>Manufacturing &amp; Engineering</td>
<td>37</td>
</tr>
<tr>
<td>Other Sectors</td>
<td>36</td>
</tr>
<tr>
<td>Public Administration</td>
<td>22</td>
</tr>
<tr>
<td>Research and Development</td>
<td>41</td>
</tr>
<tr>
<td>Did not say/unemployed/doing something else</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>268</td>
</tr>
</tbody>
</table>

**INTERVIEWS WITH EMPLOYERS**

Employer interviews were designed to gain insights into the impact of doctoral graduates in the workplace and to enable comparison with doctoral graduate perspectives. Again, target employer interviews were set based on key variables of sector and size to ensure at least a minimum coverage across broad industry groups. The sample was not designed to be reflective of doctoral graduate employment. In particular, the research team sampled very few HE employers, and in these instances focused attention on the impact of doctoral graduates working in non-academic roles in HE.

We initially recruited employers via doctoral graduate interviewees. The research team asked interviewees for permission to contact their employer. This yielded 119 contacts which converted to 67 successful interviews.

Once we had exhausted the supply of UK based non-HE graduate interviewees, we sourced further employer contacts from a range of other sources as follows:

- Employer contacts provided by research councils
- CFE Research employer contacts
- Commercial database of employers
- Known major employers of doctoral graduates
We asked screening questions to determine whether contacts employed doctoral graduates and their awareness of which staff had doctorates. Awareness of employees' level of qualification was important to ensure that interviewees would be able to discuss the impact of those with doctorates compared to those without. The organisation type, sector and size of the employer interviewees are shown in Tables 3, 4 and 5 below.

**Table 3: Employer interviewee organisation type**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Number of interviewees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private organisation</td>
<td>42</td>
</tr>
<tr>
<td>Public organisation</td>
<td>36</td>
</tr>
<tr>
<td>Charitable/not-for-profit or voluntary</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>96</td>
</tr>
</tbody>
</table>

**Table 4: Employer interviewee organisation size**

<table>
<thead>
<tr>
<th>Organisation size</th>
<th>Number of interviewees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small (1-49)</td>
<td>12</td>
</tr>
<tr>
<td>Medium (50-249)</td>
<td>16</td>
</tr>
<tr>
<td>Large (250 or more)</td>
<td>68</td>
</tr>
<tr>
<td>Total</td>
<td>96</td>
</tr>
</tbody>
</table>
Table 5: Employer interviewee sector

<table>
<thead>
<tr>
<th>Industry sector</th>
<th>Number of interviewees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education (Other)</td>
<td>1</td>
</tr>
<tr>
<td>Finance, business, IT and legal</td>
<td>7</td>
</tr>
<tr>
<td>Health and Social Work</td>
<td>6</td>
</tr>
<tr>
<td>Higher Education</td>
<td>17</td>
</tr>
<tr>
<td>Manufacturing &amp; Engineering</td>
<td>18</td>
</tr>
<tr>
<td>Other Sectors</td>
<td>17</td>
</tr>
<tr>
<td>Public Administration</td>
<td>7</td>
</tr>
<tr>
<td>Research and Development</td>
<td>23</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>96</strong></td>
</tr>
</tbody>
</table>
04. DESTINATIONS OF DOCTORAL GRADUATES

This chapter discusses our findings on the employment rates, sectors of employment and occupations of doctoral graduates seven to nine years after graduation. It also offers an insight into doctoral graduates’ satisfaction with various aspects of their current role, such as job security and intellectual challenge.

Key findings

Doctoral graduates responding to our survey have high levels of employment. 89 per cent of doctoral graduates were in employment at the time of our survey. Just 3 per cent were unemployed. This is only very slightly higher than reported in previous studies of doctoral graduates at three and a half years after graduation. High employment and low unemployment have been maintained despite the economic downturn.

50 per cent of respondents work in higher education. This masks differences by subject discipline; graduates with doctorates in arts and humanities (62 per cent) and social sciences (65 per cent) most likely to be working in this sector.

The proportion of doctoral graduates who remain working as researchers in higher education appears to have declined over time.

Doctoral graduates are clustered in sectors and roles that relate to the specialist skills and knowledge that doctoral training provides.

79 per cent are employed on a permanent or open-ended contract seven to nine years after graduation. However, amongst HE research, this figure was only 26 per cent.

Generally, doctoral gradates are satisfied or very satisfied with their current role, and in particular with the intellectual challenge. HE researchers appear least satisfied with their role, showing particular concern over job security and career prospects.
Introduction

Research to date on the employability and careers of doctoral graduates has focused on relatively short timescales after graduation. A key aim of this research project was to fill gaps in knowledge by providing information on the employment, role and sectors of doctoral graduates in the medium term. DLHE and L DLHE survey data provide information on employment destinations six months and three and half years after graduation respectively. It is useful to understand the extent to which early employment patterns, as reported by these studies, is a good indicator of medium term employment. It would be anticipated that the additional experience doctoral graduates are likely to have accumulated, alongside their higher level skills, will ensure that they continue to have high rates of employment.

This chapter reflects on the employment status of doctoral graduates responding to our survey, seven to nine years after graduation, covering industry sector and occupation. We see that doctoral graduates generally enjoy high levels of employment, with evidence suggesting higher than average incidence of full-time working, especially for women. Common sectors of employment reflect those found in previous studies, with the key sector being higher education, but research and development and other play a significant role. Employment is also clustered in particular occupations, with teaching, scientific research and managerial roles being most prominent. We begin by reporting the general picture of doctoral graduate destinations and then explore key differences by doctoral discipline, gender and occupational cluster.

What doctoral graduates are doing seven to nine years on

OVERALL FINDINGS

The research suggests that, seven to nine years after completing their PhD, doctoral graduates have high levels of employment. A total of 89 per cent of our survey respondents were in some form of employment, with just under 3 per cent being unemployed.⁴ Amongst the remaining 8 per cent, the majority were either retired or engaged in further study or training.

L DLHE survey data for the 2004-05 cohort collected in 2008 found a slightly lower unemployment rate of 2 per cent, and that unemployment had more than halved since six months after graduation (Hunt et al, 2010).⁵ The same survey of the 2006-07 cohort undertaken in 2010 found a slightly higher unemployment rate of 2.4 per cent (Mellors-

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⁴ An individual is classified as ‘unemployed’ if they are not in a job, but actively looking for work.

⁵ Please note that, given our methodology for disseminating the survey and the fact that the sample of individuals who completed our survey will not be the same as the sample of previous studies, caution must be taken with any comparisons we make with previous studies on the destinations of doctoral graduates. In contrast to previous surveys, students from outside the EU were also eligible to take part in the survey and form a small proportion of our total sample.
Bourne et al, 2013). Our study suggests that seven to nine years on from graduating, essentially these patterns of high employment and low unemployment amongst doctoral graduates have been maintained.

Four-fifths (81 per cent) of employed doctoral graduates responding to our survey were working full-time, with 11 per cent working part-time and 7 per cent reporting that they were self-employed. 79 per cent of doctoral graduates are currently working on permanent or open-ended contracts, with 20 per cent on a fixed-term contract.

Examining the employment sectors and occupations of doctoral graduates responding to the survey, we found that doctoral graduates are clustered in specific sectors and roles that draw on the specialist skills and knowledge that doctoral training provides. As Figure 3 below highlights, higher education is the most common employment sector for doctoral graduates completing our survey. There were large differences in the proportion of doctoral graduates working in higher education by discipline. Just 38 per cent of graduates with doctorates in physical science and engineering were based in this sector, compared to 62 per cent of graduates with doctorates in arts and humanities and 65 per cent of social scientists.

Survey respondents were not randomly selected, and a key channel for recruitment was through alumni offices. There is a risk therefore that our results over-represent those working in higher education. As this survey is currently the best data available on the destinations of the target cohorts seven to nine years after graduation it is difficult to verify our findings. However, where evidence from other sources, including our qualitative interviews, supports or helps to explain our findings we have referred to this. And it is clear that a substantial proportion of doctoral graduates continue to develop careers outside of academia.
Other less common but significant sectors of employment for doctoral graduates include research and development, manufacturing and engineering and finance, business, IT and legal. In many ways, the key employment sectors of doctoral graduates responding to our survey mirror findings from the DLHE and L DLHE surveys of 04-05 doctoral graduates. However, one key difference is the proportion of doctoral graduates working in health and social work, which was far higher in previous studies.

Our research indicates that nearly three-quarters of doctoral graduates responding to our survey work within three broad occupation types. Just over one-third (36 per cent) of survey respondents are working as teaching professionals (of which 90 per cent are working in higher education); a quarter are in scientific research and development roles (25 per cent), whilst almost an eighth of respondents (12 per cent) are in managerial roles. These findings show some similarity to the occupations 04-05 doctoral graduates were working in three and a half years after graduation (Hunt et al, 2010). However, our survey has a far larger proportion working as teaching professionals.

Figure 4 highlights the breakdown of doctoral graduates by occupational cluster, showing that that nearly one-third (32 per cent) of our population is working in HE teaching, with 12 per cent in HE research roles. Between the DLHE survey and our study, we have seen a continuous upward trend in the proportion involved in teaching (from 17 per cent to 32 per cent) and a steady fall in the proportion involved in HE research (from 26 per cent to 12 per cent). Three and a half years after graduation 22 per cent of 04/05 doctoral graduates were working in HE teaching roles with 19 per cent in HE research roles (Hunt et al, 2010). This is a trend that one would expect within HE, as doctoral graduates initially begin their careers in research roles, before being offered the opportunity to become a lecturer in an
academic department. This is supported by the small number of qualitative interviews we carried out with doctoral graduates working in HE (see page 45).

12 per cent of respondents were working as researchers outside HE. This compares to 15 per cent per cent in these roles six months after graduation and 13 per cent three and a half years after graduation. This suggests that the proportion of doctoral graduates in research roles outside HE is much more stable than within HE.

Figure 4: Occupational cluster of doctoral graduates (base = 1615)  

Research plays an essential role towards the long-term growth of an economy. As we shall see later in this report, doctoral graduates working in research roles are often involved in different types of innovative activity, such as developing new knowledge and understanding. The recent Allas (2014) report also notes that researchers can be key to future economic prospects by facilitating the adaptation and utilisation of new technologies and therefore increasing the absorptive capacity of businesses in the country. Considering the importance of research, it is useful to see the proportion of doctoral graduates from our survey involved in research activity. 24 per cent of our survey respondents are working in predominantly research roles in higher education or elsewhere. This is likely to be an under-estimate of doctoral graduate involvement in research. We know, for example, that those working in higher education teaching roles are also likely to undertake research. 31 per cent of survey respondents employed in the UK stated that they conducted research most of the time in their current employment, whilst a further 34 per cent conduct research some of the time.

Nearly three quarters of doctoral graduates responding to our survey are satisfied or very satisfied with their current role as shown in Figure 5. Doctoral graduates identified that it is the intellectual challenge of their current role that most satisfies them (80 per cent).

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6 See page 16 for information on what each occupational cluster covers, including other common doctoral occupations
However, far lower levels of satisfaction were evident for salary level (61 per cent), job security (65 per cent) and career prospects (55 per cent). Dissatisfaction with career prospects in particular is mainly driven by particularly low levels of satisfaction with this amongst those working as HE researchers (see page 36).

**Figure 5: Doctoral graduate satisfaction with different aspects of their current role (bases = 1620 to 1630)**

**DIFFERENCES BETWEEN GENDERS AND DISCIPLINES**

The broad findings reported above hide a number of interesting variations in working patterns, employment sector, and occupation related to doctoral graduates’ discipline and gender.

There are clear differences in employment type by gender (Figure 6) with a significantly higher proportion of males working full-time (89 per cent, compared to 72 per cent of women), and a significantly greater proportion of females working part-time (20 per cent, compared to 4 per cent of men). To give some context, a recent publication from the ONS on the graduate labour market (anyone who left education with a qualification above A level standard) found that between April and June 2013, 32 per cent of females with a graduate qualification were working part-time compared to 8 per cent of males. Whether we choose to include those individuals who are self-employed or involved in voluntary work in the analysis of type of employment, the statistics would still suggest that a greater proportion of females with a doctorate work full-time, but this comparison should be treated with caution, given the ONS definition of graduates. There may also be different methodologies utilised in defining a full-time worker.

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7 ‘Graduates’ in the ONS report refer to those individuals who have left education with qualifications above A level standard. This means that the graduate data reported would include those with doctorates.
Gender differences are also evident in occupations as shown in Figure 7. We find a significantly greater proportion of females (41 per cent) are working in the teaching profession (in HE and elsewhere) compared to males (32 per cent), whilst a significantly greater proportion of males are in managerial roles (15 per cent, versus 10 per cent of women) and employed as engineering professionals (6 per cent, versus 1 per cent of women). This suggests that amongst the most highly educated members of the workforce, career choices continue to be linked to gender.
Employment rates were similar across disciplines (varying between 90 and 94 per cent), except for graduates with a doctorate in the arts and humanities, who had a lower employment rate (82 per cent). The key reason behind this appears to be the significantly higher proportion of arts and humanities doctoral graduates who are now retired (6 per cent) or involved in other activities (such as full-time caring). Respondents from this discipline do have an older age profile compared to individuals from many of the other subject disciplines (see page 39 for further details). Experiences of unemployment are explored in more detail in the next chapter.

Figure 8 below shows that full-time employment is also lower amongst doctoral graduates from arts and humanities, biomedical sciences and social sciences disciplines in comparison to biological and physical sciences and engineering. Some of this pattern can be accounted for by the fact that women generally are more likely to be in part-time employment (see page 28), either through choice or necessity, and there are higher proportions of women with doctorates in these disciplines. However, doctoral graduates from arts and humanities subjects recorded the lowest full-time employment rates, even after accounting for gender.
This could reinforce previous evidence that doctoral graduates in these subjects typically engage in higher levels of portfolio working\(^9\) when compared to other disciplinary groups. Amongst the small number of arts and humanities doctoral graduates interviewed who were not working full-time some had more than one job. Additionally, our survey results indicated that 48 per cent of arts and humanities doctoral graduates working part-time had more than one job. We explore the differing motivations for undertaking a doctorate in the next chapter, but this may also account for different employment patterns amongst arts and humanities doctoral graduates.

\[\text{Figure 8: Employment type by doctoral discipline (bases vary)}\]

Excluding those working in higher education, biomedical scientists are most likely to be working in the public sector as shown in Figure 9; this is the only discipline where the proportion of public sector employment was higher than the private sector. Considering our survey data, this appears to be down to the number of biomedical doctoral graduates working for public healthcare bodies such as the NHS. Almost one-third of arts and humanities doctoral graduates were employed in the charitable/not-for-profit sector. For arts and humanities doctoral graduates, the distribution of employment was near uniform across the three sector types indicating more diverse sector destinations than their counterparts.

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\(^9\) Portfolio working can be defined as having multiple roles and employers at the same time or in quick succession, generating different sources of income to develop a broad portfolio of skills and experience or to enable the pursuit of particular interests and ambitions while maintaining a degree of security of income.
Outside of higher education, employment sector tends to vary according to doctoral discipline, as we can see from Figure 10 below. For example, 44 per cent of biomedical scientists working outside higher education are employed in the health and social work sector, whilst 36 per cent of physical science and engineering doctoral graduates not employed in higher education are working within the manufacturing and engineering industry.
Figure 10: Employment sector by discipline, excluding higher education

Biomedical Sciences [90]

Arts and Humanities [80]

Physical Sciences and Engineering [340]

Biological Sciences [125]

Social Sciences [70]
Our survey findings in terms of destinations are similar to the initial (6 months after graduation) destinations reported by the 04-05 cohort in the DLHE survey (Haynes and Metcalfe, 2007). For example, in the DLHE survey, the main sector of employment (excluding higher education) for physical science and engineering doctoral graduates was manufacturing, whilst for biomedical doctoral graduates, it was health and social work. Similar trends were also found in the L DLHE survey; however one key exception to this was for physical science and engineering doctoral graduates. In the L DLHE survey, it was finance, business and IT which was reported to be the key sector of employment for these graduates, rather than manufacturing. Our qualitative research revealed nothing that might explain this change, and it may be due in part to our sampling method. In general however, the survey data suggests that doctoral graduates appear to be remaining in similar sectors to those they initially enter on completing their doctorates. We explore doctoral graduates’ mobility between employment sectors in the following chapter.

Figure 11 below shows that large proportions of arts and humanities and social sciences doctoral graduates are involved in HE teaching roles (43 per cent and 52 per cent respectively). This trend is also supported by analysis of DLHE and L DLHE surveys of the 04/05 cohort (Haynes and Metcalfe, 2007; Hunt et al, 2010). The analysis of L DLHE data shows that arts and humanities, as well as social sciences doctoral graduates were more likely to pursue a PhD because they wanted an academic career. In all other subject disciplines, less than a third of doctoral graduates are working in HE teaching positions. There are a relatively large proportion of biomedical scientists (18 per cent) and biological scientists (20 per cent) in HE research roles.
Figure 11: Occupational cluster by discipline

Arts and humanities (%)

Biological Sciences (%)

Physical sciences and engineering (%)

Biomedical sciences (%)

Social sciences (%)
While overall most doctoral graduates responding to our survey were on a permanent or open ended contract there are interesting differences here between sectors and occupational clusters. A greater proportion of those working in the private sector were on a permanent contract compared to those in the public or charitable/voluntary sectors. The prevalence of short-term contracts in the public sector is likely to be as a result of those working in HE research. Further exploration of the data shows that just 26 per cent of researchers in higher education have a permanent contract, which is significantly lower than the proportion amongst any other occupational group as shown in Figure 12. We investigated whether there was any relationship between contract type and age, however we found that once we controlled for occupational cluster, there was no association between these two variables.

Figure 12: Type of contract by occupational cluster

With this finding in mind it is unsurprising then that respondents working in HE research report relatively high levels of dissatisfaction with job security. 58 per cent of those working in HE research reported that they were either dissatisfied or very dissatisfied with the security of their job. In all other occupational clusters, the proportion was below 25 per cent. HE researchers were also most worried about the career progression offered by their role, with just 34 per cent satisfied or very satisfied by the prospects their position provided. Researchers in higher education were, however, much more positive about the intellectual challenge of their position, with 87 per cent stating they were either satisfied or very satisfied with this feature of their job – the highest of any occupational cluster. Despite this, HE researchers are the least satisfied overall with their current role. In the next chapter, we explore some of the reasons for doctoral graduates moving out of HE roles into industry.
Chapter conclusion

Our survey responses suggest that at around seven to nine years after graduation, the vast majority of doctoral graduates are in employment. Unemployment of doctoral graduates is only very slightly higher than that reported in previous studies for doctoral graduates at three and a half years after graduation. This study therefore shows that over the longer term doctoral graduates continue to experience high levels of employment and low unemployment. A potential reason for this could be that over the medium term, doctoral graduates are able to build their experience in the workplace and use their skills and attributes to greater effect, making them ever more important to their employers. We shall discuss this issue in more detail in chapter 6. It is also notable that these rates of employment have remained high in spite of the economic downturn that the UK has experienced. This suggests that doctoral graduates remain highly employable and their employment may, as previous studies have suggested, be relatively recession proof.

There are gender differences in working patterns and employment sector of doctoral graduates. Female doctoral graduates are more likely to be working part-time, but our evidence suggests that female doctoral graduates have higher rates of full-time working than female graduates more generally. There are also clear gender differences in some employment sectors, showing that career choices at doctoral level, as at others, are linked to gender. Work should continue to address these inequalities at all educational levels.

Overall a slightly lower proportion of doctoral graduates are employed in research roles than had been identified in previous studies of doctoral graduates at earlier stages in their careers. In particular the proportion of doctoral graduates in higher education research roles has declined over time. We also found that over time doctoral graduates progress out of higher education research roles into higher education teaching roles. In contrast the proportion of doctoral graduates in research roles outside higher education seems to remain relatively stable over time.

In spite of efforts within the sector to improve conditions for researchers in higher education, challenges remain with regard to the opportunities afforded to those who work these roles. A far smaller proportion of those in higher education research roles have permanent contracts than those in other sectors and occupations. Moreover, individuals in these roles are also particularly dissatisfied with their job security and career prospects. We understand this is not a new problem, and have no evidence that the situation is worsening. However there is a possible risk that talented researchers may avoid entering the sector, despite this being a time when the UK needs to maintain and build upon the strength of its research base. The next chapter goes on to explore the career pathways since graduation in more detail, using data from both the survey and our interviews with doctoral graduates.
05. DOCTORAL GRADUATE CAREER JOURNEYS

This chapter discusses the career pathways experienced by doctoral graduates in the seven to nine years since they graduated. It suggests that doctoral graduates engage in a wide variety of career journeys, often influenced by their sector, occupation and stage of life.

Key findings

We identified three broad types of doctoral graduate: early, mid and late career graduates, as determined by where individuals are in their careers when undertaking doctoral study.

Social science and arts and humanities doctoral graduates have an older age profile than science doctoral graduates. These graduates, along with those with doctorates in education, are more likely to be mid-career graduates than those from other disciplines.

92 per cent of doctoral graduates responding to our survey who were working in higher education six months after graduation were also working in this sector in April 2013. However, other evidence suggests that movement between sectors is potentially greater than indicated by this statistic.

The insecurity offered by research jobs in higher education, together with more attractive prospects in other sectors, are key reasons for doctoral graduates moving out of the sector.

The most common career pathway for those who cross sectors is a short period of time spent in higher education as a post-doctoral researcher or research assistant followed by a move out of higher education to another sector.

Self-employment and portfolio careers amongst our interviewees are almost always an active and positive choice, providing freedom, flexibility and the opportunity to apply their skills.

27 per cent of survey respondents have experienced one or more periods of unemployment since graduation, with younger doctoral graduates more likely to have gone through a period of unemployment. A higher proportion of individuals working in either higher education research or research roles elsewhere have had a spell of unemployment, when compared to those in other sectors.
Introduction

The previous chapter set out what doctoral graduates responding to our survey were doing on a specific date seven to nine years after graduating. Moving beyond this snapshot in time, the key research aim in this chapter is to understand the medium-term career pathways of doctoral graduates by drawing on the qualitative interviews with doctoral graduates. This research builds on DLHE and L DLHE data, and represents one of the first studies to capture the dynamic career pathways of doctorate graduates from a medium-term perspective.

We also want to understand the levels of mobility of doctoral graduates between sectors over time, and in particular to what extent doctoral graduates move in and out of higher education and the reasons for this. We begin by considering the role of a doctorate within an overall career and how this is linked to an individual’s motivation to study, before exploring broad career journeys in more detail. We focus on single and cross-sector careers, career changes, portfolio careers and entrepreneurial careers. This chapter closes by looking at doctoral graduates’ experience of unemployment.

Variations in when and why people take doctorates

Our research shows that people start their doctoral career journeys at very different points with different motivations to study, which has a significant influence on subsequent careers. Initial motivations to study a doctorate may evolve over the course of an individual’s studies, and a doctoral graduate’s eventual career may not be the product of a firmly preconceived career choice or preference. Initial motivation is flexible and may change entirely as a result of studies (Jackson, 2007). The age and personal circumstances of a student are important too, as is the type of doctorate. The appetite for an academic career following graduation may be less apparent in mid-career professionals who already have a career outside academia. In particular, those completing professional doctorates are highly likely to be further on in their own careers, potentially already in senior positions (Raddon and Sung, 2009). Meanwhile, others may often come to the end of their PhD with little certainty as to what they wish to do next, as highlighted by Rugg and Petre (2004).

Based on our interviews with doctoral graduates, our research identified three broad types of doctoral graduate: early, mid and late career graduates. This related to where doctoral graduates were in their career journey at the time of undertaking the doctorate. These groups often had differing motivations and this led to distinct career pathways. There were clear variations in the age of doctoral graduates responding to our survey by subject area studied, as the table below indicates, which is suggestive of varying motives to pursue doctoral study. For instance, whilst some may have pursued a lifelong interest, other individuals may have chosen to complete a doctorate to support their career ambitions. Broadly speaking, social sciences and arts and humanities doctoral graduates have an older age profile than sciences doctoral graduates.
Early career graduates completed their doctorate early in their working life. They moved straight from completing an undergraduate degree or Masters onto a PhD, or in some cases took a short break in between, for example for travelling, internships, temporary and/or non-graduate work, or to gain work experience in a chosen industry or profession.

My studies continued from formal education and were followed by a post-doc position for two years in ... (a similar field to my doctorate) in [name of institution]. ... I had wanted the doctorate as a logical progression, to see if I could do it.

Biological sciences graduate

Just over 30 per cent of our doctoral graduate interviewees indicated that they had completed their doctorate early in their career. However the age profile of interviewees suggests that almost double this proportion could fall into the category of early career graduates.

Mid-career graduates decided to undertake a doctorate mid-way through their career journey – although some said they would not describe their activities before undertaking the PhD (for example, raising a family, undertaking a range of non-graduate jobs) as a ‘career’. Just under 40 per cent of our doctoral graduate interviewees described a career pathway that fell into this category. Mid-career graduates from all disciplines were well represented, although greater proportions of social science, arts and humanities and education doctoral graduates were mid-career graduates compared to other disciplines. This reflects the age profile of the wider survey cohort, where arts and humanities and social science doctoral graduates are more likely to be over 40 than other disciplines.
Mid-career graduates can be split into three broad sub-groups: those pursuing professional development or interests, those seeking a change in career or new opportunities, and those undertaking a PhD purely for interest unconnected to career goals.

Those **pursuing professional development** undertook doctorates to enhance their careers by improving their qualifications or to investigate topics of professional interest further. Specific motivations included to gain promotions or pay-rises, enhance their professional capability, to raise their credibility and to enable them to undertake more challenging or interesting projects.

Mid-career physical sciences and engineering doctoral graduates often alluded to the fact that their doctoral studies had been sponsored by their employers. Some doctoral graduates (particularly social science graduates) identified research topics directly related to their work that they wished to pursue in-depth to enhance performance (their own and other practitioners), and/or to satisfy their own curiosity and interest.

I decided to take my doctorate because of a combination of two things: to differentiate me from others doing similar work, and interest in the topic. I was trying to understand a great deal more about this particular topic, of which virtually nothing was written in text books.

**Social sciences graduate**

This sub-group included doctoral graduates who worked in clinical professions (biomedical scientists responding to our survey tended to have a higher age profile than some other disciplines). In addition, the L DLHE survey of the 2004/05 cohort of doctoral graduates found that biomedical scientists were more likely to be motivated to undertake a doctorate in order to enhance their career and employment prospects and less likely to be motivated by interest (Hunt et al, 2010). Biomedical sciences doctoral graduates were also most likely to have undertaken further training or qualifications after completing their doctorate. This appears to fit with the requirements for ongoing professional development in medical professions.

For other mid-career graduates the doctorate facilitated a **change of career** or opened up new opportunities. This group of doctoral graduates frequently (but not always) had no previous experience of higher education and undertook a first degree as a mature student which then often led directly to a doctorate as a natural progression.

Career-changers decided to return to education for a plethora of reasons. They were frequently working in non-graduate roles and feeling dissatisfied, had been raising a family, or were spurred by a change in circumstances (for example, illness or redundancy) to follow long-held ambitions to go to university.
There was a third, very small sub-group of mid-career graduates, predominantly social sciences and arts and humanities doctoral graduates, who pursued a doctorate unrelated to their work, purely out of interest and without any career ambitions in mind. These doctoral graduates in many ways had more in common with the late-career graduates. They sometimes undertook their doctorate during a career break (for example, while raising a family) in order to keep them intellectually stimulated.

**Late-career graduates** completed their doctorates either post-retirement or just before they retired. They were usually motivated by subject interest, often pursing a PhD within the field of their career; a desire to achieve a long-held ambition; or to set themselves a personal and intellectual challenge. Unlike the doctoral graduates previously discussed, the late-career graduates were not motivated by financial or career-related ambitions.

> To take a degree was something I’d wanted to do for as long as I could remember, but it just wasn’t possible. And then after I retired from teaching and after both my parents died I found myself in a position where I could fulfil that ambition.

**Arts and humanities graduate**

Very few of our doctoral graduate interviewees fell into this category but this is largely a result of our purposive sampling which focused on interviewing doctoral graduates in
employment. Seven per cent of survey respondents were over 60 at the time of the survey, suggesting they would most likely fall within this category.

Motivation to study at doctoral level was not a specific focus of this research although it often came up in interviews when discussing career journeys. Previous studies (Hunt et al., 2010 and Emery and Metcalfe, 2009) found that motivation was driven by interest in the subject and research. A study by Purcell et al. (2005) also identified more passive motivations to study which can be difficult to detect through pre-coded survey responses alone, such as a desire to be challenged, or incidental reasons where a student was unable to undertake their first choice of course.

**Medium term career pathways of doctoral graduates**

Our survey and interviews with doctoral graduates seven to nine years after graduating gives a good opportunity to better understand their medium-term career pathways. The research indicates that there are typical pathways and progression routes, but within these there is great diversity in the variety and combination of roles that doctoral graduates undertake.

Career decision-making and choice is complex and career journeys themselves are varied and are influenced not only by individual decision making, but wider structural factors (Hodkinson, 2008) and chance events (Mitchell et al., 1999). To help understand some of the variety and complexity of doctoral graduate career pathways, we first attempted to identify whether doctoral graduate interviewees who continued their career post-doctorate (that is, excluding “late-career” graduates), had pursued single or cross-sector career pathways. Where it was possible to code the doctoral graduate interviewee data as either single or cross-sector, we found slightly more doctoral graduate interviewees (just over half) had experienced cross-sector careers than single sector careers (further definitions of these terms are given below). No wider inferences should be made from this as the doctoral graduate interviewees were purposively rather than randomly selected.

**SINGLE SECTOR CAREERS**

Doctoral graduates following a single sector career pathway remained working within the same industry after completing their doctorate. This group of graduates included those working in strongly vocational or professional roles including academics, doctors and other clinicians such as psychologists, lawyers, and teaching professionals. However, single sector careers were far more diverse than this and included an array of other roles.

Many of those with single sector career paths have remained with the same employer since completing their doctorate, while others have worked usually for between two and four

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10 UUK attribute these statistics to doctoral students in their report, but PRES covers all postgraduate research students (including those undertaking Masters by Research), not just those at doctoral level (which constitute 78 per cent of the PRES sample).
employers since graduating. Those with single sector careers, particularly those who remained with the same employer, tend to be working in roles or industries with clear progression pathways. Progress can be noted in terms of simple stepped promotions (particularly for those remaining with same employer) often from junior to senior roles, then into managerial and directorial level roles.

I’ve been at my job now for nearly ten years since I finished my PhD, came straight from PhD, was still writing up my PhD actually when I started the job [...] I’ve progressed from unaccredited assessor to accredited assessor to senior assessor, and then I took on a management role four years ago. So yes, there’s been progression, but the basic role is the same.  

Biomedical sciences graduate

Progression is also achieved in terms of taking on new challenges, additional responsibilities, working for larger firms or in roles with greater reach (for example, moving from national to global level of operations).

I initially moved into a technical role at a trade body which was very much focused on implementing, within an industry, what my doctorate was on. After about two years of doing that when it was clear that it was becoming implemented within the industry I transitioned into a small private company that was developing services along those same lines [...] Ultimately I became one of the directors of that firm, before more recently moving on to another key leadership role in a much larger firm undertaking similar activities but on an international scale.  

Physical sciences and engineering graduate

Doctoral graduates following single sector careers had in some cases moved across disciplines or to different occupational groups within the same sector. For example, they moved from specialist technical roles into management, from clinical practice to policy or research roles, and from academic roles in HE to administrative roles. Doctoral graduates with single sector careers had also moved from being an employee to working as a self-employed consultant, often serving the same kinds of organisation they had previously been employed by.

Many of those mid-career graduates who undertook a PhD for career development reasons had experienced such single sector career pathways. These graduates had very specific career goals in mind and were enabled to achieve them with their doctorates.

A smaller number of doctoral graduate interviewees had worked within the same sector but experienced less obvious upward progression in terms of role. This sub-group included mid-career graduates whose motivation for PhD study was more about pursuing professional or personal interests than career development and whose working life was enhanced as a result
without necessarily entailing promotion. These individuals were generally already in senior or unique roles before embarking on their doctoral study, but the doctorate saw them become more effective in their existing role.

I was already working as director of a small charity which uses research and evaluation work, and I have continued in that post. The doctorate was motivated by a wish to improve the quality of the work we are doing and also to improve access to contacts, which has largely happened. I haven’t changed role or position; I am doing the same thing, just better.

Graduate from other discipline

The doctoral graduates we interviewed with single sector careers had doctorates across all the discipline types, although there were some notable differences between disciplines. Arts and humanities doctoral graduates were more likely to have cross-sector careers (see following section). Those with single sector careers tended to be either academics or to be mid-career graduates in well-established career roles (for example museum manager, musical director) prior to embarking on their PhD.

Amongst the doctoral graduates interviewed, social science and biomedical science doctoral graduates were slightly more likely have single sector career paths than cross-sector paths. Social and natural scientists had often progressed through clear professional pathways (for example, junior scientist, senior scientist, principal scientist; research assistant, research manager, research director), or had moved from specialist into more managerial or generic roles concerned with policy or quality.

Well, my doctorate was an applied doctorate [...] Since qualifying I have pursued a career as a clinical psychologist in the NHS. I started as a junior psychologist and worked my way up to become a consultant, which is what I am now.

Biomedical sciences graduate

Single sector career doctoral graduates include those remaining in higher education over time. The focus of this research was very much on understanding career paths and impact outside of higher education, and as a result we interviewed only a limited number of doctoral graduates who were currently working within HE. It is difficult therefore to draw wider conclusions based on the small sample of doctoral graduate interviewees. We found that doctoral graduate interviewees working in academic roles (as researchers or teachers in HE) had generally hoped for a career in academia, which was their motivation for completing a PhD. All those we interviewed in this category had worked entirely within HE since completing their doctorate. Most had progressed from work as post-doctoral researchers or research fellows into lectureships and senior lectureships. Although a very small sample and not representative, it does illustrate how HE research proportions may decline over time and teaching professional proportions rise, as discussed in chapter 3.
Just before I finished the doctorate I got a research fellowship in [institution]. I went there but I only had it for one term, because then the lectureship came up, which is the lectureship I’m still in now... I wouldn’t have done a PhD if I didn’t think there was a chance of a career in academia.

Arts and Humanities graduate

But single sector doctoral graduates working in HE also included those in non-academic roles, such as widening participation officers or administrators. We carried out a larger number of interviews with doctoral graduates who were working in non-academic roles at the time of the survey. There were a number of typical routes into non-academic roles in higher education. Many had progressed from their PhD into researcher roles then into non-academic roles either as opportunities within their HEI arose, or after they became disillusioned with academic posts (see discussion below under cross-sector careers). However some doctoral graduates had spent time outside of HE first before returning to non-academic roles (cross-sector careers). A smaller number had worked in non-academic HE roles since graduating – either because they had been in these roles prior to undertaking their PhD as career development, or because working in HE during their PhD had brought them into contact with opportunities for a non-academic career in HE.

Graduate example: building a non-academic career in HE

This biomedical sciences graduate developed a career in HE participation and partnership on the back of volunteering while a PhD student.

When I was writing up my PhD I became a student ambassador at [name of HEI] which involved outreach work with schools as part of [name of programme]. This gave me an insight into that sort of work.

The graduate took a job at an HEI while still writing up his PhD then a year later moved into a participation officer role at another institution. From here they gained promotion to team leader. Most recently they moved took on the role of partnership development manager at a different HEI.

As we have shown above, single sector post-doctoral careers, far from being static or lacking mobility, are frequently characterised by upward progression. Doctoral graduates taking this career path have often built or enhanced highly vocational or professional careers following their doctorate.
CROSS SECTOR CAREERS

Many of the doctoral graduate interviewees have moved across sectors since completing their doctorate. This would, by definition, include those who had spent some time in HE before moving out, as well as a considerable number of others who had moved across non-HE sectors. Based on the interviews, of those doctoral graduates who had clear cross-sector careers, nearly three quarters had spent at least some time after completing their doctorate working in HE.

Often doctoral graduates had moved into roles immediately on completing their doctorate that were not necessarily ideal in terms of overall career ambitions, or which they subsequently found they were unsuited to. We explore the reasons for movement into and out of HE over time in further detail later in this section. This led to movement into other sectors that were often more suitable or appealing over time as opportunities appeared. In some cases doctoral graduates needed to step across sectors and roles more than once to move indirectly towards their desired roles, by gathering necessary experience, building a CV and making contacts on the way. Other cross-sector moves were instigated by factors outside of doctoral graduates’ control such as employer restructuring or relocation.

I wanted to go into industry but couldn’t straight away, so I stayed at uni to do post-doctoral work. I stayed for two more years until my break in industry came, firstly in an agro-chemical background. This was a big change, because it wasn’t in my specialism [...], but I moved after three years into a more appropriate role.

Biomedical sciences graduate

Major changes of career post-doctorate often required retraining (see below) but where doctoral graduates moved across sectors in pursuit of their ideal career or were forced to move roles due to circumstances their strong transferable skills appear to be an asset.

After I finished my PhD I looked for work for a few months, then started working in the financial services sector, in insurance, using my mathematics background to do modelling. I moved directly to [name of research and development sector employer] and have been working here ever since. I have been working on ocean science and subjects more closely linked to my PhD.

Physical sciences and engineering graduate

Movement from HE to other sectors

While many doctoral graduates develop careers in academia, it is clearly not for everyone. Our research demonstrates that doctoral graduates develop satisfying and stimulating careers outside academia. There were many doctoral graduates who had never worked in academia, and after finishing their doctorates went on to work in sectors and professions other than HE research and teaching.
The survey data suggest little movement between HE and other sectors over time for many doctoral graduates. 92 per cent of survey respondents working within HE six months after graduation are still in HE at the time of our survey. Similarly 90 per cent of respondents working outside HE six months after graduation are still outside HE at the time of the survey. Hunt et al (2010) also looked at the movement of doctoral graduates into different occupational clusters between the DLHE and L DLHE survey. In this study, approximately 75 per cent of those in higher education six months after graduating were still working in the same sector. This data suggests greater movement between HE and other sectors than our survey results indicate.

Amongst our doctoral graduate interviewees slightly more had changed sector since graduating, and of these a large proportion had worked in academia at some point after completing their PhD. Of these doctoral graduate interviewees, the most common path by far was to spend a relatively short time working within HE, as post-doctoral researchers or research assistants before moving out of HE into other sectors. A very small number of those with cross-sector career paths and experience of working in HE moved into HE after working in other sectors on completing their doctorates. A similarly small number had moved out of HE for a time and then returned, or had moved into HE from other sectors to leave again. These were generally as a result of having to take an available job, often for a relatively short period of time, that may not fit with overall career plans or preferences due to external factors such as redundancy or a need to relocate. A small number of interviewees highlighted that they worked in HE in part-time or visiting roles in parallel with careers in other sectors.

As with single-sector careers, there were some notable discipline related differences. As noted above, arts and humanities and biological sciences doctoral graduates were more likely to have cross-sector careers, and graduates from these disciplines were most likely to have spent some time working in higher education. We already know that doctoral graduates in these disciplines are more likely to want to pursue a career in academia and to undertake a doctorate for these reasons.

Doctoral graduate interviewees who had moved on from HE had done so for a variety of reasons, and sometimes these were overlapping. Some doctoral graduates had made an active choice to leave HE and pursue a career elsewhere, while others were forced to seek work in other sectors but would have preferred to stay in HE. Reasons for doctoral graduates moving from higher education to other sectors, for deciding to leave academia on completing their doctorate, can be roughly split into four types:

— Disillusionment with academia,
— Lack of suitable opportunities within the sector,
— Desire to gain industry experience, and
— Working in academia did not suit them
Generally speaking, the individuals who started working in academia then transitioned into industry did so after a period of around two to three years. Post-doctoral research is often related to fixed-term project funding, which represents a juncture in the careers of doctoral graduates. Certainly the short-term nature of many research contracts and the need to continually secure project funding were among reasons frequently cited by doctoral graduate interviewees as reasons for their frustration with HE careers.

**Disillusionment with academia:** these doctoral graduates became frustrated and decided to leave academia. Reasons cited included: pay, lack of job security, workplace politics, the pressures of applying for funding, perceived large amounts of administration/bureaucracy and a lack of progression:

> You just end up in an education factory. You have particular targets to meet, and you have to publish this, that, and the other, and you just get sucked into the vortex that is academia

Arts and humanities graduate

There was also evidence that there was a ‘pull’ from industry in terms of providing more attractive and interesting prospects, as well as a ‘push’ factor from HE.

**Lack of suitable opportunities:** some doctoral graduates did not become disillusioned with academia, but could not continue to work in the sector because there were no opportunities for them to do so. Typically this occurred when funding ran out or the research landscape changed and as a result there were no or limited academic opportunities in the area. Other factors, in particular family responsibilities, meant that these doctoral graduates were often unable to move to other areas to seek out new academic opportunities.
Graduate example: The consequence of changing research priorities

This social sciences graduate worked as a researcher in HE after their doctorate, working on projects for central and local government and their agencies. However changes in government policy and priorities had a major impact on the availability of funding and commissions.

*The thing is when I started my PhD, regions were the hot topic. My PhD was about regional government, and then, [...] the balloon just burst and it was just boom, gone.*

What work was left in this field was subject to intense competition. Eventually the graduate was made redundant.

**Desire to gain industry experience:** These doctoral graduates actively chose to work outside of academia because they wanted ‘real world’ experience and / or they felt they could make more of an impact outside higher education:

* I think I left academia because I wanted to do research with more direct policy relevance.
* I felt other organisations were having more of an impact.
  
  **Social sciences graduate**

**Academia did not suit:** This category is perhaps similar to the disillusionment category in some respects; the key difference is that whilst those who became disillusioned were unhappy with the academic processes and organisations, these doctoral graduates simply felt that the nature of academic work ‘was not for me’; it did not suit their personality or strengths. For example, they wanted more interaction with colleagues, they did not want to teach or they wanted to be more creative. In some instances doctoral graduates had no ambitions to work in HE but simply took a role for pragmatic reasons.

* I decided that working in a lab wasn't for me, it didn't suit my personality; I found it frustrating and lonely.
  
  **Biological sciences graduate**

Once people had left academia and moved into other areas of work, their career paths varied and fell into the same broad types as people who went straight from completing their doctorate into non-academic careers.
Post-doctorate career changes
A small number of doctoral graduates completed their PhDs and then undertook major changes of careers. This was usually an active choice: graduates had discovered early post-doctoral job roles were not suited to them (see above in relation to HE), offered more limited progression than they had hoped for, or they were simply tired of their role and wanted to try something different. Life changes such as redundancy, illness, starting a family and relationship breakdowns also played a role in prompting doctoral graduates to reflect upon their career or pursue alternative vocations.

Graduate example: Career change pathway
After completing their doctorate in physical sciences and engineering this graduate decided to retrain in contemporary dance performance. The change of career emerged as a result of a change of personal circumstances and a growing desire to pursue their hobby of dance further.

> The subjects I had studied had been intellectual. But now I was learning with my body and I was discovering new things about it; it fascinated me in the same way as understanding the universe.

They have since become a self-employed dance practitioner, working with people with physical and learning disabilities and mental health problems. Although this is major shift from their doctoral subject, the graduate is still making use of the problem solving and research techniques developed during their doctoral study.

> It’s related through the method of doing research; using one discipline to tackle another, so using dance and drama to deal with problems that arise from learning and physical disability or mental health problems. There’s no text book for it, so it’s about applying your analytic skills to a problem, coming up with a model, testing it and refining it.

Portfolio careers
Our research also identified a small number of doctoral graduates with what could be described as portfolio careers. This can be defined as having multiple roles and employers at the same time or in quick succession, generating different sources of income to develop a broad portfolio of skills and experience or to enable the pursuit of particular interests and ambitions while maintaining a degree of security of income. Portfolio careers can also include voluntary/charitable work. These roles do not have to be related to each other or someone’s doctorate. Portfolio careers might be taken out of necessity in an unstable economic climate, or out of choice to develop a more diverse and interesting career. The doctoral graduate interviewees whose careers most resembled this pathway were often, but
not exclusively, arts and humanities doctoral graduates pursuing creative vocations, for example, combining creating artworks or performances with teaching and consultancy roles.

**Entrepreneurial careers**
Doctoral graduates with portfolio careers often incorporated freelance working within this, and we found other examples of doctoral graduates with entrepreneurial aspects to their careers. Within this type of pathway we have included those working freelance as self-employed sole traders, and doctoral graduates who have set up and developed their own businesses.

7 per cent of our survey respondents in work said they are self-employed. Most of our doctoral graduate interviewees who had entrepreneurial careers undertook freelance work, either as their main job or as one of a number of roles. This was, for most, a positive and active choice that brought many benefits. In the majority of cases working freelance was the result of a combination of a desire to work differently and circumstances that arose to provide the necessary opportunity. Freelance doctoral graduates valued the flexibility and freedom of being self-employed, and for many, the ability to fit their work around children and other caring responsibilities was a key factor mentioned. Very few interviewees reported that being self-employed was something that they had no choice over and was purely the result of being unable to secure an employed position.

Freedom to pursue interests and the ability to take greater control of career direction were also given as key reasons why doctoral graduates had set up their own company. These entrepreneurial doctoral graduates frequently spoke of feeling frustrated working for other people, a desire to be more creative and innovative, or wanting to pursue projects that they felt were important or had potential where employers had been slow to recognise this. In some cases, doctoral graduates had wanted to progress to more managerial roles or conversely remain focused on technical work, and had felt establishing their own business enabled them to steer their career accordingly. Redundancy was also a spur to action in these cases, with at least one respondent setting up a spin out company with colleagues when their employers’ company was wound up.

Notably, a large proportion of entrepreneurial doctoral graduates were also mid-career graduates who had undertaken their PhDs later in life, often after developing successful careers. 63 per cent of survey respondents in self-employment are between the ages of 35 and 49, with late career graduates representing over one-quarter (26 per cent) of those who were self-employed. We will see in the next chapter that work experience and skills gained from sources other than the PhD are important in enabling doctoral graduates to set up their own businesses.
Experience of unemployment

We saw in the previous chapter that doctoral graduates have low levels of unemployment, at 3 per cent overall. However just over a quarter (27 per cent) of survey respondents had experienced a period of unemployment of one month or more since completing their doctorate. The interview data suggests that experience of unemployment is generally short term, and where doctoral graduates experience longer-term unemployment this is influenced by factors other than their PhD.

Experience of unemployment was higher among doctoral graduates under the age of 40\textsuperscript{11} (29 per cent) when compared with doctoral graduates aged 40 or above (23 per cent). Figure 14 shows a higher proportion of individuals working in either HE research or research jobs elsewhere have experienced unemployment since graduating, even after accounting for age as a factor. This might be attributed to the short-term and unstable nature of the funding provided to complete work in these posts.

Figure 14: Experience of unemployment by occupational cluster for doctoral graduates

A small number of doctoral graduates (6) sampled for interview were unemployed at the time of completing the online survey. Our pool of interviewees also included doctoral graduates who had experienced a period of unemployment. Many of the doctoral graduate interviewees who had experienced unemployment since completing their doctorate reported that they had been unemployed for a short period of time whilst changing jobs. For example, having been made redundant or their contract ending doctoral graduates then spent some time looking for a new job. Periods of unemployment tended to be relatively short, usually lasting a few weeks or months. It is reasonable to assume that people who are in a

\textsuperscript{11} at the time of the survey
transitional phase of working (that is, between jobs) may have a short spell of unemployment between the end of an old role and the beginning of a new one.

The reasons for periods of unemployment across doctoral graduate interviewees were varied. It is interesting to note that some doctoral graduates seeking to return to work on a part-time basis after starting a family found some employers inflexible, making it more difficult for these doctoral graduates to find appropriate employment. Where doctoral graduates had been unemployed for longer periods of time, other factors were suggested to be the main reason for this. Age was commonly mentioned: most of the unemployed doctoral graduates interviewed were over 50.

No, no the fact that I’m still unemployed three years later is more to do with the time of my life than my PhD

Physical sciences and engineering graduate

Other factors mentioned that impeded unemployed doctoral graduates’ ability to find suitable work related to the local labour market conditions and the doctoral graduates’ limited mobility due to family commitments. This is not unique to doctoral graduates, but it is not unreasonable to suggest that the more specialised the role, the harder it may be to find opportunities in all parts of the country.

Their PhD qualification was felt by some doctoral graduates to be problematic when applying for roles that did not require such a high level qualification, and in particular for non-graduate roles. Doctoral graduates sometimes needed or wanted to apply for less demanding jobs in order to gain experience in new sectors, re-enter the labour market after a break, or because these were the main jobs available in a desired geographical location. Some doctoral graduates admitted down-playing their PhD or leaving it off the CV for fear it would be off-putting to some employers. One respondent had heard informally from an employer that they would be put off employing someone because they held a PhD. Doctoral graduates felt that employers sometimes perceived them as ‘too clever’ or that colleagues or employers who do not hold a PhD might feel envious and that this could be a barrier to securing employment.

My PhD was a bit off-putting because some employers thought I was overqualified for certain jobs and I did have to take a significant pay cut to show commitment to starting a job lower down on the chain.

Biomedical sciences graduate

A few of the doctoral graduates that we interviewed also stated that employers tended to expect doctoral graduates to demand higher salaries, which might adversely impact their employability. Other research into employers’ views on this subject suggests that those that do not employ doctoral graduates may perceive them to have “high expectations in terms of
salary and career progression” (Morgavi et al, 2007). Employers’ attitudes to doctoral graduates, including positive and negative perceptions, are returned to in Chapter 6.

Chapter conclusions

This research shines a light on the careers of doctoral graduates seven to nine years since they graduated. The survey of doctoral graduates offers a substantive body of evidence on career pathways; although the sampling approach does mean that some conclusions can only be drawn tentatively. Our qualitative work adds depth and detail to the quantitative analysis. Our interviews, along with other evidence, suggest that there is more movement between higher education and other sectors than the quantitative data would lead us to believe.

In Chapter 3, we highlighted the level of dissatisfaction amongst doctoral graduates currently working in HE research, with regards to career prospects and job security. The interviews we conducted with doctoral graduates have allowed us to begin to build a greater understanding of the reasons people leave higher education and move into other roles. This has included a mixture of both ‘push’ factors, such as disillusionment with different aspects of academia and ‘pull’ factors including better prospects in industry. Whilst it is positive to see doctoral graduates enjoying fulfilling careers outside academia, we need to ensure that research positions in higher education continue to attract and retain high-quality candidates for reasons noted in the conclusions to Chapter 3. Later in this report, we will provide examples of the positive impact research in universities can have on innovation and societal well-being. The Allas (2014) report highlights the comparatively low number of people employed as researchers as a concern for the British economy, and notes that many doctorate holders do not end up in research roles. Whilst our work provides an initial understanding of the reasons why doctoral graduates may not end up in research roles within higher education, future work could look in more detail at why doctoral graduates are taking-up research roles more generally in greater numbers.

Only a small proportion of doctoral graduates responding to our survey are self-employed, undertaking freelance work or running their own businesses. The desire for freedom to pursue interests and the ability to take greater control of career direction are the main motivating factors in pursuing these career pathways. In line with previous studies, this research also found that portfolio careers were most prevalent amongst art and humanities doctoral graduates, most of whom described this as a positive choice rather than a result of necessity.

This chapter has provided an insight into where and how a PhD influences the careers and lives of doctoral graduates. Amongst the three different types of graduates identified here, some of the examples we have given have begun to highlight how the doctorate has benefitted the individual, whether that be through a promotion or finding a more satisfying career. We now move on to explore the benefits to doctoral graduates in more detail.
06. BENEFITS FOR THE INDIVIDUAL

This chapter looks at the benefits to individuals from doctoral study. This includes both the financial and non-financial benefits from completing a PhD.

**Key findings**

The salaries of doctoral graduates responding to our survey range between £15,017 and £300,000, with the median pay being £40,700.

The financial rewards of doctoral study differ by employment sector. Pay levels are highest in the finance, business, IT and legal sector. The median salary here is £60,000.

87 per cent of graduates responding to our survey believe that their PhD has helped them progress towards their long-term career ambitions.

Completing a doctorate often requires grit and determination. As a result it builds resilience and confidence in graduates which enables them to take on new tasks and better meet life’s challenges.

Graduates report their doctoral experience broadened their horizons and developed their critical thinking making them more discerning consumers of information, which benefits them beyond employment.

Doctoral study can help build lifelong friendships and networks of contacts, instil great feelings of pride in graduates and help them to be role models to others.

Only 6 per cent of doctoral graduates responding to our survey stated that it was likely or very likely that they would work towards a different qualification given the choice of studying for their doctorate again.
In this chapter, we explore the medium term impacts of doctoral study on the individual graduates. In our logic chain we suggested that doctoral training would enhance not only graduates’ earning capacity but also other aspects of their quality of life, for example by providing skills and attributes that can be used outside the workplace. Our research provides further evidence to develop and enhance understanding of the individual benefits to doctoral study.

Other research (for example, Conlon et al 2011, and Hunt et al, 2010) suggests that doctoral graduates on average earn more than those with just a first degree. In this chapter we begin by reporting on the financial benefits to the individual including the distribution and average earnings of doctoral graduates. This is followed by an exploration of how pay varies amongst different sectors and by subject, set against a consideration of how these trends compare to the findings of previous research in this area. As a result of linking the survey data to HESA data, a short discussion of the trends in doctoral pay over time is provided.

The chapter then considers the non-financial benefits of gaining a PhD. Such benefits are considered as other literature has often focused on the financial returns of educational qualifications and not considered other rewards to studying at doctoral level. By triangulating quantitative and qualitative evidence we are able to make a unique contribution to the existing evidence base in this area. This is noteworthy because it illustrates the other ways in which doctoral study adds value to the lives of individuals, which can subsequently result in benefits to wider society.

**Financial benefits to the individual**

Our survey found that the median salary for doctoral graduates seven to nine years after graduation was £40,700, with 80 per cent of doctoral graduates completing our survey earning between £30,000 and £65,000. The majority of doctoral graduates (37 per cent) were earning between £30,000 and £40,000 as shown in Figure 15 below. This data is for doctoral graduates in the UK only and excludes those working in part-time jobs and/or working in more than one job at the time of the survey.

Wider evidence suggests that there can be significant returns to a doctorate qualification. The ONS (2013) have provided data showing how earnings for all those with at least a degree or equivalent qualification (so this would include doctoral graduates) vary over time. Around 10 years after graduating, the average wage stands at approximately £31,000. Doctoral graduates in our sample are earning substantially more, whether we consider the mean or the median salary. However, we should treat this comparison with caution. Past research has found that PhD graduates do earn more than those with lower level qualifications. For instance, Machin et al (2010) highlight that those with a PhD earn 23% more on average over the course of their lives than those with a first degree, whilst individuals with a Master’s earn 15% more. Additionally, Conlon et al (2011) find that the earnings premium for doctoral graduates in comparison to those with just a first degree is
approximately 16-17 per cent, but they do acknowledge that this may be an overestimate given that these individuals will also most likely possess a Masters level qualification too.

**Figure 15: Median pay of doctoral graduates in one full-time UK based job**

![Frequency and Cumulative percentage frequency chart]

However as one would expect, the range and average salary earned by doctoral graduates seven to nine years on varied quite markedly depending on the sector they worked within, as the Figure 16 and Table 6 below suggest.
A Kruskal-Wallis statistical test was applied to the salary data set out in Table 6 and it highlighted significant differences in median salary depending on the sector that an individual is working in. If we consider the main employment sectors (and therefore exclude ‘other sectors’ from the discussion), we can see that average salaries for our sample of doctoral graduates are highest in the finance, business, IT and legal sector, where there also appears to be quite a large variation in pay. In fact, 65 per cent of respondents who indicated
that they work in this sector are currently earning a salary in excess of £50,000. Elsewhere, those working in health and social work or manufacturing and engineering are also relatively high earners. Almost 50 per cent of doctoral graduates completing our survey working in health and social work earn above £50,000, whilst the proportion is 38 per cent for those employed in the manufacturing and engineering sector. In all other key employment sectors, median salaries seven to nine years after graduation vary between £36,000 and £40,000.

The survey also revealed that, outside higher education, median salaries for doctoral graduates responding to our survey are higher for social sciences and biomedical sciences graduates, compared to those from other subject disciplines. With respondents in both these fields earning a median salary of £48,000 or more, compared to other doctoral graduates from other subject disciplines, where the figure ranged from £37,850 to £42,000. However, this is likely to be a consequence of the sectors that individuals from these disciplines work within. Outside higher education, the main employer of social sciences graduates is the finance, business, IT and legal sector. For biomedical sciences, the main sector is health and social work. Our analysis highlights that average salaries for our cohort of doctoral graduates in these two industries are quite high, relative to other major sectors, and hence it is the wages offered in these sectors that are most likely to be driving the relationship between subject discipline and pay. Indeed, recent literature also seems to find similar associations between subject and pay. Research by Casey (2009) indicates that the subjects that bring about the highest rates of return include medicine, as well as financial and business studies. More recently, work by Elias et al (2011) has sought to establish whether the expansion of higher education, and the associated rapid increase in participation, has had a negative impact on the distribution of earnings. Through analysis of the Labour Force Survey between 1994/1995 and 2009/2010, they found that the return from a doctorate in medicine and related subjects has increased over time.

Looking in a bit more depth at the higher education sector, we are able to compare the pay levels of survey respondents working in research, teaching and other roles within this sector as shown in Table 7. As has been consistently found in previous analysis of the L DLHE for doctoral graduates the three and a half years’ post graduation, those in HE teaching roles earn higher average salaries than those in HE research positions. Our analysis revealed that 61 per cent of survey respondents working in HE teaching roles are currently earning above £40,000 per year, compared to just 24 per cent of researchers in higher education. Salaries tend to be more variable in the HE Other category, although 44 per cent of respondents working in this particular occupational cluster have a wage in excess of £40,000.

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12 When disaggregating data to this level, the frequencies upon which some of these statistics were based were quite small. The minimum frequency in a particular subject category for this analysis was 15.

13 We present this data with the accompanying caveat that the frequencies on which they are based are quite low.
Table 7: Salary levels by occupational cluster in higher education for those working in one full-time job in the UK

<table>
<thead>
<tr>
<th>Occupational Cluster</th>
<th>Median (£)</th>
<th>10th Percentile (£)</th>
<th>90th Percentile (£)</th>
<th>Total frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>HE Research</td>
<td>36,000</td>
<td>29,950</td>
<td>44,000</td>
<td>110</td>
</tr>
<tr>
<td>HE Teaching</td>
<td>43,000</td>
<td>35,000</td>
<td>56,000</td>
<td>225</td>
</tr>
<tr>
<td>HE Other</td>
<td>39,000</td>
<td>27,502</td>
<td>69,500</td>
<td>55</td>
</tr>
</tbody>
</table>

Where doctoral graduates responded to both the survey in this study and had completed the DLHE six months post-graduation, it has been possible to undertake some analysis of the direction and extent to which individual pay levels have progressed. Within our dataset there were 240 respondents who provided salary data in both the survey for this study and the DLHE survey. Figure 17 below illustrates how the salary ranges have changed over time for this group. Graduate salaries for our cohort have generally moved upwards, and in some instances at quite a significant rate. For example, amongst those earning less than £25,000 six months after graduating, 45 per cent are now earning above £40,000. Almost 60 per cent of doctoral graduates who earned between £25,001 and £30,000 at the time of the DLHE survey now earn above £40,000. All graduates who earned more than £30,000 nearly nine years ago have remained in or moved up a pay band.

Figure 17: Current salary band of doctoral graduates compared to salary six months after graduation

Non-financial benefits to the individual

As we have noted above, the financial benefits of doctoral study will differ depending on the sectors graduates move into, which is likely to be driving the differences by subject. However, completing a PhD can bring many other non-financial and tangible benefits.
These benefits have only been explored to a limited extent in previous studies and we try to address this gap in the existing evidence base through our analysis.

87 per cent of doctoral graduates responding to our survey stated that their doctorate had helped them to some or a great extent to progress towards their long-term career aspirations, although there were significant differences found by subject discipline, as shown in Figure 18. A significantly greater proportion of arts and humanities graduates felt that their doctoral experience had not helped them at all in terms of progressing towards their future career ambitions when compared to any other subject discipline. However we also know that arts and humanities graduates have an older age profile, and that they are more motivated by subject interest and less motivated by enhancing career prospects than graduates in other disciplines (Hunt et al, 2010). That the doctorate did not impact on their long term career progression may be because it was never their intention that it should.

Figure 18: Impact of doctorate on long-term career progression

Arts and humanities doctoral graduates experienced benefits from their study in other ways. For example, 61 per cent of arts and humanities doctoral graduates agreed that their PhD had improved their social and intellectual capability to a great extent. The figure was 58 per cent for social scientists, whilst among the three science disciplines, the proportion in each discipline ranged between 39 per cent and 41 per cent.

The interviews with doctoral graduates in this study suggest that the experience of independent study, which is a central aspect of completing a PhD, can enable graduates to look at issues from a different perspective and communicate more effectively. Indeed, across the graduate cohort we interviewed, individuals noted the confidence that the PhD experience had given them. For some, the experience provided reassurance of their capabilities, whilst others considered themselves to be more able to try tasks that they wouldn’t have previously attempted. The determination and perseverance required to
complete a doctorate has resulted in them feeling better able to handle challenges they face in their day-to-day lives. Doctoral graduates also described how they had developed their problem-solving skills to tackle different issues outside the workplace and the self-belief to learn and apply new techniques.

*The general confidence permeates into the rest of your life. If I want to do something, I realise I’m capable of doing it. Even if it’s just a plumbing job at home, I can find the information, understand the technique, and work out what to do.*

Physical Sciences and Engineering graduate

*Basically nothing worked in my whole PhD until right at the end. It’s just the most stressful time ever, but this is why I would totally go back and do it again. It teaches you that you can look at all the options and work out how to get around it, and if you can’t get around it, then you still get something out of it. So it’s more the mental status, overcoming obstacles, which I think is quite useful.*

Biomedical Sciences graduate

Some interviewees also made reference to the ways in which the doctorate led them to look at issues from a broader perspective, which facilitated the development of a more investigative or research-based mindset. In some instances, the need to travel had also enabled them to broaden their horizons. Doctoral graduates believe that this mindset enables them to be more sceptical or enquiring consumers of information.

Doctoral study also presented a number of graduates with the opportunity to develop long-term friendships and networks with like-minded people. Individuals felt that there was a greater sense of community and highlighted the importance to them of having a close circle of friends, with whom they kept in contact with even after completing their studies. A few, however, did state that during their PhD, the stress and pressure of the work placed a strain on their personal relationships. Having a PhD also led some individuals to feel they were treated with greater respect amongst family, peers and in the wider community, generating a great sense of pride and satisfaction for graduates. Moreover, doctoral graduates said that people were generally more willing to listen to their views and opinions, because of their PhD.

*I made a lot of friends. We are still very good friends. So that has been a really nice thing, you have a bigger social circle of people that are similar to you. Even if we have not really kept touch, they have sent me messages and support, friendly faces you see at conferences. It is definitely a community.*

Biomedical Sciences graduate
A minority of the doctoral graduate interviewees stated that undertaking a doctorate had delayed the start to their career and had resulted in a negative impact on their earnings and career progression. This assessment was made relative to their contemporaries who had had not undertaken a doctorate, resulting in them entering the labour market sooner. These interviewees were generally working in roles where a PhD was not a requirement. Consequently, they questioned the value of their PhD when they saw others without doctorates progressing equally quickly.

— Social Sciences graduate

Despite some of the dissatisfaction graduates highlighted with issues such as career progression and pay, the majority would not change their choice of doing a PhD, as the data in Figure 19 below indicates. Rather than following a different route, graduates were more likely to have changed their subject choice. Around one-fifth of graduates reported that they would do a different subject or study at a different institution. By undertaking some analysis of this data by subject discipline, we found that 24 per cent of biological sciences and physical sciences and engineering graduates stated that they would do a different subject if they had the opportunity, which were the highest figures across all the disciplines. In all other disciplines, the proportion was either 20 per cent or below.
At the beginning of this chapter, we explored the salary level of doctoral graduates seven to nine years after graduation. Our longitudinal analysis does suggest that doctoral graduate salaries for this cohort have been rising over time and in some cases, quite rapidly. Yet, there are differences in pay levels by doctoral discipline, which seem to be driven by the sector that doctoral graduates are employed within. Aside from identifying the financial returns, where this study adds to the existing literature is by describing some of the intangible benefits of doctoral study. The length of time and level of work required in completing a thesis helped many to develop their determination and resilience. Given the standard of work required for a doctorate, graduates also reported increased self-confidence, in knowing that they could produce a substantive piece of work of such high quality. Doctoral graduates highlighted that during their time spent studying they formed networks and life-long friends; thus building their social capital. Additionally, they gained the respect of and / or inspired those around them such as their friends and family. As we shall see later in this report, these benefits of the doctorate can prove particularly useful in the workplace and contribute to creating wider impact.

Whilst some doctoral graduate interviewees highlighted negative impacts of doctoral study, such as the impact on finance, the majority of survey respondents indicated that they would not change their decision to study for this qualification given the opportunity to do so. This offers an indication of just how highly doctoral graduates value their experience and qualification. We now move on to investigate whether employers share similarly positive views about the skills and attributes of doctoral graduates.
07. **THE VALUE OF DOCTORAL GRADUATES TO EMPLOYERS**

Doctoral graduates represent a considerable value to employers, although many jobs do not formally require doctoral qualifications. Employers value the enhanced skills and knowledge that doctoral graduates bring beyond subject specialist knowledge. Typically, this includes strong problem solving skills, as well as the ability to think creatively.

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**Key findings**

The employers we spoke to value doctoral graduates deep and specialist subject knowledge, particularly where there is a clear link between this and their business needs. However good disciplinary knowledge can also help graduates develop expertise in related areas more quickly.

The key skills developed through doctoral study are the ability to solve problems and think creatively. 98 per cent of doctoral graduates responding to our survey indicated that their PhD had helped them develop problem solving skills to some or a great extent, whilst 96 per cent said the same for the ability to think creatively.

Employers across sectors also highly value graduates excellent research and analytical skills, their capacity for critical thinking, as well as their ability to bring fresh perspectives to the organisation.

Doctoral graduates interviewed experience some negative stereotypes of their strengths and interests, but these do not appear to be widely shared by those employers with direct experience of employing doctoral graduates.

Work experience outside academia is crucial for many of the employers we interviewed, particularly as it provides evidence of doctoral graduates’ ability to work in a commercial environment.
A key mechanism through which doctoral graduates can generate economic, environmental and/or social impact is their work. We aim in this chapter to determine the extent and ways in which doctoral graduates form an integral part of the workforce by exploring how and why employers value them. Doctoral graduates clearly have detailed specialist knowledge and high level research skills, but the ability to apply their knowledge and skills in a commercial setting is also important to generate wider impact. As doctoral study has by nature a narrow focus, it is also important for doctoral graduates to have excellent transferable skills such as problem solving and analytical skills and to have the confidence and communication skills necessary to fully exploit their expertise.

We examine the extent, particularly from the employers perspective, to which doctoral graduates exhibit these key skills. We begin by considering the skills and qualities employers seek in doctoral graduates, and the extent to which doctoral training develops these skills. We then discuss the skills that employers said they thought were lacking in doctoral graduates. This section also uncovers some of the negative or stereotyped perceptions that continue to persist from the viewpoint of some doctoral graduates. Our research provides good evidence to counter many of these stereotypes and makes a clear case for the value that doctoral graduates bring to different sectors.

As an alternative indicator of the value placed by employers on doctoral graduates we conclude the chapter by looking at the extent to which employers seek to recruit doctoral graduates and pay them a premium.

**The doctoral graduate skills and knowledge valued by employers**

Employers of doctoral graduates value a range of key skills and attributes that doctoral graduates excel in. A high level of subject or discipline specific knowledge was raised as a key attribute that doctoral graduates contribute by one-third of employers consulted. Doctoral graduates’ specialised knowledge was particularly valued where there was a clear match between this and the niche needs of an employer.

*What we do is very unique and specific, so experience is very useful, which means that those with doctorates are most suitable.*

— Small employer, research and development

Many of those employers who highlighted the specialist knowledge of doctoral graduates as a key asset were from science and technology related industries or functions, but also included employers where a clear link between core business and the specialised knowledge of doctoral graduates could be made, for example, museums. Subject or discipline specific knowledge is particularly valued by employers in the science and technology industry, where there is a need for high level specialised skills or where more general subject knowledge enables graduates to develop understanding and capability quickly.
Some employers and graduates also highlighted the benefits of good, broad disciplinary knowledge, as this enables graduates to build on this to quickly develop understanding in areas other than their PhD subject. This indicates that even if doctoral graduates are not drawing on their specialist knowledge directly, it can still provide a sound basis for developing expertise in related areas.

Doctoral training develops strong transferable skills in problem solving, research and analysis, as well as the ability to communicate complex information. These attributes were all frequently mentioned by employer interviewees as strengths of doctoral graduates. Additionally, interviews with doctoral graduates highlighted the same areas as being key strengths. Figure 20 below shows the extent to which doctoral graduates responding to our survey thought their doctoral study had contributed to the development of these key transferable skills. Abilities to solve problems and think creatively, in particular, are honed during doctoral study.

**Figure 20: The extent to which doctoral study enabled graduates to develop key transferable skills**

The survey results did flag up differences between disciplines in the extent to which respondents felt their doctorate had helped them develop key skills. For instance, 53 per cent and 61 per cent of arts and humanities and social science graduates respectively highlighted that their doctoral study has enabled them to solve problems to a great extent. For science based disciplines, the percentage ranged from 69 per cent to 72 per cent. However, it was arts and humanities graduates who were most likely to say that their doctorate had allowed them to communicate complex information to others to a great extent (53 per cent) and this supports our qualitative findings for these graduates too. For the remainder of this section we explore how doctoral study has supported the development of these skills and why they are valued by employers.
Research and analysis skills and the ability to work with large amounts of information were frequently highlighted by employers and doctoral graduates alike as key skills of doctoral graduates. This is in line with findings from a small study of employers for the UK GRAD programme (Jackson, 2007).

What a doctorate can provide more effectively, though not exclusively, is the ability to synthesise information and the ability to extrapolate from incomplete information in a way that is effective. I think I have been regularly surprised at how much more you can rely on people with advanced degrees to have those skills.

Arts and humanities graduate

Some employers suggested that the research doctoral graduates undertook was more rigorous, due to their understanding of research methods and theory. This was particularly mentioned by research focused employers. Some employers described the way rigour can raise standards or be a spur to asking questions. Again, this view was reflected in interviews with doctoral.

Ironically it’s one of the things that I also find frustrating, but is probably a positive thing, and that is the challenge and rigour. [Doctoral graduates] won’t necessarily accept something because it is somebody’s opinion.

Large employer, finance, business, IT and legal

Employers often highly value doctoral graduates’ strong problem-solving skills, as highlighted in other research (Rubio and Hooley, 2010; Morgavi et al, 2007; Jagger et al, 2001). Our research supports this, as problem solving and critical thinking were suggested by some employers as key attributes contributed by doctoral graduates.

Understanding the fact that you’ve got to define your problems, you’ve got to solve problems, there’ll be things that crop up along the way that you don’t expect and have got to work around, collaborating with others to solve problems. Those are all positive skills that [doctoral graduates] bring to the job.

Large employer, manufacturing and engineering

One employer interviewee, in a sector not typically associated with doctoral graduates, had brought a doctoral graduate into their team specifically because they believed they would offer a fresh and different perspective on the work and be able to come up with new solutions.

Graduate interviewees often said that the way they approach a problem or task had been informed by their doctoral training and is different perhaps from colleagues without a doctorate. They described the ways in which they had honed their skills in problem solving through conducting their PhD projects, which involved a structured way of defining problems, developing approaches, and designing and testing solutions. They also
highlighted the fact that they often had to respond to challenges that arose throughout their doctoral studies.

> I think it is something you don't really do as an undergraduate, but having to do your own research and figure out problems [...] when you come across a difficulty, you have to figure your way round it. Sometimes that comes with chatting with people at a conference, sometimes you are just plugging away with some books and some papers, but I think it was very valuable in helping me to build the skills that I use.

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Physical sciences and engineering graduate

Doctoral graduates also felt they were able to look at problems from a different angle or ask questions that others had not considered. This is a key skill for contributing to innovation and is explored in more detail in the next section.

> The doctorate has opened my eyes to wider possibilities. It has also reassured me that alternatives can be explored. If you don't explore alternatives you can't find new knowledge. There were instances I asked questions in meetings; [...] I am trying to evoke an answer that will release new seeds.

---

Social sciences graduate

Effective communication skills, in particular the ability to communicate highly complex information, are highlighted in the literature as particular PhD graduate attributes (Forbes et al, 2010, Souter, 2005). Some of the PhD graduates believed that their doctoral experience was very valuable in terms of helping them to improve their teamwork and communication skills.

In comparison, there was more of a mixed response on this point from employers. While communication skills were often mentioned by employers as a particular strength, these generally related to strengths in writing reports and presenting information and data to others. A few felt that interpersonal and softer communication skills needed for effective team working might be lacking in some graduates.

> They definitely bring communication and written skills; that is always seen as better with that type of candidate.

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Small employer in other sector

> Team building, communications skills - the softer skills can be lacking. Doctoral graduates spend a lot of time working on their own, so these skills can be a challenge.

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Large employer in finance, business, IT and legal
Employers also appreciate doctoral graduates’ tenacity, confidence and motivation. Doctoral graduates' ability to get to grips quickly with a role and ‘hit the ground running’ was mentioned by a few employers, though less frequently by the graduates themselves. Not only does disciplinary and subject specific knowledge give doctoral graduates firm foundations on which to build other knowledge, but some employers said they required less supervision or additional support and progressed within the organisation more quickly.

The skills are already advanced [...] and the ability to work with very limited supervision on whatever the task is, especially at the very beginning. It is not the same for a graduate student or junior people; they require a higher involvement in the activities from the management.

Large employer, finance, business IT and legal

Personal qualities of confidence, dedication, resilience and motivation were all recognised, and valued by employers of doctoral graduates. Some employers specifically made the connection between the demands of studying for a doctorate, such as working independently over an extended period of time and defending a thesis, and the personal qualities developed and demonstrated as a result. These employers clearly had a good understanding of what gaining a PhD involved besides detailed subject knowledge and intellectual capacity.

As highlighted in the previous chapter, doctoral graduate interviewees often discussed how their doctorate experience had allowed them to develop these types of personal characteristics, which are highly beneficial to them both in and out of the workplace. Some also suggested that having a PhD gives colleagues or an employer confidence that they can deliver which results in them being given tasks or roles they might not otherwise have been set.

Being listened to and I think joining in more capably: I think there, the experience of the degree and the status has certainly moved me into a different level of participation within the organisation.

Doctoral graduate

We found that doctoral training is perceived as making more limited impacts on doctoral graduates’ ability to set up their own business. Where interviewees were self-employed or had set up their own business, we asked them the extent to which their doctoral training had helped them with this. Most said their doctorate had not helped them at all in terms of understanding how to set up and run a business; they had gained this through other routes, such as past experience, or other training, study and support such as doing an MBA. Just one interviewee referenced the short transferable skills course he had received while studying for his PhD and this was cited as only one of a number of sources of support for this. Where the PhD had helped was in providing the specialist knowledge or expertise on which self-employment or a business was sometimes built; it was the interviewees’
knowledge or skill that was being ‘sold’. Some highlighted the confidence boost provided through their PhD study. The credibility conferred by a doctorate and contacts gained from academia were also mentioned as elements that had contributed to securing work as freelancers or developing small businesses.

**Skills that could be enhanced**

Some negative stereotypes of doctoral graduates exist among employers, but these tend not to be shared by those who have direct experience of employing doctoral graduates. Doctoral graduate interviewees participating in our study did highlight occasionally negative or stereotypical perceptions of others about what the achievement of a PhD entails and as a result what someone with a PhD would be like. Interviewees reported that others sometimes assumed they would have only narrow knowledge or interest in their specialised area, have little real-world experience, or be socially inept. Some felt this had a negative impact when applying for work where employers perceive doctoral graduates to be over-qualified, unlikely to be interested in the work available, expect higher salaries or have skills too specific for their needs. This was a particular issue where interviewees had applied for non-academic or non-graduate jobs, because this is what was available or fitted with their career plans. A few felt the expectations that someone with a PhD would be a ‘genius’ increased the pressure on them to perform or to be capable of anything asked of them.

*There is a polarised reaction; some people look at you as if you're some kind of genius and some people look at you as some kind of freak. I don't think that's fair because I think what is required to do a PhD is determination and bloody-mindedness.*

**Physical sciences and engineering graduate**

Interestingly these more negative stereotypes described by some graduate interviewees were not generally shared by the employers we interviewed, presumably because they have direct experience of the knowledge, skills and attitudes of doctoral graduates. The idea that these negative perceptions arise from employers who have not hired doctoral graduates is supported by other research (DTZ, 2010). Morgavi et al (2007) concluded that employers who had experience of hiring doctoral graduates were more appreciative of the attributes they brought and employers who did not typically recruit PhD graduates would often raise their potential drawbacks such as a lack of interpersonal skills and over specialisation.

The presence of negative stereotypes about doctoral graduates may indicate there is a need within the labour market to communicate more effectively the value and attributes of PhD graduates. Jackson (2007) argues that there is a need to ensure better dialogue between employers, careers services and researchers, with researchers needing to better explain the key skills acquired through their degree to ensure they demonstrate their potential. Rubio and Hooley (2010) also highlight that a number of employers who hire PhD graduates find that some do not demonstrate their attributes and business awareness when interviewed. Purcell et al (2006) contend that more needs to be done to ensure more employers recognise
the potential attributes of PhD graduates and their ability to contribute to innovation and competitiveness.

The literature on doctoral graduates highlights other areas of concern for employers in regard to doctoral graduates. These include lack of work experience, lack of commercial awareness, and having difficulty adapting to a new or non-academic environment (Forbes et al., 2010; Jagger et al., 2001; Rubio and Hooley, 2010). Some of our employer interviewees also raised these as issues. We asked employers of doctoral graduates if there are skills or qualities they felt were lacking in doctoral graduates. Just over one third replied with an emphatic “no” and highlighted how pleased they were with the value their doctoral graduate employees added. Any weaknesses were attributed to individual characteristics rather than the nature of doctoral training per se, or else were not seen as attributes that would be expected in a doctoral graduate in any case and would be provided by other team members.

Where employers expressed concerns these mainly related to doctoral graduates’ limitations in being able to adapt and work in a commercial environment; this was cited by one-fifth of the employers we consulted with. This included the ability to apply theory to real world scenarios or draw out the policy and practical implications from research. Some employers felt that doctoral graduates without experience outside academia could take time to adapt to the necessary pace of work. The analytical and rigorous nature of doctoral graduates sometimes leads to tensions when employers require outputs to be merely ‘good enough’.

> I think the ability to do good enough rather than to go for the perfect answer and to put the research into a policy context and to understand that we are in a client relationship with people who pay for the research, so I suppose it’s often about compromise.
> Large Employer, Finance, business, IT and legal

It is arguable that these are not skills that doctoral graduates can be trained in, but are rather a case of experience and adaptation. Many of the employers we interviewed stated that work experience was as important as a qualification, if not more so. Those mid-career graduates who carried out a doctorate to further their career are likely to be well equipped in this regard.

> They [doctoral graduate employees] tend to be people who have studied, then worked and then gone off to study some more and then come to do some work again. If I had someone that all they had ever done was been in academia then in my view, they don't have any real world experience of dealing with things like customers, project negotiations and all this sort of stuff. The ones that I have hired have tended to do the PhD later in their lives [...] in my experience they aren't really lacking stuff, no.
> Medium employer, Finance, business, IT and legal sector

As discussed above, a smaller number of employer interviewees raised inter-personal and team working skills as an area where they felt graduates were lacking.
Figure 20 shows that doctoral graduates were less likely to feel that their doctoral experience had enabled them to develop leadership skills in comparison to other transferable skills. This is perhaps unsurprising; this is not something that has traditionally been part of the skill set necessary for a PhD and it was not highlighted as a particular need by the Roberts Report. Only in a minority of cases did employers cite a lack of management and leadership qualities that were lacking among doctoral graduates.

There are skills that [doctoral graduates] certainly don't have but we don't expect them to have; we don't really expect our researchers to be managers when they arrive but that's not what we are looking for.

Large Employer, research and development

And although doctoral graduates did not feel leadership was something their doctorate had particularly helped them develop, they did evidence a number of ways in which they influence, support and act as role models to others; this is covered in more detail in chapter 8 where we explore evidence for spillover effects.

Recruitment of doctoral graduates

Outside of higher education, a doctoral qualification is recognised and seen as desirable or beneficial by many employers of the doctoral graduates we interviewed. In the survey of doctoral graduates almost 50 per cent of respondents stated that having a doctoral level qualification was a formal requirement for their job, but this high proportion was closely linked to the need to have a PhD within higher education.

Over half of the employers interviewed recruited doctoral graduates for specific roles within their organisation, with employers in the health and social work sector more frequently stating that they did. The recruitment of doctoral graduates was also more prevalent among the larger organisations we interviewed, with employers attributing this to the breadth of their operations, and the necessity to satisfy business need (specifically in a technical context), or maintain or expand their organisation’s reputation.

We are a research and technology company so the type of roles we have require intelligent people who have the ability to think, who can come up with novel solutions and cutting edge technology. [...] people with PhDs have proven that they can do this.

Large Employer, Research and Development Employer

As noted by Metcalfe (2005), the skills of doctoral graduates have become increasingly attractive to a wider employer base, with the PhD being held in high regard as both a generalist and specialist qualification. This is consistent with the broader shift in debates about what a PhD is, including the importance of developing as a researcher and not solely focused on writing a thesis.
The importance of the doctorate to the employer, as seen from the doctoral graduates’ perspective, excluding survey respondents from higher education research or teaching occupations, is illustrated in Figure 21. Only a very small proportion of doctoral graduates surveyed are in jobs where their doctorate is a formal requirement, but most saw it as important or helpful. Our survey shows that outside of higher education a doctoral qualification is most likely to be a formal requirement for those of our cohort working in health and social work (24 per cent) and research and development sectors (40 per cent).

**Figure 21: Factors that were important to the employer hiring you for the job (excluding HE research and teaching)**

![Bar chart showing factors important to employers](chart.png)

Although many roles outside of higher education do not require a doctorate, the exception to this is in highly specialised, technical or clinical roles where a doctorate is more likely to be a requirement. Just over one-third of employers interviewed reported that a PhD was a formal requirement for specific roles within their business. Here, the demand was found to be strongest within academia and in the research and development sectors, accounting for over half of employers who stated this. Employers with roles for which a doctorate is a legal requirement to practice (for example, clinical psychologist) were also represented. Many employers across all non-HE sectors went on to say that a PhD was viewed as desirable, or that a candidate having a doctorate influenced recruitment decision making (for example, scoring candidates with a doctorate more highly), but that they do not seek out doctoral applicants specifically. Some employers made the point that although they did not insist on applicants having PhDs to avoid limiting the pool of applicants, most of those recruited to these positions would indeed have a PhD. Several employers highlighted that many of their positions were targeted at the graduate and masters level but this attracted the interest of doctoral graduates too. Interestingly two of the employers interviewed specifically mentioned that they had not necessarily recruited PhD graduates, but had supported and
encouraged existing staff to pursue doctoral study. This again demonstrates that for these employers, doctoral graduates are a desirable asset, even if they do not consider a doctorate a requirement for employment.

Employers emphasised, as illustrated in Figure 21, that work experience plays a crucial role in the hiring of doctorate graduates (as it is likely to do in recruitment of staff more generally).

*Work experience* is very important, they have to be in the industry, and have the relevant experience, we would not consider someone for that role if they did not have the experience.

**Medium sized employer, Other Sectors**

Four in ten employers interviewed value an applicant’s doctorate and work experience equally when hiring staff. Just over one-fifth were of the opinion that work experience was more important than an applicant’s PhD with the same proportion suggesting that the importance of work experience in comparison to qualification level would be dependent upon the role. It is interesting to note that only a small minority of employers stated that an applicant’s PhD was more important than work experience and that this alone would demonstrate they had the qualities sought.

*Because we know people with PhDs brains are wired in a certain way we would take them straight from university without necessarily having work experience.*

**Large employer, Research and development**

As noted in the previous section, the importance of relevant work experience may be linked to the desire of employers to recruit doctoral graduates who have proven ability to work in a commercial or non-academic environment. This appears to be a skill that employers do not believe a doctorate alone can deliver.

Outside higher education, physical sciences and engineering graduates were more likely to say the subject of their doctorate was important or essential to their current employer (57 per cent); arts and humanities were most likely to say the subject of their doctorate was not important (43 per cent), which far exceeds the figures provided by graduates from other subject areas (in all other subject disciplines, this percentage was always below 25 per cent). This may be related to the types of roles arts and humanities PhD graduates tend to enter, with fewer subject-related roles existing outside of higher education.

Cyranoski et al (2011) find that overall the supply of doctoral graduates outstrips demand, with evidence of under-supply in some sectors. Jackson (2007) found that while employers found PhD researchers highly employable, there was a complaint that they could not always
access the quantity they wished to. Rubio and Hooley (2010) surveyed over 100 employers from a number of sectors. Almost a third of employers stated that they already actively target PhD graduates in their recruitment activities, and over 70 per cent would welcome more applications from doctoral graduates. The growing interest in doctoral graduates is a reflection both of the specialist field of a PhD, but increasingly the training that a PhD provides for high-level positions in careers outside academia.

Our employer consultations reveal that that just under three-quarters of employers are able to recruit sufficient graduates for their needs. Just under two-thirds of employers interviewed estimated that less than a quarter of their workforce had PhDs and in the main the low proportions of potential roles to fill meant they did not struggle to recruit doctoral graduates. Recruitment difficulties (either in the past or currently) were most commonly cited by employers in the research and development industry and smaller employers in particular where they highlighted respectively the specific technical skills required and geographical constraints (the location of their business in certain parts of the UK) as a factor in the difficulty in recruiting the right calibre of applicant.

I don't think there is enough depth, especially from where we are in Northern Ireland. I don't think there's enough migration to the island from elsewhere, so you're only looking at more local graduates, so there's a lot of demand on the good ones, so sometimes you end up with people who perhaps are not as good as you might want, but you have to fill the position.

Small employer, research and development

Another possible indicator of the degree to which employers value doctoral graduates is whether they pay them a premium compared to others in similar roles with first degree or Masters. Of those employers we interviewed who employ staff in similar roles with and without doctorates just under two-thirds said they would not normally pay doctoral graduates a premium. Where doctoral graduates would not be paid a premium this was explained as being due to having rigid salary scales with little room for negotiation (particularly in the public sector), because the job rather than the person was graded, or because pay was based on experience rather than qualification level.

In a few cases, employer interviewees said the qualification level would be just one of a number of factors considered when negotiating pay, and that any enhancements would not be automatic. Employers who do pay a premium said this was because they recognised doctoral study as the equivalent to a similar number of years’ experience or because they were keen to retain or recruit doctoral graduates and needed to offer competitive salaries. Higher salaries were sometimes offered as recognition of the time that doctoral graduates have invested in their development due to the greater value they could add to the business.
It's usually the expected potential which is higher....if someone has a PhD you expect a higher education, you expect a higher potential of the person within the organisation.

Large employer, manufacturing and engineering

Chapter conclusions

Overall, this research has found a generally positive story about the value of doctoral graduates to employers. Even where employers do not specifically target doctoral graduates for recruitment, they value both the subject knowledge, and also more commonly, the transferrable and analytical skills gained through doctoral study. Even outside of higher education, where a doctorate is not usually a formal requirement for a role, employers indicated that a PhD was attractive. However, experience is also valued alongside the doctorate. Our study focuses on seven to nine years after graduation when individuals are more likely to have gained relevant work experience and demonstrated their strengths and attributes, increasing their employability and importance to the companies they work for.

Employer concerns over the skills that doctoral graduates may lack generally relate to their ability to adapt to working in a commercial environment, and work experience outside academia (alongside the PhD) is important for many employers. Given the importance of work experience to employers outside academia, it is important for early doctoral graduates to consider if and how they can build their experience whilst completing their qualification, which would consequently increase their employability and may enable them to access their desired career paths more quickly. It would also give them an insight into whether they are suited to particular career paths and thus could facilitate a better matching of employers and graduates. Whilst there are some skills that doctoral study does not particularly help develop, we need to be cautious of expecting doctorates to develop all or too wide a set of skills that employers might find desirable. The strength of the doctorate is in its depth and rigour; expecting further breadth could dilute this.

While graduates themselves sometimes experience negative stereotypes about the narrowness of their skills or interests, these do not appear to be widely shared by employers with direct experience of employing doctoral graduates. There may be a need therefore for more effective communication of the value of employing doctoral graduates in certain roles and sectors in order to maximise both the opportunities available to doctoral graduates themselves and the benefits of their skills to employers and the UK economy.

Part of the benefit of doctoral study also potentially comes from an increased ability to innovate - another point of value for employers. Evidence on doctoral graduates’ contribution to innovation is considered in the next chapter.
08. CONTRIBUTION TO INNOVATION

In this chapter we consider how far doctoral graduates can contribute to aspects of innovation in the workplace and enhance organisations’ absorptive capacity.

Key findings

Developing new knowledge and understanding often forms the foundation for innovation. 93 per cent of doctoral graduates completing our survey said they had been involved in developing new knowledge and understanding, and of these 92 per cent said their doctorate was vital or important to their contribution.

Doctoral graduates are also frequently involved in developing new or improved products (goods and services) (71 per cent) and new and improved processes or ways of working (82 per cent).

Their specialist knowledge supports the creation of new or improved products, particularly in the research and development and manufacturing and engineering sectors.

Graduates’ creativity and problem solving abilities also enable them to develop improved ways of working to generate efficiencies or enhanced outputs for employers.

Doctoral graduates contribute to the absorptive capacity of their employers by enabling links between knowledge generation and application. They have the contacts and credibility to forge effective links with higher education.

75 per cent of doctoral graduates responding to our survey stated that they had been engaged in collaborative projects between universities and industry.
Ways of contributing to innovation

Innovation and technological progress are the vital ingredients in raising the productivity, competitiveness and growth potential of modern economies. In a difficult financial environment, new approaches can help to improve the quality and quantity of output. In this chapter, we explore the ways in which doctoral graduates contribute to innovation in the workplace. We gathered data on how doctoral graduates contribute to the different types of innovative activity and used the following definition in interviews with graduates and employers:

Innovative activity includes developing new or improved goods, services, processes or practices. It can also include acquiring, adapting and transforming knowledge, ideas and technologies. Innovation might be pursued for economic ends (for example to create growth or income), to address social challenges, or both.

Knowing the characteristics of innovative people (detailed subject knowledge, creativity, excellent communication and problem solving skills), a key question is whether the ability to innovative is something that can be developed, or an innate quality. And if it can be developed, is doctoral study effective at this. In the previous chapter, we showed that survey respondents reported their doctoral training had made an important contribution to developing problem solving skills and creativity – both key skills for innovation, and that their employers recognised and valued their problem solving skills in particular.

As set out in the introductory chapter of this report, we suggest that the ability to contribute to innovation is related to wider contextual factors. An important precondition for doctoral graduates to be able to innovate is for them to be working in roles and organisations where they have the necessary opportunities and support. We therefore explore the extent to which the evidence collected suggests that doctoral graduates have the opportunities to innovate in the first place.

We then go on to look at doctoral graduates’ involvement with and contribution to the following different types of innovation activity:

— Developing new knowledge / understanding
— Developing a new or significantly improved product (good or service)
— Developing a new or significantly improved process, way of working, policy or strategy
— Developing a new or significantly improved form of organisation or business structure
— Creating intellectual property such as patents and licences.
While we know that doctoral graduates working in academic roles make important contributions to new knowledge and understanding, we also examine the ways in which doctoral graduates add to other types of innovative activity outside of HE.

Finally, doctoral graduates have high levels of specialist knowledge, along with experience of and contacts within HE gained through their doctoral experience. This should place doctoral graduates in an excellent position to enable knowledge transfer and collaborative working between academia and industry. We explore the evidence for this in the final section on absorptive capacity.

### Opportunities to innovate

In the majority of cases, doctoral graduate interviewees perceive that they have the opportunity to innovate in their current role and in some cases they stated this was expected of them. This was in line with what employers told us.

Opportunity and expectations for innovation varied according to role and employment sector. Research and development and manufacturing and engineering sector employers often expected their doctoral graduates to innovate and had specifically recruited them for their innovative ability. In these industries, it is often vital for organisations to bring through new products to the market.

*We expect [doctoral graduates] to do so [contribute to innovation], so if they don't there is a problem.*

Large employer, research and development

Organisations outside these two sectors also value innovation and demonstrate this through devoting resources towards activity that supports innovation. For example, one doctoral graduate discussed his work for a sustainable transport charity. Innovation is supported through the provision of a specific innovation fund. Within the finance, business, IT and legal sector another doctoral graduate explained how they are constantly required to find innovative solutions for clients. Given this need for innovative activity, the company has innovation centres around the world looking to foster and apply innovation to client requirements. In these instances, graduates clearly not only had opportunities to innovate, but it was often expected and supported through formalised structures and was well resourced.

However, in the majority of cases, it was left to doctoral graduates to bring forward their ideas to senior management, who could then provide the backing and funding required to put those ideas into practice. Management were often supportive and encouraging of innovation, but it was not necessarily a core part of an employee’s role. This more reactive approach to innovation was evident across all sectors and experienced by doctoral graduates in a range of roles.
In these instances in particular it is down to the doctoral graduate to generate opportunities for innovation and to be proactive in exploiting these. As such doctoral graduates need not only to be knowledgeable, creative and have excellent problem solving skills to generate innovative ideas, but to have excellent communication skills and the confidence to question the status quo and make a case for doing things differently. As we have seen in the previous chapter these are all skills that employers recognise and value within doctoral graduates.

A small but notable number of doctoral graduates and their employers highlighted the fact they were not necessarily involved directly in innovation, but played a valuable supporting role in enabling innovation undertaken by others to flourish. For example, a doctoral graduate working for a regulatory body explained how she was working on providing guidelines to support small companies in order to enable them to get their innovations successfully licensed.

The big pharma companies generally have big teams of people [...] they will have experts and things, but the smaller companies, so the start-up companies, [...] they will not necessarily have the expertise behind them. So the guideline being out there on how to apply the technique, and then also what kind of data they need to present to get it approved for a potential licence is really useful for them. [...] If their product doesn’t get through, their company doesn’t survive, and for them it can be quite impactful.

There were very few instances where graduates felt they had limited or no opportunity to undertake innovative activity or where employers were not at all interested in innovation. Sometimes, the reason for this was due to the fact that the role was not conducive towards innovative activity. For example, a few graduates and employers in heavily regulated industries argued that this effectively meant that there was no chance to be innovative.

Not at all, we have to work to building regulations, there really isn't room for them to come in and do their own thing and rewrite the rule book.

The other key reason that some graduates believed that they had restricted opportunity to innovate was due to being in a position which was quite low within the company hierarchy.
Doctoral graduates’ involvement in innovation activity

Employers clearly value the contribution of doctoral graduates to innovation and almost all employers interviewed felt that the doctoral graduates they employ contribute to innovation, reinforcing earlier research findings (for example, Forbes et al, 2010). Practically all doctoral graduate interviewees were able to give an example of innovation of some kind and appeared keen to highlight their ability to innovate. Innovations claimed by doctoral graduates were extremely varied but there are differences in the ways that doctoral graduates contribute to innovation, often determined by discipline and employment sector.

As shown in Figure 22 doctoral graduates responding to our survey working within and outside of HE have been involved at some level in different types of innovative activity.

Figure 22: Doctoral graduate involvement in different types of innovative activity.

In the remainder of this section we explore in further detail the different ways that doctoral graduates contribute to these key innovation activities.

DEVELOPING NEW KNOWLEDGE

Doctoral graduates, both within and outside of HE, make a major contribution to developing new knowledge: this includes new and improved technologies, techniques, evidence and understanding. This may not always lead directly to innovation, but is often the first stepping stone in innovation, providing the understanding that underpins the development or improvement of a product, service or way of working.
Over 90 per cent of graduate survey respondents said they had been involved in developing new knowledge and understanding since completing their doctorate. This is perhaps unsurprising given the key objective of a PhD is to make an original contribution to knowledge. Developing research and analytical skills is central to doctoral training and necessary to generating knowledge. As one graduate interviewee put it:

*Research is inherently innovative [...] You are always searching for the next big question to work on and figuring out how to answer that question.*

Physical sciences and engineering graduate

Doctoral graduates working within HE clearly make important and substantial contributions to new knowledge and understanding, and this can have wider impacts on the environment, economy and society as the example below illustrates.

**Employer example: Providing data on the 2010 Icelandic volcanic eruption**

This UK Research Centre was involved in collecting and analysing data to inform the UK Civil Aviation Authority recommendations on the response to the 2010 volcanic eruption that caused the closure of European airspace. The institution was actively involved in putting research aircraft and instrumentation to measure the levels of volcanic ash in the atmosphere. The approach enabled the regulator to determine when the airspace could be re-opened and will contribute into developing new technologies for use in the future.

*There was a dire need to have measurements, in order to guide regulators as whether they should let planes fly again. Our group worked night and day with the specialist research aircrafts and closely with the Met office. Because of this work, we provided enough data within a very short space of time to allow the government to change the regulations, and allow the airspace to open.*

In another example, as part of their doctoral research a biological sciences graduate contributed to a career-defining result that has advanced basic science. They developed new genetic material, which provides a platform for the development of new asthma drugs.

*We broke the hypothesis that DNA and RNA are the only genetic materials. [...] You could argue that this was one of the biggest successes in synthetic biology in Europe in 4 or 5 years. It improves European scientific standing in the field.*

Biological sciences graduate
It is notoriously difficult to predict how technologies might be developed and used in the future. Doctoral graduate interviewees often highlighted the difficulties of tracking impacts from research knowledge over time. Despite this some interviewees from a variety of sectors gave exciting examples of how they had contributed to the generation on new knowledge and understanding that has huge potential for the future.

**Graduate example: improving the evidence base**

A physical sciences and engineering graduate is currently developing cutting-edge approaches to better measure and detect electronic crime. This improved evidence base has the potential to improve policy making as the resources and approaches required will differ depending on the type and scale of crime. It is an ongoing piece of work, which has already contributed to speeding up and improving the detection of phishing emails.

*What we’ve been doing is try to debunk some of the "cybercrime is costing us trillions of dollars" nonsense, because if you understand that it actually costs you a couple of billion then you can be realistic about how much resource you put into trying to fight it. But equally we can also show that a lot of the crime that matters is not the exotic attacks which are really cool to read about but far more mundane.*

**DEVELOPING NEW OR SIGNIFICANTLY IMPROVED GOODS OR SERVICES**

Doctoral graduates’ specialist knowledge, problem solving skills and creativity allows them to create or contribute to new or improved goods and services. 71 per cent of survey respondents said they had been involved in developing new or improved goods and services. A high proportion of doctoral graduate interviewees gave examples of their involvement in this type of innovation; these were diverse and fascinating. New or improved products include: sensors for use in cars, an ante-natal programme, alcoholic drink formulations, heating systems, websites and apps, teaching aids, anti-bodies, musical compositions, pet food, cancer treatments, visitor attractions and sports analysis. Doctoral graduate evidence in this regard was largely supported by our interviews with employers.

The sector and role in which doctoral graduates work affects the ways and types of innovation in which they are involved. 85 per cent of researchers outside of HE indicated that they have been involved in developing a new or improved good or service compared to just 52 per cent of researchers in higher education. Sectors outside academia are more likely to demand and provide opportunities to turn knowledge into goods and services. Many of those doctoral graduate interviewees who cited examples for these types of innovations are working as researchers or in product development roles.
We gathered a number of examples where doctoral graduates have taken methods and specialist knowledge developed as part of their PhD and used these directly to develop new products and techniques. These types of innovation were predominantly, if not entirely, claimed by doctoral graduates in STEM subjects. Their doctorate was of key importance in enabling them to generate this type of innovation and they were likely to say that someone without a doctorate would not be able to generate similar innovations. This was verified by employer interviewees (including those matched with graduate interviewees) who made clear links between specialist knowledge gained during doctoral study and employees’ contribution to innovation. For employers in research and development and manufacturing and engineering sectors in particular, it was doctoral graduates’ knowledge of new technologies or techniques, often developed or explored in depth as part of a PhD, that were valued as crucial contributions to innovation. Several employers highlighted that doctorates would be employed in specific developmental roles in the business to develop more competitive or new products, using their skills and knowledge to look at the technology and ‘push the boundaries’.

Some of our business units come to us and say we’ve got a problem with this aircraft material and we employ doctoral graduates to think through those problems, understand the theories, be able to apply that practically to problems and come up with solutions which may be totally new solutions that nobody has thought of before.

Large employer, manufacturing and engineering

**Employer example: applying doctoral research to create an award winning design**

A doctoral graduate working in the manufacturing and engineering sector applied the knowledge gained from their PhD to research and design an audio amplifier for the telecommunications market. The individual was asked to explore new design ideas with a remit for the product to be both smaller and become more efficient.

This final design was one of a number of designs used to secure a design-win with a telecommunications company leading to the business securing a multimillion pound contract to supply the amplifier. This also contributed to significant increases in the size of their research and development team.

*We have used their design in a number of high volume mobile phone designs, which was recognised as a class-leading design and won an award at a circuit conference.*
DEVELOPING NEW OR SIGNIFICANTLY IMPROVED PROCESSES OR WAYS OF WORKING

Doctoral graduates are strong in developing new processes, ways of working, policies and strategies. Survey respondents, both in and outside of HE, reported high levels of involvement in this type of innovation (80 per cent and 88 per cent respectively). Doctoral graduates involved in this kind of innovation appeared to make greater use of transferable skills and doctoral graduates’ attitude than specialist knowledge.

Requests for new or improved processes are often driven by a need to strengthen performance or to meet specific customer or sales team requests. Squeezed budgets also drive doctoral graduates, particularly those working in or with the public sector, to look at ways in which processes might be improved to generate better outcomes with less resource. In some cases doctoral graduates recognised opportunities to create new or improved processes on joining companies or teams. In other instances graduates became frustrated with existing methods or processes and took it upon themselves to suggest or develop better approaches or new tools to streamline or make work more efficient.

The ability to identify opportunities and develop solutions to problems was linked by interviewees to the creative strengths of doctoral graduates. They can look at things from a different angle, see the ‘bigger picture’ of how an idea be exploited, and to ‘think outside the box’ when considering how problems could be resolved. Employers often shared this perspective.

If he doesn’t have the answers he loves problem solving so he would go out of his way to go and research it all and come back with the information. [...] He comes up with different ideas that perhaps the rest of us don’t see in the same way, and he’ll come up with them, suggest different ways of doing things.

Medium size employer, education (non-HE)

Several employers suggested that the most important contribution of doctoral graduates to their business was as innovators. We found several examples of employers using the skills and knowledge from doctoral graduates from disciplines not traditionally associated with their business to solve problems by approaching the issue from a different perspective.

We are using mathematical modellers, analytical chemists, and mechanistic chemistry so a whole lot of scientific disciplines to answer questions that would have historically been answered by different kind of disciplines and it really is those post docs with creative flair that can bring that.

Large employer, manufacturing and engineering
DEVELOPING A NEW OR SIGNIFICANTLY IMPROVED FORM OF ORGANISATION OR BUSINESS STRUCTURE

Doctoral graduate survey respondents were less likely to have experience of developing new or improved forms of organisation or business structure compared to other innovative activities, which is also reflected in the graduate and employer interviews. This type of innovation is more common for those doctoral graduates working outside of higher education, and almost 70 per cent of survey respondents from the health and social work sector have been involved in forming a new or improved forms of organisation or business structure, compared to 62 per cent of those in manufacturing and engineering. Doctoral training is considered less important to this type of innovative activity – only 50 per cent of survey respondents working outside HE said their doctorate was either essential or important to this kind of innovation. The likelihood and opportunities for developing new business structures clearly depends on the sector, role type and seniority of the graduate.

CREATING INTELLECTUAL PROPERTY SUCH AS PATENTS AND LICENCES

Although patents are only one indicator of innovation, doctoral graduates in particular sectors are making a contribution to creating intellectual property and their doctoral knowledge is important in enabling this. Almost 50 per cent of survey respondent outside HE stated that they have been involved in the creation of intellectual property, such as patents and licences. While the creation of intellectual property is relatively low in some sectors, 66 per cent of individuals working in the manufacturing and engineering sector have had either direct or indirect involvement in the development of intellectual property. In all other sectors, the proportion was below 50 per cent. In both the manufacturing and

**Employer example: improving efficiency with the business**

Owing to a change in European Union law, a finance, business, IT and legal sector employer needed to improve the efficiency and accuracy of how subsidy claims were calculated to avoid being fined for incorrect payments.

The existing system was regarded as inefficient, requiring claim agents to manually search across several databases to calculate a payment. Doctoral graduates were tasked with designing a system that could automate and therefore speed up the data mining process. The new system was seen as successful in significantly improving the time it took these agents to process a case.

*As part of [the graduate’s] work they built a suite of scripts and processes that helped the team validate these payments, in probably about a tenth of the time that they would have done through the manual process.*
engineering and research and development sectors, around 70 per cent of those involved in creating intellectual property said that their doctorate was vital or important in allowing them to do this.

Examples were provided by interviewees of patents created in areas including ophthalmology, heating systems, radiation detection, electricity distribution and fire-retardant coatings for textiles.

**Employer example: Flavours and fragrances**

This large, global employer creates fragrances and flavours for food, beverage, consumer goods and fragrance companies. People with doctoral degrees are employed especially in the research and development side of the organisation, and it is often a requirement for more senior lab roles.

Doctoral graduates contribute to technical innovations and new knowledge – for the company this means developing new molecules that change taste or create fragrance, new modes of using these molecules, and new processes for producing them. This is essential to ensure the company remains competitive.

> Most of the patents and things have been created by PhDs. If you look at our patent activity I would say 90 per cent have been written by people having a PhD.

**The role of the doctorate in generating innovation**

Our research provides strong evidence of doctoral graduates’ contribution to innovation. What is more difficult to evidence is the extent to which this is because of their doctoral skills and experience. As set out above, the skills associated with completing a doctorate appear to be utilised in fostering innovation.

A doctorate is seen as more important to certain types of innovative activity and in certain sectors, and we see greater numbers of survey respondents working in HE citing the importance of their PhD to their innovative activity as shown in Figure 23. This may be down to the fact that a PhD is generally a prerequisite to academic careers (see chapter 6); without this necessary passport graduates simply would not have the opportunity to work in HE and carry out innovative research.
90 per cent of survey respondents said that their doctoral experience had enabled them to be innovative in the workplace to a great or some extent. This masked differences by discipline. Compared to doctoral graduates in other disciplines arts and humanities graduates were most likely to say that their doctorate had not helped them at all to be innovative in the workplace (17 per cent). This could be due in part to narrow conceptions of what it means to be innovative, as it was often associated with science and technology. On another measure of interest, 66 per cent of arts and humanities graduates said that their PhD had enabled them to think creatively; this the highest proportion across all the disciplines.

When discussing in more depth with both doctoral graduates and employers in the interviews, there was more equivocation and subtlety about the role of doctoral training in enabling the development of new or improved processes and ways of working. The prevailing opinion amongst doctoral graduates was that the doctorate gave them an advantage; it helped them to ‘step up a gear’ and acted as an ‘accelerator’ to engagement in innovative activity. They suggested others without a doctorate could innovate in this way, but it would be more difficult.

Some employers found it difficult to determine whether skills that enabled innovation could be attributable to doctoral training, or more to the culture of the employer or individual personality traits. A minority of employer interviewees felt that while their doctoral graduates certainly contributed to innovation, this was not unique to them.
They all [contribute to innovation] but that’s the nature of our team and I would have to say that I wouldn’t recognise that as being any greater or lesser than other member of the team [...] They do it but it’s no different in terms of its impact or quantity than other graduates.

Medium employer, public administration

It is difficult to ascribe a causal link between doctoral training and innovation, and it is certainly not the case that only doctoral training supports innovation. However, the perceptions gathered from our interviews and survey suggests that doctoral training has a central role in supporting doctoral graduates to be more innovative.

**Doctoral graduates’ contribution to absorptive capacity**

Another way doctoral graduates might contribute to supporting innovation is by enabling industry to acquire and adapt new knowledge, ideas and technologies. The evidence collected in this study shows that doctoral graduates enable links between knowledge generation and application. They bring the latest knowledge and ideas to their employers and provide the necessary insider understanding, contacts and credibility to forge effective connections with academia. Figure 24 below outlines that high proportions of survey respondents had been involved in enabling acquisition or adaptation of knowledge, ideas or technologies.

**Figure 24: Doctoral graduate involvement in activities that contribute to ‘absorptive’ capacity**

A large proportion of graduates responding to our survey have engaged in collaborative projects between industry and academia. Collaboration between industry and HE can broaden understanding and knowledge on particular projects, thus creating an environment for innovation to occur. Doctoral graduate interviewees provided evidence of ways in which
collaborative projects were pivotal in allowing innovative ideas to break through. Examples were also given of instances of collaborative working with charities and local community organisations with clear benefits.

**People come out from universities with the latest ideas and thinking and feed that in and that’s quite beneficial.**

Medium size employer, research and development

Collaborative working with HE is slightly less common amongst doctoral graduates responding to our survey and working in finance, business, IT and legal, and education outside of HE. In both these sectors less than 60 per cent of respondents had been involved in collaborative projects. In almost all other sectors, 74 per cent or above had engaged in collaborative projects. According to the UK Innovation Survey 2011 (Robson & Achur, 2012) just over one-fifth of innovative employers work with higher education institutions on activities related to innovation. Yet only a small percentage of firms who engage in innovative activity believed that higher education institutions are a highly important source of information for innovation. There is clearly further potential, particularly in sectors that are traditionally less likely to engage in collaboration with HE, to benefit more from this kind of engagement. Examples of successful collaboration could be used to inspire and encourage others.

Doctoral graduates have a key role to play in facilitating collaboration between academia and industry. Their doctoral training is particularly important in supporting the collaboration between HE and business. Indeed, 84 per cent of survey respondents working outside HE said that their doctorate was either essential or important in allowing them to engage in collaboration.
Doctoral graduates often draw on contacts made during their time in academia to support and engage in collaborative projects. Where academic partners are sought for projects, doctoral graduates’ experience and understanding of the academic environment is invaluable in helping to secure these. If doctoral graduates do not know the right people, they know how to go about looking for them, have the confidence to approach them, understand what will attract academic involvement (for example, the opportunity to publish research in peer reviewed journals) and have the credibility to help secure it.

*I had contacts. Knowledge of how to look for the main players by going through the literature, [...] and then having the confidence to speak to these people and make sure they came [to a conference] and understood why it was important they came to it.*

Physical sciences and engineering graduate

**Chapter conclusions**

Overall the research has found that doctoral graduates believe they have contributed to a wide variety of innovative activities in their careers since graduating, and they believe in most cases that their doctorate was important or essential to this. This is reinforced by the employer interviews. Yet, doctoral graduates can only innovate in the workplace if they are offered the opportunity to do so. Our findings indicate that, in the majority of cases, doctoral graduates that took part in the research are in a position where they can pursue innovative activities.
In Chapter 3, we provided a brief discussion of the importance of research roles to the UK economy and we have been able in this chapter to highlight some of the key mechanisms by which researchers are helping to bring through innovative activity and boosting our economy as a result. Researchers often play a crucial role in the development of new knowledge and understanding, which ultimately provides the foundation for new products, technologies and inventions to emerge. Indeed, we found that those developing knowledge and understanding outside academia were generally in research based roles. Our findings provide further evidence of the importance of research both inside and outside academia.

The Allas (2014) report notes that while collaboration between universities and businesses is perceived as strong, the UK ranks as average on collaboration between higher education institutions and small and medium enterprises (SMEs) and suggests that this may in part explain the low levels of innovation among SMEs. A recent BIS (2013) analysis paper emphasises the importance of small companies in terms of being the ‘seedbeds’ of innovation and increasing competition within markets, thereby boosting productivity. Our research provides evidence from graduates and employers that doctoral graduates can play an important role in bridging the divide between industry and universities as they have the contacts and credibility to forge effective links with higher education. Doctoral graduates also contribute to the absorptive capacity of their employers by enabling links between knowledge generation and application. It may be worth exploring how collaboration between SMEs and universities can be developed, as this is likely to prove mutually beneficial.

Additionally, Sear et al (2012) examine graduate recruitment in SMEs and note that smaller companies may be undervaluing the contribution of graduates while graduates may not fully appreciate the opportunities of working in SMEs. 22 per cent of our survey respondents work in an SME; this may suggest that there is potential for more doctoral graduates to work in these types of companies. Given the importance attributed to small and medium sized organisations as engines of innovation and growth, perhaps future research should look more extensively into doctoral graduate recruitment into SMEs and the types of barriers that exist. This may include, for example, negative perceptions of doctoral graduates or lack of awareness by doctoral graduates of job openings. Intervention to tackle these issues may be needed, if such information failures were apparent at this level.

Within this chapter, we have started to encounter evidence of the wider benefits generated by doctoral study, (for example, developing a platform for the formation of future drugs and an invention that has led to company expansion and job creation). In the final chapter of this report, we explore the wider impacts of doctoral training, including those of innovation, in more depth.
This chapter considers the impact generated by doctoral graduates for both their employers and wider society. It examines the evidence for the extent to which graduates can influence the productivity or creativity of others, thus generating ‘spillover’ effects.

**Key findings: Impact of doctoral graduates**

The employers we interviewed reported that the doctoral graduates they employ contribute to acquiring new clients, markets and income streams, which helps to enhance their profitability or sustainability.

They also gave examples of doctoral graduates contributing to increased productivity, efficiency gains and savings, which enhance competitiveness.

Employers also said that doctoral graduate enhance the profile and credibility of the organisation, with the doctorate acting as a mark of quality and authority.

Doctoral graduates are vital to the success of many businesses; three-quarters of employers, across a range of different sectors and business sizes, suggested the loss of them would have a major impact on their operations.

More than one-in-five employer interviewees see doctoral graduates as business critical and the loss of them would be catastrophic; without them these businesses would cease. These were predominantly employers whose business is science and technology based, often in the manufacturing and engineering and research and development sectors.

We found evidence of the ‘spillover’ of doctoral training benefits to others. 90 per cent of doctoral graduates working outside higher education who responded to our survey have been involved in improving the problem solving skills of others and 88 per cent have been involved in helping others to think more creatively.

Doctoral graduates also influence others through imparting their specialist knowledge and by encouraging, supporting and inspiring others to achieve more.
Defining impact

Based on their comprehensive review of the literature on impact, Raddon and Sung (2009) conclude that there is no single or group of studies that tells succinctly the full picture of doctoral impact. Overall existing studies have tended to focus on impact in economic terms, focusing in particular on pay, as well as employer and graduate views of economic impact. This has left a considerable gap with regard to understanding the socio-cultural impact of a doctorate as well as the wider impact of doctoral graduates in the workplace and community. To this end we are adopting a broad definition of impact as follows:

*Effect on, change in (or benefit to) the individual, employers of doctoral graduates as well as to the UK economy, society, culture, public policy or services, health, the environment or quality of life, in and beyond the higher education sector.*

In our logic chain (see chapter 2), we identified three broad types of impact: impact on the individual doctoral graduates, impact on employers, and wider socio-economic and environmental impacts.

A thorough consideration of the impact of doctoral study on individual doctoral graduates was set out within in Chapters 3 to 5. Aspects of the value of doctoral graduates to their employers were then considered in Chapter 6. We therefore focus in this chapter on a more in-depth examination of the impact of doctoral graduates on their employers. Within this chapter we consider both the ways in which doctoral graduates generate impact for their employers and the nature of the resulting impact. We also explore the impact of doctoral graduates to civil society.

This chapter is structured in three parts. First, we consider the extent to which impact can be attributed to doctoral graduates. Second, we explore direct impacts on employers and associated spillover effects. Third, we examine the range of societal impacts that doctoral graduates have contributed to, providing some notable examples.

Attributing impact to doctoral graduate employees

The ability of employers to attribute specific achievements and impacts to doctoral graduates varies according to the roles that graduates play within the organisation and whether a doctorate is regarded as essential to the role. We identified four different ways doctoral graduates contribute to impact which affects the ability of employers to attribute impact. The key differentiating factors are the extent to which doctoral graduate skills and knowledge are essential or beneficial, and the extent to which doctoral graduates contribute to impact as a team or as individuals. The typology is presented in Table 8.
### Table 8: Typology of impact by doctoral graduate employees

<table>
<thead>
<tr>
<th>Individual contributions</th>
<th><strong>Type 1</strong>: Making notable individual contributions where doctoral knowledge and/or skills are essential in their role</th>
<th><strong>Type 2</strong>: Making notable individual contributions where doctoral knowledge and/or skills are non-essential but beneficial in their role</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Collegial contributions</strong></td>
<td><strong>Type 3</strong>: Working in teams where doctoral knowledge and/or skills are essential across all members of the team</td>
<td><strong>Type 4</strong>: Working in teams where doctoral knowledge and/or skills are essential or beneficial to some members of the team</td>
</tr>
</tbody>
</table>

**Type 1** doctoral graduate employees are specifically recruited by employers for their specialist knowledge or skills, and while a doctorate is not necessarily a formal job requirement, it was a key factor in their appointment. As employees, these doctoral graduates provide unique or niche contributions that are crucial to the business or project. They use their deep specialist knowledge that employers would find difficult to source otherwise. This scenario was observed in particular, but not wholly, in SMEs in research and development and manufacturing and engineering sectors. The way in which doctoral graduates generate impact in this scenario is distinct from other graduates. Employers as a result found it easier to give specific examples of the achievements and impacts of doctoral graduates and indicated that the loss of doctoral graduates would have a more significant impact on their businesses. However, while the ‘lone genius’ model of creating breakthrough impact is often associated with physical and technological sciences, other disciplines, such as the social sciences, often generate impact in more incremental ways (Bastow et al, 2014).

> *We are in a, as I mentioned before, in a niche industry. We’re a small organisation, and for us to thrive and survive in this business, it’s important for us to be a leader technically as a business. Certainly that’s a capability that those individuals bring to us as a business and it would be very difficult for us to maintain that technical leadership without people operating at that level.*  
> Small employer, manufacturing and engineering

In contrast, **Type 2** doctoral graduate employees were not specifically recruited for their doctorate knowledge/skills, and typically a doctorate would not be seen as particularly necessary in these roles. That said, in such roles doctoral graduates are notable for their particularly good transferable skills and/or ability to work at a higher level than colleagues, which differentiates them from peer employees without a doctorate. Employers can therefore pinpoint specific contributions that they make. Doctoral graduates in these
scenarios might work more productively, have highly developed analytical skills and/or be able to view problems from different perspectives. As such, Type 2 doctoral graduate employees add value to employers without their doctoral knowledge and skills necessarily being essential. The ability of doctoral graduates to generate impact in this way depends to some extent on there being opportunities and encouragement for them to use their doctoral knowledge and skills.

My other staff don’t have a doctorate and they are all excellent and really very experienced staff and do some wonderful stuff with the children. We all ask [doctoral graduate] questions, because he has that extra knowledge, that depth that perhaps we don’t always have.

Medium size education (non-HE) employer

We also identified examples of Type 3 doctoral graduate employees, whereby doctoral graduates are recruited to a team in which doctoral knowledge and skills are crucial for most, if not all, members of the team. These teams often provide central or essential functions for the organisation such as product development. Doctoral graduates therefore perform a key function, and although an employer may not be able to attribute the impact to individual doctoral graduates they can describe the importance of doctoral knowledge and skills more generally. Without doctoral graduates these organisations would not be competitive and/or would be able to function, as they are built on expertise and knowledge of doctoral graduates.

It's very difficult [to attribute specific examples of impact] because we have doctoral graduates across the whole of our organisation, so practically every new product that you see on the shelf will have a significant population of PhDs working on it. It's difficult to pick out that this was done because this person has a PhD because we have projects that have many, many people involved in them, of which lots of PhDs will be involved.

Large manufacturing and engineering employer

Type 4 doctoral graduate employees frequently work in teams alongside others employees without doctorates. This might be because doctoral level knowledge and skills are not necessary or beneficial for all roles or because the necessary skills/experience for roles could be gained another way. From the employer perspective, the contribution of doctoral graduates is of equal value to the contribution of other team members, and as a consequence employers found it more difficult or were more reluctant to attribute achievements and impacts to doctoral graduates specifically. Typically, such employers suggested that team members bring a range of different but complementary skills and qualities, and that doctoral graduates are just one part of the mix.
Our science trained doctoral graduates are brilliant at bringing their particular skills and expertise to this, but they are not doing it in isolation, they are working with others who have other skills. [...] There’s a whole host of things we are proud of here, but I’m not going to try and allocate achievements to people just because they’ve got doctorates. That’s not the way we work or think about the team.

Large health and social care employer

Perhaps unsurprisingly the doctoral graduates interviewed were more able than their employers to identify and provide examples of impact in the workplace. Almost all doctoral graduates interviewed were able to provide an example of an impact they had contributed to achieving, whether this was either as an individual or as a part of a team. And while the vast majority of doctoral graduates reported that while they cannot attribute their achievements in employment solely to their doctorate, making such an impact would have been harder, riskier or the results of a lower standard were it not for their PhD. Only a small number of doctoral graduates perceived their doctorate to be either essential to their achievement, or to have made no difference to their achievement. Doctoral graduates and their employers alike reported that it would be unlikely that someone with undergraduate level skills could perform the same tasks. One doctoral graduate attempted to describe the extent to which they could have achieved the same degree of impact without their doctoral qualification, concluding:

It would have been possible, but I don't think it would have been as good. I was working with other consultants who didn’t understand the area as well as I did because I had done a doctorate in this area.

Social Sciences graduate

Impacts for employers

This section addresses the key issue of the impact of doctoral graduates in employment and how they contribute to the success of these businesses. We explore specifically how and why impact has been generated by doctoral graduates and in turn the impact created by the businesses and organisations that employ them.

It is clear, as was outlined in the preceding chapter, that impact for employers can be generated through doctoral graduates’ contribution to innovation, and/or as a result of the essential or value-added contribution that they make to the organisation that employs them. Furthermore, impacts experienced by employers are often complex and inter-related, with certain impacts inextricably linked to others, for example increased efficiency may lead to enhanced profitability and new customers are likely to generate additional sales.
For the purpose of this section we have categorised and presented the impacts in the terms in which graduates and employers discussed them. The table below shows the three main types of impact that doctoral graduates help to realise alongside examples of activities for which we found evidence that doctoral graduates had instigated, led or contributed to.

**Table 9: Types of impact achieved by doctoral graduates in employment**

<table>
<thead>
<tr>
<th>Impact achieved</th>
<th>Examples of activities undertaken by doctoral graduates</th>
</tr>
</thead>
<tbody>
<tr>
<td>New clients, markets and income streams</td>
<td>Generating income, or directly enhancing the profitability of the organisation that employs them.</td>
</tr>
<tr>
<td></td>
<td>— Sales of goods and services developed by doctoral graduates</td>
</tr>
<tr>
<td></td>
<td>— Increased sales due to improved quality</td>
</tr>
<tr>
<td></td>
<td>— New income streams secured due to the expertise of doctoral graduates</td>
</tr>
<tr>
<td></td>
<td>— Winning new clients or business</td>
</tr>
<tr>
<td>Increased productivity, efficiency gains, and savings</td>
<td>Enhancing the competitiveness of the organisation that employs them.</td>
</tr>
<tr>
<td></td>
<td>— Enhanced efficiency or productivity as a result of new or improved processes or skills and knowledge of doctoral graduates.</td>
</tr>
<tr>
<td></td>
<td>— Reduction in operating costs or overheads</td>
</tr>
<tr>
<td></td>
<td>— More differentiated products, improved quality of product or service.</td>
</tr>
<tr>
<td>Enhanced profile or reputation</td>
<td>Enhancing the profile and credibility of the organisation that employs them.</td>
</tr>
<tr>
<td></td>
<td>— Gaining recognition for work through awards or high-profile projects</td>
</tr>
<tr>
<td></td>
<td>— Contributing to the credibility of the organisation or its products; the involvement of doctoral graduates is an indicator that outputs will be high quality, innovative and / or research based.</td>
</tr>
<tr>
<td></td>
<td>— Engaging with customers or partners that also have doctorates</td>
</tr>
</tbody>
</table>

In the remainder of this section we consider the contributions made by doctoral graduates to generating these impacts for employers in more detail. We also explore the nature of doctoral graduates’ involvement in each of these activities and how this has resulted in the creation of impact.

**NEW CLIENTS, MARKETS AND NEW OR ENHANCED INCOME STREAMS**

In previous Chapters of this report (see chapters 6 and 7) we demonstrated that the specialist and strong transferable skills of doctoral graduates are valued by employers and enable doctoral graduates to contribute to innovation. We have also seen in the preceding chapter that doctoral graduates frequently cited the development of new or improved goods and services as a key achievement. In some cases, doctoral graduates and their employers then went on to describe the impacts of this for their organisation in terms of generating new or increased sales and reaching new markets or customers. We provide below an
example where the contribution of a doctoral graduate led to impact in the form of increased revenue.

**Employer example: Health and safety in the Olympic Park**

This large government agency developed a software tool to help measure safety culture in organisations. The tool was compulsory on the Olympic Park as part of the legacy programme to ensure that construction companies were operating to the highest possible health and safety standards.

> It's generating substantial revenue for us and it's clearly having a big impact on those organisations that buy it because those of them that report back to us, 90 per cent of the time report a significant improvement in their safety performance.

A doctoral graduate, along with other colleagues, helped develop the tool into a commercial product that is now sold around the world. They were described by the employer as the “intellectual engine” behind the innovation. This example shows the way an immediate benefit for an employer (in this case a revenue stream) can have knock-on benefits for other organisations and wider society (improved health and safety).

In a few instances, we identified whole businesses that were being built on technologies and ideas developed by doctoral graduates. These particular companies attributed the existence of their business to their doctoral graduates, as the organisation had been established based on PhD technologies.

The contribution of doctoral graduates to improving products was also seen to impact on employers’ ability to win new customers, but also keep existing ones happy and returning to them. Contributing to constant innovation or improvement is a key way here that doctoral graduates help keep their organisations competitive.
Examples of doctoral graduates helping to generate income or secure grant funding were given by public and voluntary sector employers and employees. The status of doctoral graduates and their specialist knowledge are certainly a contributory factor that employers (and graduates) say help them to secure work. For example, one employer described how a doctoral graduate’s specialist knowledge had helped them to win new business.

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**Employer example: Reducing investment risk for clients**

A doctoral graduate working for this large finance sector employer has come up with a way of optimising the way that a client hedges their portfolio of investments, such that they reduce the risk that they run. The standard way of doing this is not necessarily the most efficient way. Benefit for the client also means benefit for the employer.

*Hopefully that client will value [Employer name] more and try to reward [Employer name] for that value that we’ve bought to them by trading more with us. So there’s an element of relationship building with the client.*

The employer valued the enhanced creativity of doctoral graduates and their ability to research and develop new ideas.

*There are individuals with doctorates that have developed new research ideas that are truly innovative. [...] [It’s] definitely the case that there’s a real value there. I think some of that will come again from the rigour of the thought process in terms of understanding and being able to look at a problem and think very widely around it, and think laterally around it.*

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Examples of doctoral graduates helping to generate income or secure grant funding were given by public and voluntary sector employers and employees. The status of doctoral graduates and their specialist knowledge are certainly a contributory factor that employers (and graduates) say help them to secure work. For example, one employer described how a doctoral graduate’s specialist knowledge had helped them to win new business.

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*One of our doctorates was key, through their knowledge of the subject matter, to us winning new business. It was a major win, it was an in-road for a new client as well, which was even better because it opened the door [...] and clearly when other projects followed, they were keen to have this individual work on their projects.*

— Small employer, research and development

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**INCREASED PRODUCTIVITY, EFFICIENCY GAINS AND SAVINGS**

Employers most frequently described the impacts of their doctoral graduates in terms of enhanced productivity, efficiency gains and savings. Improved efficiency or productivity was attributed by some employers to the quality of graduates’ work and their ability to work effectively with little or no supervision. For example, one employer highlighted a graduate’s
excellent attention to detail that meant work progressed smoothly and without difficulty, and another that they could delegate important work with confidence and knowing that the graduate would ‘take ownership’ of and progress the work without the need for oversight.

A few of the employers that we consulted also suggested that doctoral graduates themselves are highly productive. The example below conveys a typical view held by such employers, suggesting that the time a doctoral graduate on spends contributing to a team is more productive than that spent by other members.

> Basically his creativity and his speed at solving problems for example, makes his one day a week worth several days of anyone else’s time. So that’s a real star performance from a guy with a PhD background.

— Medium size employer, manufacturing and engineering

As we have seen in the previous chapter, doctoral graduates are also heavily engaged in developing new and improved ways of working. Doctoral graduates and their employers suggested in a number of cases that they had helped to make progress with long-standing problems or had clearly accelerated progress on projects. Additionally, they provided fresh thinking and new perspectives that in turn helped to create new opportunities for enhanced productivity. Doctoral graduates also reported improvements in efficiency generated by their confidence in handling and analysing large amounts of data, enabling them to generate insights into how activities could be run more efficiently. This was corroborated by their employers.

Beyond simply generating ideas for improvements, key skills are necessary to transform these into practice. Confidence is required to make the suggestion in the first place and effective communication skills are needed to make a case. The credibility of the person making the suggestion can help persuade others of its value. Tenacity may be needed to pursue ideas and address obstacles to progress. The evidence from graduate interviews indicates that their doctoral training was instrumental in providing them with these skills and enabling inspiration to lead to impact. The examples below illustrate efficiency gains that doctoral graduates have contributed to, and the skills, confidence and credibility provided by their doctorate that helped them to achieve these impacts.
Graduate example: keeping knowledge fresh

A biological sciences graduate introduced a series of new practices and disciplines to their employer to improve the way lab notes were kept, communicated and archived. Before, information was difficult to keep track of and learning was lost as a result.

> We have improved our ability to communicate and to pass knowledge amongst ourselves and keep our knowledge still fresh even five years after you have done something. So the company operates more efficiently and ideas are better and rather than having to dig through old notebooks we can find the records of the old experiment and you can find the answer to the new question from previous experiments.

The doctoral graduate felt that their PhD experience had certainly helped them achieve this result. The ideas for the practices introduced were familiar from experience in academia. They suggested it might have been harder to introduce the systems without this relevant past experience.

> I was able to show clearly that this does work and it was easy to persuade people.

Graduate example: transforming local authority care

A self-employed social sciences graduate worked on a major transformational project to transfer eight local authority residential care homes to the public sector. The institutional care model was replaced with extra-care housing to enable around a third of residents affected to live independently again. As well as improvements in quality of life for residents, the project secured savings for the authority of £1.5 million.

The graduate was helped by the experiences and knowledge of stakeholder relationships and organisational culture learnt during their doctorate.

> Without the doctorate and the knowledge and the confidence that it brings, it would have been more difficult for me to have done that. Without the doctorate, I may not even have got appointed as a consultant or set my own business up.
ENHANCED PROFILE OR REPUTATION

Perhaps less tangible than generating new income or making savings, some employers described impact in terms of enhanced profile or reputation. Although less frequently mentioned, for those employers that highlighted this type of impact, it was often of great importance to them. Impacts of this nature were frequently attributed by both doctoral graduates and employers to the status that doctoral graduates confer on a business. In the same way that a doctorate can contribute to the status and credibility of an individual, so it can with an organisation. Having doctoral graduates as employees is seen to provide a level of validation for research and education related outputs; having doctoral graduates contribute to a project or product is said to act as an indicator of quality or innovation. Outputs such as research or new products that doctoral graduates had led or developed have won awards, thus contributing to an organisation’s profile.

From a company point of view we have won awards for research we couldn't have done without our doctoral graduates.

Small employer, research and development

Cutting edge projects or projects with a wider social impact can help to enhance employers’ reputation due to the prestige. Other impact examples provided helped to protect an employer’s reputation - for example, one graduate interviewee led a multi-million pound investigation to design and build regulatory practices, thus managing the company’s reputational risk and saving potential fines.

Where a key part of the employers’ core business is intellectual capital it would be difficult to ‘sell’ this or to operate with authority without doctoral graduates. Employers from higher education and other sectors, which included cultural institutions, highlighted in particular the importance of credibility among peer institutions and the general public, as illustrated here:

We would be unable to meet public remit to be a point of authority in relation to the materials we collect and exhibit. If we didn't have [doctoral graduates] we would not be able to do it.

Large employer, other sectors

GRAPPLING WITH DEADWEIGHT: WHAT WOULD HAPPEN IN THE ABSENCE OF DOCTORAL GRADUATES?

Given the challenges associated with attributing impact directly to doctoral graduates, we found that a more effective way of exploring the impact of doctoral graduates in employment was to ask their employers what the impact would be to their business if they were no longer able to employ doctoral graduates. This approach revealed that for three-
quarters of employers interviewed, the loss of doctoral graduates would have business critical or significant impact on their business operations.  

For one-in-five of the employer interviewees who provided a response, doctoral graduates are business critical and the loss of them would therefore be catastrophic; without doctoral graduates the business would not be able to function. These were predominantly employers whose business was based on science and technology, often in the manufacturing and engineering and research and development sectors. Their businesses were built on the specialist knowledge and innovation of doctoral graduates and without this basic building block they could not function. This is illustrated by the views of these large employers:

> We wouldn’t have got started without [doctorate graduate] had he not been writing papers about the potential of the technology then people wouldn’t have seen the commercial potential for it and taken it forward. If he did leave tomorrow it would be very difficult. He has a level of knowledge that goes beyond what engineers with Master’s degrees and ten years’ worth of experience would have. He just knows more about this through having done his PhD.
> Large employer, manufacturing and engineering

> I don’t think we’d function. [...] We’re a science and technology organisation. If we don’t have high calibre scientists, technologists, working for us, we couldn’t function as an organisation. It’s pretty fundamental, really.
> Large employer, public administration

Over half of employers interviewed suggested that the loss of doctoral graduates would have a significant impact on their business. Employers said they would find it difficult to deliver their services; communicate effectively with their customers; and there would be a negative impact on their levels of innovation. Losing doctoral graduates would mean losing an important source of creativity which contributes to innovation. The rigour of doctoral graduates’ work would also impact negatively on quality of output. This, it was said, would then affect organisations ability to maintain their market position and make them less competitive.

> I think the quality of what we do would go down. The innovation that we are able to achieve would also suffer and I don’t think our ability or our performance internationally as the leading health and safety organisation in the world would be maintained without having access to those sorts of skills and that thought leadership.
> Large employer, health and social care

Responses from employers to this question were categorised according to scale of impact as either business critical, significant, minor or no impact.
Employers said that the loss of doctoral graduates would also impact on the overall efficiency of their organisation. They might be able to deliver the same outputs, but not at the same rate. Employers implied here that to mitigate this loss of doctoral graduates, they would either have to up-skill their existing staff or would shift their attention to buying in outside professional expertise, albeit at a higher cost to the business.

*It would cost us more in order to develop the individuals to develop the skills and the understanding to the level that they would have obtained within a PhD and it would take us longer and it would cost us more.*

Large employer, manufacturing and engineering

A key impact of not employing doctoral graduates highlighted was the loss of credibility and profile for the organisation. The employment of doctoral graduates clearly acts as a badge of quality and without it relationships with customers, both internal and external to the employer, would suffer as a result. In some cases, employer interviewees highlighted the fact that many of their key customers and partner contacts also had doctorates; they feared that by not employing doctoral graduates it would be harder to engage effectively and on an equal footing in these relationships.

*We would have problems, because most of our customers have doctorates as well, so we may have trouble communicating on a similar level to them.*

Small employer, other sectors

Just over one in five employers indicated that a loss of doctoral graduates would have a minor impact on their business; just three employers suggested it would have no impact at all on their business. Businesses recognised that not employing doctoral graduates would create a shortfall of technical and creative skills and they would have to respond to that loss. In this situation employers felt that up-skilling less qualified personnel could be a solution. However, employers also acknowledged that there could be a shortfall in creativity which would be harder to replace or encourage in others. This viewpoint is illustrated by the following quote from a large employer:

*I think that they are very good at bringing in new ideas, looking at things in different ways and questioning and challenging...I think if we didn't recruit that we might lose it a bit, you would have to constantly try and encourage the team to think that way.*

Large employer, manufacturing and engineering

**Generating spillover effects**

A key assumption is that doctoral graduates are able to enhance the productivity of those without a doctorate with whom they work (Casey, 2009). Using the evidence from this study
we seek to illustrate how doctoral graduates generate such spillover effects, particularly by improving the productivity and creativity of others. There is evidence that doctoral graduates are effective at influencing others through imparting their specialist knowledge and by encouraging, supporting and inspiring others to achieve more.

Figure 26 presents the results from the question in the survey which sought to identify spillover effects. It shows that a very high proportion of survey respondents are involved in improving others’ problem solving skills and ability to think creatively. We might suppose that as improving others’ skills is a key function of education, that this is largely due to those doctoral graduates working in HE, but the findings reveal that doctoral graduates working outside HE are also involved in creating impact in this way.

Again our analysis reveals that there are differences between disciplines outside of higher education. Here we find that Arts and Humanities doctoral graduates are more likely to be involved in helping others to think creatively (86 per cent), but less likely to be involved in helping improve problem solving skills (78 per cent of Arts and Humanities graduates compared to approximately 90 per cent in other disciplines). This supports the finding reported earlier in this report that Arts and Humanities graduates believe that their experience of doctoral study has had a more significant impact on their creativity than on their problem solving skills.

The survey findings are further supported by evidence gathered from the interviews. Employer interviewees highlighted a number of ways in which graduates influenced others. Approximately half of the employers we consulted clearly stated that they felt their doctoral graduates influenced others that they worked alongside in some regard. Many of the others found this a very difficult thing to comment on and were unable to provide examples. These employers often spoke very positively about the productivity or creativity of doctoral
graduates rather than commenting on how they influence others’ abilities in these areas. Just six employer interviewees stated clearly that they did not think doctoral graduates influenced the productivity or creativity of those they worked alongside. This was said to be because they tended to work alone or contributed in a different way. A small minority commented that the level of influence on others depended on the individual concerned, and they had not observed a notable difference between doctoral graduates’ ability to influence others and other employees without doctorates. Most graduate interviewees, the vast majority of whom worked in non-academic roles, also perceive themselves to have had a positive influence on others, either in terms of productivity or creativity, or in other ways as illustrated below.

The means by which employers described doctoral graduates influencing others that they worked alongside were as follows:

- **Inspiring and motivating others through sharing their specialist or higher level skills and knowledge;**
- **The rigour of doctoral graduates and their insistence on this raised the quality of others work as a result;**
- **Formally influencing others by acting as mentors or coaches;**
- **Through peer support – where a number of doctoral graduates working together can support and influence each other. One employer described a team of doctoral graduates as being “more than the sum of its parts”**;
- **Through generating ideas and encouraging others to be creative; and**
- **As educators and role models for students at all levels.**

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*The two people who report to [the doctoral graduate] directly, we put them reporting directly because we felt that they could learn things off him. Both of them are very technical and very specific in their knowledge and understanding, but neither have PhDs. [The doctoral graduate is] there to pass on knowledge and experience that he’s built up over the last ten years of playing with the technology.*

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*Small employer, manufacturing and engineering*

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*I think what we’ve found from some post docs is that they are very useful in communicating or disseminating the information that they either have at their disposal from their PhD for instance, or which they’ve picked up from other courses. So I think that’s part of a PhD really, is the ability to be able to pass on knowledge, or to communicate that with other people.*

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*Large employer, public administration*
One employer in the higher education sector specifically described the way that doctoral graduates inspired greater ambition as “they push people to ask bigger questions”. A couple of employers said that doctoral graduates had invoked a degree of competitiveness amongst staff, which had positively influenced the performance of others, as shown here:

> I think they bring competition and in doing so people are always keen to compete. For me, it is fresh skills, knowledge and ideas which keeps people on their toes.

Medium size employer, finance, business, IT and legal

The evidence provided by doctoral graduate interviewees supports that given by employers and offers useful enlargement on the key mechanisms and contexts in which they influence others. Doctoral graduate interviewees highlighted in particular the ways they contributed to developing other peoples’ skills, and in particular, research skills. Doctoral research requires a high level of rigour and some interviewees reported that they raise the quality expectations of colleagues as a result; although a few also recognised that striving for excellence might not always endear them to colleagues. We have seen how doctoral graduates take a structured and creative approach to problem solving. Employer and doctoral graduate interviewees described how they passed on these approaches to others or helped to widen perspectives.

> [Doctoral experience] gave me confidence in trying to understand things from first principles. So I have always when working with people challenged them to do that, not just accept what the manufacturer has told them and to challenge their understanding. I think that is a really strong trait of PhD research.

Biomedical sciences graduate

Doctoral graduate interviewees felt they influenced their peers by contributing ideas, through brainstorming or ‘picking brains’ to generate better ideas and outcomes by working together. Sharing their specialist knowledge (for example, as part of a multidisciplinary team) was also a key way in which interviewees felt they had influenced others. In these instances doctoral graduates highlighted the fact that such peer support was often a two-way process; they were influenced as much by their colleagues as they influenced them. Their specialist knowledge might be vital to a project, but others with different skills and knowledge (sometimes without PhDs) were also equally essential to achieving successful outcomes.

In addition, doctoral graduates themselves frequently described how they motivate and inspire others. The tenacious attitude and attention to detail, said to be generated through doctoral study, was something that interviewees conclude that they could pass on to others that they work with. Where doctoral graduates work as manager or supervisors, they report encouraging others not to give up and or to produce the very best they can.
Having been through the PhD experience, you have to have such motivation that you motivate other people and improve their productivity because you know you can’t just give up on something. You keep going.

Physical sciences and engineering graduate

Doctoral graduates are often motivated to study at this level through a passion for a particular subject. Again this was something they felt ‘rubbed off’ on others. Some interviewees said they perceived themselves to have generated interest in others as a result of their own enthusiasms. Some doctoral graduates interviewed encourage others’ learning and personal development by showing enthusiasm themselves for ongoing learning (as exemplified by their doctorate). They act as role models and inspiration to others considering a PhD and are able to demonstrate the benefits of further learning.

I think generally I have been able to influence productivity and creativity. It’s just a mental attitude. Some people just don’t believe in themselves. By having done what I’ve done late in life it has encouraged the people I work with that they can do things.

Physical sciences and engineering graduate

I think because of my experience of doing a PhD I am keener to support all of the staff to explore and develop their own skills, because I gained so much from it.

Graduate of other discipline

A very small minority of the doctoral graduate interviewees did not perceive themselves to have influenced others, or suggested that their influence was often limited due to their role. These graduates worked largely alone, or were too junior or lacked opportunities to influence others (as one interviewee described it ‘I am a cog in a wheel’). As with creating innovation, getting doctoral graduates into the right roles, where they are supported, encouraged and enabled to influence and develop others appears to be key in maximising their impact. This is also likely to improve job satisfaction; interviewees who are able to contribute to the development of others gain satisfaction from this.

Some doctoral graduate interviewees specifically linked their ability to influence others to their doctoral training. Other respondents did not necessarily make this connection explicitly (and we did not ask them to). But many of the ways in which graduates said they influence others clearly relates, at least in part, to the skills and attributes that we have shown are associated with doctoral graduates. 70 per cent of survey respondents working outside HE rated their doctorate as essential or important in helping them improve problem solving and creativity in others as shown in Figure 27.
Wider societal impacts

In Chapters 3 to 5 we illustrated how doctoral training enables graduates to pursue a varied range of career pathways with high levels of intellectual stimulation, and how this provides benefits and positive impacts for them as individuals. We know that wider benefits of doctoral study therefore include enhanced social capital, confidence and self-belief and that such benefits will have a direct effect on how these individuals operate within both their employed roles and in their communities. Here we explore how doctoral graduates contribute to delivering benefits not just in economic terms, but also with regard to improved wellbeing and consider the potential for them to generate wider societal impacts.

Doctoral graduate interviewees were asked about the impact of their studies beyond their roles in employment. Their responses generally focused on benefits to them personally and these are reported in chapter 5. However, a few went further to set out how they had used their skills outside the workplace in voluntary or civic roles. Examples were given of where the deeper and more structured way of thinking developed during doctoral study had benefitted graduates in these roles. Some of these doctoral graduates also perceived their doctorate to have played a part in the value that others attribute to the contribution that they are able to make in these roles, notably because it lends credibility or status to causes.

_I am reasonably involved in discussion with the school’s policy and I am largely seen as a bit of a contrarian in that people think that ideas are great, and I often ask where the evidence is. I am a stickler for arguments being backed up by actual evidence._

*Biological sciences graduate*
Some doctoral graduates also spoke of inspiring or acting as a role model to other family members by demonstrating the benefits of continued education. It was their perception that having achieved a doctoral qualification themselves, it made this a more realisable ambition for those around them to aspire to.

Where employers were able to provide a specific example of the impact of the doctoral graduates that they employed, this tended to focus on the immediate impact on their business as set out in the preceding chapters. However, as many of the examples we have already provided reveal, generating impact for employers can also create wider societal impacts. Identifying and evidencing wider specific societal impacts generated by doctoral graduates is extremely difficult to achieve. As we saw in the previous chapter on innovation, impacts are not always immediately known. Furthermore ascribing wider or longer term impact to the specific skills, knowledge and actions of individuals or to the knowledge they create, or the projects they contribute to, is particularly challenging. Again doctoral graduates were more likely to offer suggestions of the wider impact of their achievements than their employers.

The type and scale of societal impacts claimed by doctoral graduates and their employers were wide ranging. These included making a difference to the health and wellbeing of an individual person, to major changes in policy, practice or technology that have affected the lives of many people.
We conclude this chapter by providing more detailed case study examples drawn from employer interviews (some of which also include matched doctoral graduate perspectives). These examples bring together key points from previous chapters in this report to demonstrate the value of doctoral graduates to employers and how their skills and qualities contribute to generating wider benefit for the employers and wider socio-economic and environmental impacts.

<table>
<thead>
<tr>
<th>Type of impact</th>
<th>Examples of activities undertaken by doctoral graduates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving health and wellbeing</td>
<td>— Developing a foetal heart rate monitor that allows users to separate the mother's heartbeat from the child's heartbeat to aid labour and delivery. &lt;br&gt;— Contributing knowledge that has the potential to lead to improved therapies and outcomes for cancer patients. &lt;br&gt;— Research that informed standard pilot training and is said to have reduced the fatal accident rate. &lt;br&gt;— Developing a water valve to cut leakage of treated water in developing countries.</td>
</tr>
<tr>
<td>Cultural enrichment</td>
<td>— Leading a voluntary project to set up a community library, thus ensuring continued access to this resource for local people. &lt;br&gt;— Setting up a new two-week literature festival attracting an audience of over 2,000. &lt;br&gt;— Running a series of talks for local schools and community about an historical site, inspiring interest amongst school pupils.</td>
</tr>
<tr>
<td>Environmental sustainability</td>
<td>— Producing an academic paper on observing the impact of climate change. This was picked up by governmental groups and was influential in making the case for continued observations of oceans in the face of pressure to cut this back. &lt;br&gt;— Developing radar technology enabling wind farms to be built in new places.</td>
</tr>
<tr>
<td>Improved policy making</td>
<td>— Advising UK regulators on health and safety in the nuclear industry. &lt;br&gt;— Providing expert advice to policy teams negotiating new EU regulations.</td>
</tr>
<tr>
<td>Improved social welfare</td>
<td>— Developing an industrial blueprint for security. This was taken up by companies around the world, including in a university in Iraq where it has helped to improve access, particularly for women.</td>
</tr>
</tbody>
</table>

Table 10: Examples of activities undertaken by doctoral graduates
Case study: improving health and wellbeing

Collaborative work undertaken by the Human Fertilization and Embryology Authority has helped to reduce multiple births resulting from fertility treatment and the associated risks to the children.

About a tenth of the organisation’s 60 employees have science doctorates and work as inspectors with responsibility for inspecting laboratories that conduct IVF.

While not a requirement for the role, doctoral graduates bring robust ability in analysis and critical thinking. They have a strong attention to detail and can understand complex scientific literature. They also have a high level of credibility as inspectors. As the organisation has moved towards greater use of statistical analysis, doctoral graduates have increasingly provided an important skill set to the team, complemented the strengths of others without doctorates and helped to influence the skills of other staff with, for example, a clinical rather than research background.

Those skills, they do rub off on other people, I have to say. That confidence with number, data, analysis, that confidence I think that brings a real genuine benefit to the team without which we probably would struggle.

The ability of doctoral graduates to communicate analysis more widely was also highlighted as an area where they add value.

When [a doctoral graduate] goes out on inspection, he will take some quite complicated stats and he’s able to explain those to the sector and explain how they can use these analyses to improve their success rates and improve the quality of service they provide.

Twin pregnancies can carry a higher risk of premature birth, low birth weight, cerebral palsy and other lifelong problems. The Authority are trying to encourage clinics, where possible, to reduce their multiple birth rate by making good choices and not putting two embryos back if it’s not needed. Through their analysis, they can tell clinics when their multiple birth rates are higher than the norm.

As a team, they have developed a new system which involves analysing success rate data in real time. This can be fed back out to clinics and then used that as a risk management tool. Almost a quarter of all IVF births previously resulted in a multiple birth; the work of this organisation has reduced this to about 15 per cent. While this major achievement was a team effort, doctoral graduates made an important contribution.

That’s quite a few babies not born prematurely, not born with life-long problems. [...] I think the skills that those doctoral scientists bring have been, yes, have contributed. It’s not all of course but [...] if you didn’t have those individuals in the team who are confident with data and analysis, it would be harder to achieve those things.
Case study: Enhancing the status of a cultural institution

The Science Museum was founded in 1857 as part of the South Kensington Museum, and gained independence in 1909. Today the Museum is world renowned for its historic collections, awe-inspiring galleries and inspirational exhibitions.

The employer representative who took part in our study particularly highlighted the positive influence of doctoral graduates on those they work alongside. The Science Museum is keen to have post-doctoral researchers working with them on shorter term projects. The nature of museum curatorship means staff tend to be in the job long-term. Having people with and researching for doctorates working with the Museum is said to help keep the other staff fresh and expose them to new ideas and ways of thinking.

The interviewee argued that without employing doctoral graduates there is a risk that an organisation such as the Museum could become inward focused. Doctoral training in the humanities was seen to sharpen the critical faculties; and this was felt to be less a feature of undergraduate or even Masters level study.

The critical inquisitiveness that a doctorate gives you allows an organisation to be self-critical and to aim for a new answer and a better answer all the time. That, I think, is the biggest transferable skill for doctoral graduates.

The Science Museum recently published an iPad app called ‘Journeys of Invention’. This is a new medium for the Museum. The two authors of the app both have doctorates. Developing the app involved a huge amount of research. The doctoral graduates took the task, conceptualised it and then worked alongside other professions such as software designers, to produce an up to date and successful commercial product. The app has now been downloaded a vast number of times across the world.

It’s the most fantastic benefit to us in terms of people knowing the Science Museum exists, and people knowing that we are a collections-based institution, that we are packed to the gunnels with interesting and provocative narratives. So it’s very good in terms of the status of the institution.
Case study: a multimillion pound business built on doctoral innovation

Moog Insensys designs, manufactures and supports blade sensing systems for the wind energy sector. Their office in the south east has 15 employees and turns over £2 million of manufacturing technology derived from research undertaken by a doctoral graduate.

The technology uses innovative optical sensors rather than electrical sensors to measure the bending of materials. The key advantage of optical over electrical is that the sensors can be applied to a variety of materials rather than just metals. The business, which now primarily markets and sells this patented product, brought the technology into new markets across the globe, particularly the energy market.

The technology has been developed into a component which is crucial to the control of large wind turbine generators and that component enables large wind turbine generators to survive in difficult wind conditions.

The organisation employs a blend of both academics and engineers at their offices combining underpinning knowledge, theory and practical skills to achieve their business objectives of advancing the product through a rolling development and continuous improvement scheme. The doctoral graduate plays a pivotal role in supporting colleagues, and passing on the knowledge and experience built up over a ten year period. They remain a crucial member of the organisation as his role evolves.

Sometimes I will propose ideas or adapt those ideas that my team has come up with... often I am the person who proposes the ideas in the first place but I am also keen to encourage the engineering team that I manage to come up with the ideas as well.

The contribution of the graduate’s research and innovations made subsequently has been at the heart of the business as stated by a senior representative of the business:

We wouldn’t have a business without him and we would really struggle to maintain the business going forward if we didn’t have him or somebody who knows as much about the technology. In terms of innovation, and developing new products or new applications, then having doctorates around you is absolutely critical.

The research undertaken by the doctorate was regarded as adding over £25 million to the UK economy and has contributed to businesses that have created around 50 jobs over eight years.
Case study: environmental and economic benefits

PassivSystems provides homeowners and businesses with the information and tools to control and optimise energy usage, delivering significant energy and cost savings. This SME has only a handful of doctoral graduates working in research and development and business development roles, yet they make an important contribution to the innovative outputs of the company.

For certain roles they look for staff with the academic rigour in research, where a PhD is a bonus, but also with commercial experience and ability in product development. They find doctoral graduates have more in-depth specialist knowledge and problem solving skills.

They’re more disciplined in research and problem solving and often they bring with them a deeper domain knowledge of areas that they’ve worked on, than someone who’s just done a first degree or an MSc.

Doctoral graduates excel in innovation and recent innovations in particular have been developed by doctoral graduates. PassivSystems develops advanced heating control systems and their latest product has almost exclusively, in terms of the control algorithms, been developed from research innovation prototyping done by a doctoral level employee. The employee interviewee takes up the story from here:

Heat pumps are difficult to control and tend to be controlled in a crude way, but I came up with a very mathematical way of controlling them which should make them a lot more efficient.

This innovation brings benefits for the company in terms of increased competitiveness, as the employer explained.

I think we will have a very differentiated product. Secondly, it enables us to talk with some amount of confidence and swagger about the product, saying that it is innovative and has been designed on good quality evidence-based research.

There are benefits for wider society and the environment too from these innovations. More efficient heating control systems can help the country decarbonise and contribute to the government’s vision for a cleaner society. Yet, what many people care about far more than carbon is money. This innovation could save 20 to 40 per cent off people’s bills. A lot of the heat pumps are used in social housing, saving money for councils and people in social housing, which is a big positive too.
Chapter conclusion

Previous research has often focused on the private and economic benefits of doctoral education, without an extensive focus on the wider impacts, despite theory suggesting that higher level study brings external benefits to society and the economy. In this chapter in particular, we have attempted to address this gap in the literature.

Employers highlighted the significant impact that losing doctoral graduates would have on their businesses, given their skills and qualifications. Discussion early in this chapter focused on summarising the different methods by which doctoral graduates are able to impact on their employers, such as developing new products, which are then brought to market. Additionally, graduates may bring productivity and efficiency gains through implementation of their ideas. Our examples have shown that not only do these bring benefits to the employer, in terms of greater profitability and competitiveness for example, but there can also be a positive impact on wider society.

Casey (2009) highlighted that whilst it is difficult to dispute that spillovers will occur from doctoral study; the mechanisms through which this occurs are less well understood. Through our qualitative research with doctoral graduates and employers, we have been able to provide a number of examples of the ways in which spillovers can occur. For example, in completing their doctorates, individuals are often challenged to think more deeply about their subject and to solve problems. When entering the workplace, they can then encourage others to take a similar approach, boosting their productivity and creativity. Employers are also often keen for the knowledge and expertise of doctoral graduates to be passed on to others in the organisation. This could be through, for instance, a mentoring scheme. In chapter 5, we explored some of the intangible benefits of doctoral study that individuals gain, such as greater resilience and tenacity. As doctoral graduates move into more senior roles, they actively encourage those they manage to keep going and not to give up, which will ultimately have a positive influence on the productivity.

At the beginning of this report, we discussed the theoretical benefits of doctoral education and that external benefits can be expected to be generated. Our research provides a more in-depth understanding of the benefits produced by the work of doctoral graduates and has also demonstrated the influence of the doctorate in enabling external benefits to emerge.
10. CONCLUSIONS

Here we summarise the conclusions that can be drawn from this research; we also identify points for consideration and areas for further investigation.

This research has extended our understanding of the destinations and career pathways of doctoral graduates seven to nine years after graduation. In this section we draw together some key conclusions and implications for policymakers and for the higher education sector in general.

Career pathways and destinations

This study attempted to track a large number of doctoral graduates from across all disciplines, seven to nine years after their graduation. The endeavour itself and the methods adopted broke new ground; previous longitudinal studies (such as the DTZ Pieda Consulting (2003) tracking study of particle physics and astronomy PhD students) have tended to be smaller scale and/or focus on doctoral graduates from specific disciplines or who have received funding from a specific research council (Raddon and Sung, 2009). The fact that we were able to track so many graduates this far into their careers is noteworthy and lessons can be learnt from the methodology that was adopted. Given the challenging circumstances, which necessitated a creative sampling strategy, we advise that the conclusions are interpreted with a reasonable degree of caution.

This study addressed the notable lack of a comprehensive picture of the medium-term career pathways (that is, beyond three and half years after graduation) of doctoral graduates. In Chapters 3 and 4, we outlined the types of employment doctoral graduates are currently in, and discussed the different types of career pathways which emerged from our interviews with doctoral graduates. The survey data indicates that the main employment sectors of doctoral graduates from different disciplines are generally very similar to those found by studies undertaken at earlier stages of their careers. Whilst our quantitative evidence did not appear to suggest great movement of doctoral graduates between higher education and other sectors, other evidence, including our qualitative research, suggests there is more mobility than the figures indicate.

A key issue that emerged from our exploration into career pathways was the conditions and perceptions of doctoral graduates working in research roles within higher education. Doctoral graduates working in the sector reported low levels of satisfaction with job security, which is unsurprising given that only 26 per cent of those responding to our survey are employed on permanent contracts. Career prospects were also another key concern for these graduates. Our interviews with graduates who had moved out of the sector again highlighted
issues such as lack of security and progression and better prospects in industry as reasons for leaving higher education. The Witty Review (2013) states that universities have a major role to play in developing the comparative economic advantage of the UK. This will require our higher education institutions to continue producing high-level research. And while we have no evidence that less than attractive conditions for HE researchers are adversely impacting on the sector, it is also arguable that this is unlikely to be helpful in attracting talented researchers either. Allas (2014) states that “a large proportion of the doctorate holders (a UK strength) do not end up working as researchers”. Future research could investigate why more doctoral graduates are not entering research roles more generally.

Benefits to the individuals and their employers

Overall, graduates responding to our survey were very positive about the impact that the doctorate had made on their careers. 87 per cent said that their doctorate had enabled them to progress towards their long-term career aspirations, with only 6 per cent reporting that they would work towards a different qualification, if they had the opportunity to do so. The median salary earned by doctoral graduates working in one full-time job in the UK was just above £40,000. Amongst those individuals for whom we had salary data from earlier in their career, there was a clear upward trend in salary, with some respondents having experienced quite significant increases in their pay. An upward trend in pay however is to be expected, as graduates gather more work experience, and are also able to demonstrate their additional skills and talents in the workplace. This study has added to other literature in this area by exploring the intangible benefits of doctoral education. Previous work has often focused on the financial gains offered by doctoral study. Our interviews with doctoral graduates found that many believed that their doctoral experience had improved their confidence and resilience; some stated that it allowed them to build a more enquiring mind. Doctoral study also provided the opportunity for individuals to make life-long friends and build networks.

Many of the skills that are developed through doctoral study were found to be highly valued by employers. Doctoral graduates bring a methodical approach to their work, and demonstrate the ability to think creatively and see the wider picture. Doctoral study requires students to continually solve problems and this was another key attribute brought to the workplace. From doctoral graduate interviews it appears that amongst those without experience of working with doctoral graduates, some negative stereotypes do remain. There is perhaps a need to communicate more effectively the qualities doctoral graduates can bring to an organisation.

Most employers interviewed highlighted the importance to them of work experience when recruiting staff. For early career doctoral graduates in particular, greater emphasis may need to be placed on obtaining relevant work experience during study, which will not only enable them to gain invaluable experience, but may also help them determine which career path they would like to follow after study, allowing for a better match between employers and
graduates. SMEs in particular may not fully appreciate the benefits of hiring doctoral graduates. More research in this area would be welcome to ascertain whether intervention is needed to address information gaps.

**Contributions to innovation and impact**

Our study looked to explore not only the private benefits of doctoral study, but the wider economic, social and cultural benefits of doctoral study. For innovation and impact to be achieved in the workplace employers must offer the conditions that allow for employees to be innovative. On the whole, doctoral graduates taking part in our research appear to be in positions which enable them to innovate. Innovation by doctoral graduates can occur through many avenues, such as the development of new products and services or bringing through new processes or ways of working. We have uncovered examples of how these innovations benefit not just the employer, through improved profitability and competitiveness, but wider society too, for example, through improved health and wellbeing, reduced environmental harm and cultural enrichment. Crucially, employers and graduates recognise the importance that the doctoral experience has played in enabling such innovations. In chapter 5 of this report, we highlighted some of the intangible benefits that doctoral study can bring. Indeed, these attributes and qualities can be used by doctoral graduates in the workplace to generate greater productivity and creativity amongst other workers, such as encouraging others to never give up and achieve more. Employers have also looked to ensure graduates can pass on their expert knowledge to others. Our research has therefore enabled us to build on the work by Casey (2009) to indicate some of the mechanisms through which doctoral graduates can create spillover effects.

Doctoral graduates also contribute to the absorptive capacity of businesses by enabling the acquisition, adaptation and utilisation of knowledge, technologies and ideas. They have the capacity to enhance collaborative links between universities and industry. Collaboration can help foster innovation by broadening knowledge and understanding on projects. While such links are often more common among larger businesses there is an opportunity for SMEs to capitalise on doctoral graduates. Future research should also consider how to promote the level of collaboration between universities and SMEs in particular given the importance of these businesses to innovation and growth.

This project has developed our understanding of the medium-term destinations of doctoral graduates and their career pathways. As discussed, many useful insights have been gained, from the confirmation that doctoral graduates’ remain highly employable, to the salary estimates and details of the wider personal and social capital benefits that these individuals experience. It has also offered a range of new insights into how doctoral graduates contribute to innovation and the links between doctoral graduates’ skills and the means by which they contribute to or add value for their employers and wider society. Nevertheless, understanding the impact (economic, social, and cultural) of doctoral graduates, particularly from the employer perspective is challenging, predominantly in terms of attributing their
contribution as distinct from that of their co-workers. Given this complexity, future research would be beneficial, to update and extend this study and ensure impact can be captured in a systematic way.
11. **BIBLIOGRAPHY**

**Allas, T (2014)** ‘Insights from international benchmarking of the UK science and innovation system: a report by Terra Allas, BIS

**Auriol, L (2010)** ‘Careers of Doctorate Holders: Employment and Mobility Patterns’ DSTI

**Bastow S, Dunleavy, P and Tinkler, J (2014)** ‘The impact of the social sciences’ Sage, London

**Bentley, K and Hooley, T (2010)** ‘What do researchers do? Career profiles of doctoral entrepreneurs’ Produced as part of a series by Vitae

**BIS (2013).** ‘Encouraging a British Invention Revolution: Sir Andrew Witty’s Review of Universities and Growth’

**BIS (2013)** ‘SMEs: The Key Enablers of Business Success and the Economic Rationale for Government Intervention’


**Connor, H and Brown, R (2009)** ‘The Value of Graduates and Postgraduates’ CIHE report

**Casey, B (2009)** ‘The Economic Contribution of PhDs’ Institute for Employment Research, University of Warwick

**Desjardins, L, King, D (2007)** ‘Expectations and Labour Market Outcomes of Doctoral Graduates from Canadian Universities’, Centre for Education Statistics

**DTZ (2006)** ‘Career Path Study of PhD Students’ Report for the Arts and Humanities Research Council
DTZ (2010) ‘The Economic Impact of PhDs’ Report for the Engineering & Physical Science Research Council (EPSRC)


Ford, E, Barratt, N and Hooley, T (2009) ‘Researchers’ skills and competencies’ Vitae


Haynes, K and Metcalfe, J (2007) ‘What do PhDs do?’ Produced as part of a series by the UK Grad Programme


HEFCE (2011b) ‘Approaches to measuring employment circumstances of recent graduates’ Issues paper


Hodge Review (2011) ‘Review of progress in implementing the recommendations of Sir Gareth Roberts, regarding employability and career development of PhD students and research staff’ A report for Research Councils UK


Morgavi, A McCarthy, M and Metcalfe, J (2007) ‘Employers’ views of researchers’ skills – A comprehensive review of the existing literature into employers’ views of the skills of early career researchers.’ The Rugby Team


Office for National Statistics (2013) ‘Graduates in the UK labour market 2013’


Research Councils UK, ‘Joint statement of the skills training requirements for research students’


Souter, C (2005) ‘EMPRESS: Employers perceptions of recruiting research staff and students’ Careers centre, University of Leeds


Vertesy, D (2012) ‘Measuring innovation’ Joint Research Centre of the European Commission

