Towards Systematic Tracking of Researcher Careers: A Scoping Review and Development Plan

Commissioned by:

Dr Justin Hutchence

Researcher Careers Working Group & University of Oxford

October 2024

Contact:

Peter Boddy
Head of Research & Evaluation
Careers Research & Advisory Centre (CRAC)
peter.boddy@crac.org.uk

Robin Mellors-Bourne
Director of Research & Intelligence
Careers Research & Advisory Centre (CRAC)
robin.mellors-bourne@crac.org.uk

Contents

Executive summary

This report, commissioned by the University of Oxford's MPLS Researcher training and development department, provides a comprehensive overview of researcher career tracking initiatives across the UK and internationally, ultimately proposing a new model for the UK system.

The report begins by examining existing UK systems, such as the Destination of Leavers from Higher Education Survey and its longitudinal counterpart, along with newer approaches like the Graduate Outcomes Survey and the Longitudinal Education Outcomes dataset and highlights the strengths and weaknesses of each approach. The report considers the limitations of other datasets focused solely on academic staff, like the HESA Staff Record, as they fail to capture the growing number of researchers working outside academia. Other UK initiatives, like the Research and Innovation Workforce Survey and targeted tracking projects, are examined for their potential contributions and limitations.

The report then turns its attention to international approaches, examining efforts by organizations like the OECD and the European Commission, along with specific national models in countries such as the USA, Australia, Canada, France, and Germany. This international overview reveals a diverse range of methodologies, from large-scale surveys to the use of administrative data linkages and targeted tracking of specific cohorts.

Based on this analysis, the report identifies three potential solutions for improving the UK's researcher career tracking system: large-scale surveys, the use of existing datasets with linkages, and an aggregation and facilitation approach. The report argues against relying solely on large-scale surveys, citing concerns about achieving high response rates while gathering comprehensive data. It also acknowledges the significant challenges associated with linking existing datasets, particularly concerning data access, privacy, and the need for unique identifiers.

The report ultimately champions the aggregation and facilitation approach as the most viable option for the UK. This hybrid model would involve collecting data from various sources, including surveys, administrative data, and publicly available information. It would be designed to allow for modularity such that data arising from different approaches could be made compatible and leveraged for insights. A central organization, potentially a national observatory or centre, would be responsible for developing standardized tools and protocols, aggregating data, and facilitating collaboration among stakeholders like HEIs, funders, and professional bodies. This approach is expected to increase researcher engagement in data sharing by fostering trust in a central, potentially government-endorsed body while allowing HEIs to maintain strong connections with their alumni and leverage their existing data collection efforts. By combining the strengths of various approaches, the report argues that the aggregation and facilitation model can provide the UK with a robust, sustainable, and insightful system for tracking researcher careers.

Introduction and aims

It is well known that there has been substantial growth in the number of doctorates awarded in the UK in recent years. While most doctoral students report an intention to continue working in the academic sector after completing their PhD research, the number of permanent positions at UK higher education institutions (HEIs) has not increased in line with the supply of aspirant researchers. The revolution in doctoral training in the UK over the past 20 years has resulted in improved career learning by many during doctoral study and greater interest in the value of the skills developed and the potential career paths in which they could be valuable.

Nonetheless, while funding for academic research has increased in recent years and with it the need for trained researchers to carry it out, this has primarily manifested in an increase of project-based funding for research. This in turn has increased the number of early career researchers embarking on post-doctoral research contracts (i.e., usually fixed term, often short-term (1-2 years), project-based research) after completing their doctoral studies. However, the academic sector does not have the absorptive capacity for all those ECRs to progress to permanent academic roles. Thus, overall, most doctoral graduates will eventually transition 'out' from doctoral study and/or an academic role into other sectors (Vitae, 2013).

Inter-sectoral mobility of researchers is seen as favourable within the UK's R&D strategy which considers research and innovation, much of which occurs beyond the academy, a key driver of economic growth and societal improvement (BEIS, 2021; NCUB, 2023). To possess an inclusive, dynamic, productive, and sustainable R&D ecosystem the UK must attract and retain talented researchers with the right skills to pursue R&D activities. However, such researchers require long-term career stability, progression prospects, and fulfilment at work. The current lack of understanding about the career pathways of people with a doctoral qualification engaged in research or R&D in the UK, especially those working outside the academy, hinders the effective operation of these workforce sectors. Information about these career pathways is critical for career planning, workforce planning, and researcher development initiatives. A better understanding of the labour market for doctoral graduates would be highly valuable as part of career learning by doctoral students (and other ECRs).

The aims of this project and report are, first, to review the current state of the art in tracking doctoral graduates and other researchers, both in the UK and abroad through a literature and evidence review. Second, through synthesis of that evidence and distillation of insights from it, the project seeks to identify key potential approaches or options for more systematic career tracking of researchers in the UK. This would enable the subsequent development of feasibility studies, possibly pilot activities, and ultimately identification and proposal of a 'solution' and development of a business case for its funding and implementation.

This project builds upon preliminary work undertaken by Vitae's Working Group on Researcher Careers[1] (RCWG) and discussions within the Researcher Development Concordat Strategy Group[2] (RDCSG). Funding for this work was made available by the University of Oxford, through Dr Justin Hutchence; that support is gratefully acknowledged.

---

[1] www.vitae.ac.uk/membership/Vitae-Working-Groups/researcher-careers-working-group
[2] www.researcherdevelopmentconcordat.ac.uk/about/

Why tracking research careers is important

Some valuable outcomes of improved understanding of researcher careers include to:

- Identify the impact and economic contribution of researchers;
- Provide a stronger evidence base upon which to base policy decisions about different research funding options and related initiatives;
- Provide valuable additional measures of the impact of different doctoral training approaches, in terms of employment outcomes;
- Assess the supply and demand balance of researchers in different sectors and potentially in different areas of the UK;
- Understand more about researchers' skills and how they are being used, to inform doctoral and ECR training approaches;
- Provide an evidence base with which to support researchers in their career development – e.g., to raise awareness of pathways open to trained researchers and evidence the likelihood of successfully pursuing different career paths;
- Improve alumni engagement with research performing organisations (RPOs) – which could lead to the formation of valuable networks and collaborations. These could be especially valuable if they include alumni who are working in a variety of roles, sectors and locations;
- Measure the diversity and inclusivity of post-PhD careers and any possible to identify barriers to progression or systemic bias.

International researchers

Given the high and increasing proportion of UK doctoral students who are international students, it is important to track the extent to which they enter the UK workforce and how long they remain in the UK. In France, recent research (Alimukhamedov & Tõnismann, 2024) suggests that there is a challenge in integrating researchers into the broader French R&D workforce after completion of their PhD. Are there similar challenges in the UK? These issues could be related to the notion of "brain-drain". While the UK is thought to be a net beneficiary of mobility of highly qualified workers, it is constantly competing with other research-intensive economies for research talent. Gaining a clearer understanding of the pathways of international UK PhD graduates would help develop policies to encourage them to integrate into the UK workforce.

UK workforce planning

Related to this, in an interesting think piece for WONKHE Michael Salmon (2024) argues that career tracking may provide a method to measure of the "absorptive capacity" of the economy for skilled individuals. Knowing where researchers end up working, and why, may allow for policy interventions to be developed which encourage them to work in the sectors, locations or fields which require their skills. Overall, intersectoral mobility has been an underused strategy in workforce planning in the UK. Such proactive steps could go further in aligning the UK's R&D industrial strategy (i.e., the "demand side") with the activities of academic institutions which are training researchers (i.e., the "supply side"). This would be in addition to the value of such labour market information in developing researcher development activities and career guidance for doctoral students and ECRs.

UK approaches to tracking researcher careers

In this section we review existing or recent approaches to researcher tracking in the UK, based on our internal knowledge as well as published literature. Our objective is not to provide a detailed analysis of each initiative, but rather through these descriptions to provide an overview of the research landscape in this field (tracking researcher careers), key resources, and to highlight some of the benefits, drawbacks and value different approaches possess.

Destination of Leavers of Higher Education Survey

Between 1994 and 2017, the annual Destination of Leavers of Higher Education (DLHE) survey, administered by the Higher Education Statistics Agency (HESA), collected information about the first destinations of all UK and EU domiciled[3] graduates from UK HEIs, on average six months after graduation (HESA, 2018). Deployment of the survey was largely on the basis of questionnaires sent/emailed from HEIs to their alumni, augmented by telephone contact. It focused on details about employment (or study) including occupation, industry, sector, and location and was linked to demographic and study data collected by HEIs about students within the HESA Student Record.

This survey provided a very short-term snapshot of the near-immediate outcomes for all UK and EU graduates (including doctoral graduates). Some of its data provided measures that became a critical Key Performance Indicator for HEIs (chiefly for undergraduates). A 'first destination' survey such as this can be useful in that it provides a baseline against which further career changes could be compared. However, it was increasingly recognised that employment circumstances at six months after graduation were an unreliable indicator of sustained outcomes, as many graduates did not transition immediately to a 'career job'. Nonetheless, the survey was systematic, annual and returned data for a high proportion (well over two thirds) of graduates in scope.

Destination of Leavers of Higher Education Longitudinal Survey

The Destination of Leavers of Higher Education Longitudinal Survey (DLHE-L) measured similar career outcomes as the DLHE, but three years later (i.e. on average at 3.5 years post-graduation) (HESA, 2017). It ran between 2002 and 2016/17 every other year, as a following up survey of individuals who had previously participated in the DLHE survey and asked further questions relating to, for example, the career satisfaction of respondents.

CRAC-Vitae and the Research Councils petitioned successfully for a designated additional questionnaire section for doctoral graduates, providing deeper insights into their activities at work and the skills they used. Although the response sample was much smaller than the DLHE, from the perspective of tracking doctoral graduates, it was sufficient to provide a much more valuable picture of their early career pathways. Three and a half years was generally enough time for many graduates to have found stable roles, such as to have completed a first postdoc and decided what to do next, while their intervening experiences may allow them to provide more nuanced feedback concerning their doctoral training and its value to their post-doctoral careers. Most of Vitae's *What do Researchers do?* reports

---

[3] This means that only students which were ordinarily resident in the UK or EU when applying for their course, irrespective or their nationality, are included. This excluded other international PhDs from the dataset.

utilised data from these two surveys to derive a robust understanding of the early career paths of doctoral graduates. Interestingly the model of the DLHE and 'DLHE-L' survey combination was mirrored almost exactly in Australia, albeit there called 'Graduate outcomes' (described later).

Graduate outcomes survey - HESA

In place of the DLHE and DLHE-L, since 2018, HESA has collected data about graduate destinations using the annual Graduate Outcomes Survey (GO) (HESA, 2024a). It runs 15 months after graduation, not six months, which was thought to provide a better indication of post-study outcomes. It collects broadly similar data to the DLHE survey, and international students are now also in scope. However, response rates have fallen somewhat (44% in 2021-22, lower than its 60% target) compared with DLHE participation.

A further development was incorporation of optional banks of questions on certain themes, of which HEIs could select a number (involving additional payment). One such optional bank was questions for doctoral graduates. This collected data on graduates' views of their research degree, its relevance to their current employment and their satisfaction with their course. However, making incorporation of these additional questions by HEIs optional resulted in far fewer doctoral graduates answering them, because HEIs opted instead for extra questions on other topics (for all graduates, not just doctoral) that presumably they considered strategically more important. Some minor enhancements to the survey have taken place since launch.

Longitudinal Education Outcomes dataset – DfE

The Longitudinal Education Outcomes dataset (LEO) is created by the UK's Department for Education (DfE) (DfE, 2024). It links HESA data about students and graduates to employment information held by the UK tax office HMRC and the Department for Work and Pensions (DWP), which use the national insurance number as an identifier. It originated as an approach to model the extent to which student loans would be repaid to the UK Government. The novelty of this project is that it is created by combining administrative data from several various sources. This results in an anonymised administrative dataset, which can (for example) be probed at degree or subject level. Its outputs initially focused on whether graduates were employed and their earnings. Through analysis of earnings in a recent tax year for graduates in different prior years, allows for the have generation of employment and income outcomes results for graduates (including doctoral graduates) one, three, five and ten years after graduation (albeit not for the same cohort of graduates).

While the benefit of this project is that large scale insights can be obtained, and potentially much further into careers than a single destinations survey, the linking of imperfect datasets leads, inevitably, to limitations in the data. It is restricted to employed and self-employed UK workers, cannot distinguish between full-time and part-time work in its results on earnings, and data has been patchy. However, data about industrial sector and UK region are now also being incorporated (from HMRC data about employers), which is beginning to expand what were very limited insights into employment outcomes. While the LEO data project is designed to allow for analysis of long-term career outcomes in terms of sector and salary, it can only provide partial insights into doctoral career outcomes.

Staff Record - HESA

The HESA staff record consists of data submitted by HEIs in the UK about their academic staff (mainly) and other staff (now optional) (HESA, 2024b). It contains detailed information about key personal characteristics, employment, role and contract, discipline, funding and earnings. Data are collated by HEIs from their internal/HR records and returned to HESA annually. It thus provides highly detailed annual snapshots of the academic workforce in the UK, but individuals cannot be tracked between annual datasets. Also, extensive work by CRAC using this dataset reveals that not all fields are completed – for example, the level of highest qualification held is recorded for most academic staff but the proportion for whom this is 'missing' is increasing significantly year on year. Crucially, in the context of researcher career tracking, by definition it lacks information about researchers working outside academia and the data are not linked to other HESA datasets or other data sources.

Research and Innovation Workforce Survey - DSIT

The Research and Innovation Workforce Survey (RIWS) was run first in 2022, and the second iteration was run in summer 2024 (DSIT, 2023). It arose out of the UK Government's People and Culture Strategy: *People at the heart of R&D* (BEIS, 2021) which acknowledges the importance of gaining insight into the research and innovation workforce in the UK across all sectors and at all levels. The focus is to characterise the UK R&D workforce, map its skills, diversity, incentives, promotion structures etc, with a view to optimising the workforce.

It takes the form of an online survey, run by a commercial survey company, and is advertised in a targeted fashion to R&D actors. Its first iteration yielded around 7,500 responses, although it was estimated that 1.7 million workers were in scope. RIWS aims to collect data on individuals' demographics, educational background, career trajectories, working conditions, research impact and subjective insights about motivations and their career's determining factors. In its second iteration, mobility questions were added along with a target of 10,000 respondents.

While RIWS is intended to be comprehensive and aims to cover a variety of R&D roles, across all disciplines and in the academic, private and non-profit sectors, participation in the survey was patchy in 2022. Overall, the academic sector was over-represented, and the under-representation in the private sector exacerbated by a strong over-representation of people reporting that they were at a senior level. Targeted efforts were made with the aim of achieving a more balanced sample in 2024. However, there is a clear tension between aspirations for detailed insights from individuals (requiring many detailed questions) and the need to achieve high response numbers (requiring a short questionnaire and simple questions). It seems unlikely to achieve both.

Labour Force Survey - ONS

The UK Labour Force Survey (LFS) has been conducted by the UK's Office for National Statistics (ONS) since 1992 (ONS, 2024). It is conducted quarterly through administered questionnaires on a sampling basis, designed to derive a cross-sectional sample of the whole UK population. It collects information on participants' current employment, and working conditions, and salary information, while also recording holding educational level data. In recent years participation has diminished and in response changes were made in 2024.

While the LFS can provide interesting snapshots and insights into some aspects of the career paths of people working in research, it is clearly not a tool tailored to tracking researcher careers. Given its sampling method, the likely representation of researchers would be low (and/or doctoral graduates, in line with their representation in the population overall). Moreover, the data on employment collected and its coding are not sufficiently detailed to allow for distinctions between fields of research or roles within research. Given its cross-sectional nature, the LFS sheds little light on career progression, transitions and inter-sectoral mobility. Finally, as with several of the initiatives in this section, the LFS is exclusively directed at UK residents, so it gives no coverage of international outward mobility.

UK Medical Education Database

The UK Medical Education database (UKMED) combines administrative data (from UCAS, HESA's Student record, educational records including Clinical Aptitude Test data from the University Clinical Aptitude Test UCAT, as well as that held by the General Medical Council (GMC)) on medical doctors as they progress through the medical training pipeline (MSC, 2024). The training pathways data contains descriptive data of doctors' routes through medical training pathways and evolving careers. The database contains information related to HE study, personal characteristics, and employment outcomes, according to a common taxonomy.

Given that the database is focused on its single target population, it makes the process of collecting, linking and managing the data relatively simple compared with the challenges of tracking researchers in the broader population. One way in which the process of linking accounts is facilitated is that medical practitioners possess a unique identifier, their GMC affiliation number. Access to the information contained within the database is tightly controlled and facilitated by way of an application process.

Researcher Career Mobility Taskforce - NCUB

The National Centre for Universities and Business (NCUB) has a strong focus on understanding and enhancing mobility between HE and the private sector in particular, including sectoral mobility of researchers. To understand mobility, it has been doing some interesting work in the field of researcher career tracking in recent years, and some of this activity and approaches are worthy of mention here. One approach has been to analyse HESA staff data which contains some data about time of entry to the institution and about where staff previously worked. This allowed NCUB to create some statistics on the sector mobility of researchers between academia and the private sector. However, the data upon which this was based is partial (it exists for well under half of academic staff) and a key field of data (year of start of employment with HEI) is no longer collected. Its statistics should therefore be treated with caution.

A potentially more interesting study, in the context of this project, involved the web scraping of 430,000 profiles of UK researchers (predominantly individuals working at HEIs in the UK) from LinkedIn (Ospina & Rodriquez, 2023). Data concerning the employment history of individuals was then extracted and analysed to build up a picture of career trajectories and sector mobility. Such an approach has great potential as it can provide large samples, detailed data and many associated data items (such as skills) which can allow for insightful analysis and comparison. Databases are relatively cheap to build and the technology for

web scraping is relatively accessible to non-specialists. However, there may be issues of the currency or reliability of such data and, while this was mentioned by NCUB as a benefit, working with publicly available data could obviate privacy concerns but this remains, in our opinion, a grey area.

Targeted tracking projects

Smaller UK projects that aim to track certain groups of researchers are growing in frequency and of direct interest here. In 2013, Wellcome conducted a qualitative study about how doctoral researchers choose their careers (as CRAC-Vitae had done in 2012 (Vitae, 2012)), and subsequently began to track some groups of researchers it had funded, on an individual basis, resulting in development of a range of identifiable career tracks (Ipsos Mori, 2013?). More recently, the Royal Society and the British Academy have both, in recent years, invested in 'career pathway tracker' type projects largely based on surveys of alumni of their early career award schemes (Mellors-Bourne, Metcalfe & Pollar, 2018; Royal Society, 2018; British Academy, 2024). These detailed surveys – designed and implemented by CRAC – have provided both fascinating insights into the career trajectories over the last few decades of many hundreds of UK researchers but also measures of the impact of these awards, in relation to development of the researchers. The methodology within the Royal Society and British Academy projects is distinct in that it aims to established sustained tracking over time, i.e. longitudinal, in addition to being comprehensive across the lifetime of the award schemes. In practice, these approaches combine an initial baseline phase to collect data on all previous cohorts, but with successive waves going forward to incorporate newly emerging alumni but also update data about previous respondents. These surveys have obtained response rates of over 70%, and we expect that other schemes will be covered in future by these and other funders. The study for the British Academy has also experimented with augmenting survey response data with search of web-based data for those not reached or engaging in the survey (using the method described for the University of Toronto '10,000 PhDs' project in the next chapter).

While these projects have been identified specifically as tracking, in practice numerous evaluations of research funding schemes and awards (that have a career development focus) have involved surveys that investigate career outcomes of awardees to varying extents, but they tend not to be comprehensive.

In addition, there have been a few specific career investigation studies of certain groups of students or researchers, such as the Futuretrack study that sought to track the careers of all applicants to first degrees in the UK in 2005/06 – of which some will subsequently have become doctoral graduates (Warwick Institute for Employment Studies, 2021). However, massively falling engagement over time meant that tracking segments of the cohort became unrealistic. CFE Research undertook a study for the UK Research Councils in 2014 which attempted to establish doctoral career destinations around seven years after graduation through a national survey, but this achieved only 1839 responses (4% of the target population of doctoral graduates between 2003/04 and 2005/06) of whom half were working in academia (Diamond et al., 2014). A more specific and targeted approach was undertaken by Vitae in 2016 (Vitae, 2016), when it sought specifically to track former postdoctoral research staff who had 'left' academia to understand the other career pathways they subsequently pursued.

Several individual HEIs are running specific tracking exercises of their own researchers, of which a current project underway at the University of Cambridge (in 2024) is a good example. In this case, a researcher has been hired to collect career data about all the postdocs who have worked at the university over the last decade. While the restricted scope of this project ought to make tracking the researchers feasible, it is possible that the HEI's records on postdocs may be sparser than for some other staff as their contracts are often shorter – so their contact details may not be maintained. The project is believed to incorporate both survey and other evidence-gathering approaches. We believe that other HEIs have similar studies underway, either of doctoral graduates or other ECRs.

International approaches to tracking researcher careers

OECD

The most prominent organisation which collects data on aspects of researcher careers is the Organisation for Economic Co-operation and Development (OECD).

In their "R-D personnel" datasets the OECD has reported statistics on the R&D workforce in member countries since 1981 (OECD, 2024). The high-level dataset includes information about the headcount of personnel (broken down by researchers / total R&D employees) and expenditure, broken down by their sector of employment (Business, Government, HE, Non-profit), their field of science (i.e., STEM and Humanities fields), the type of R&D being conducted (basic research, applied research, experimental development etc), level of qualifications (including PhD), and gender.

One prominent survey run by the OECD under the auspices of the OECD/UNESCO Institute for Statistics/Eurostat project on Careers of Doctorate Holders (CDH) project was: 'Careers of doctorate holders: employment and mobility patterns' (Auriol, 2010; Auriol, Schaaper & Felix, 2013). The study was conducted in 2007 and 2010 and collected data on researchers, resident in the 26 participating countries[4] who had completed a doctorate since 1997. Its foci were (1) the early career of doctorate holders; (2) their career trajectories; (3) their international mobility; and (4) the competences and skills of doctorate holders.[5] Five broad categories of data were requested: personal characteristics, educational characteristics, labour force status, international mobility, and scientific output. Some nations provided data which they already collected through surveys or which they held in administrative databases or measured using labour force surveys. Others used survey materials from the OECD, adapted to their needs. One of the most challenging aspects of the latter style of data collection was building directories of doctoral graduates to contact to participate. This meant that the dataset was complete for different variables in different countries.

Given the heterogenous nature of the overall dataset, the CDH lacked comprehensive coverage of researchers who obtained their doctorates abroad. Similarly, because it was reliant on data from participating states, each of which had several methodological and records issues, it resulted in many incomplete data fields.

For the purposes of this review, it is worth mentioning that the OECD publishes guidelines for best practice in collecting, reporting and using data on R&D activities and workforces and tracking the careers of doctorate holders (e.g., the Oslo manual (OECD & Eurostat, 2018), the Frascati manual (2015), Mapping Careers and Mobility of Doctorate Holders Draft guidelines (2012)). The guidelines on mapping careers and mobility of doctorate holders are of particular importance for the project at hand.

Because the OECD has a relatively long history of collecting data on the careers of researchers, it should come as no surprise that in 2022 the European Commission announced the creation of the Research and Innovation Careers Observatory (ReICO), to be managed by the OECD (European Commission, 2024).

While details are currently sparse on the intended activities of the Observatory, it seems likely that the data to be collected will be similar in nature to that collected in the CDH

---

[4] Not including the UK
[5] The study was largely inspired by the USA's SED and SDR, described below.

project. It would be important for any systematic tracking of researcher careers in the UK in future to align sufficiently with ReICO guidelines and datatypes.

More 4 project - EC

The Mobility Patterns and Career paths of EU researchers (More 1-4) projects, funded by the European Commission, were an attempt to evidence the career paths and mobility of EU researchers both within the European Research Area (ERA) and internationally (European Commission, 2021). They collected information on, demographics, academic background, career paths, mobility (international, intersectoral and geographical) and working conditions, and recorded them as a set of around 30 key research indicators. The data was based on two surveys (one targeted at researchers working at HEIs within the ERA (n=10,000) and a second (n = 4,000) targeted at researchers working internationally – the majority at HEIs) as well as through desk research on existing administrative data sources[6].

While this dataset provides valuable insights into the employment and careers of academic researchers (with some overlap with data collected in the UK through the CEDARS survey and its precursor the CROS survey run by CRAC-Vitae), it is less illuminating about the careers of researchers in other sectors. It was also developed as a tool to measure the flow of researchers within the ERA and differences between member states, to evidence policy.

Doc Enhance - EC

In 2022, the EC Horizon Europe funded the DocEnhance project which involved developing a career tracking survey (DocEnhance, 2022). The work-package was led by the European Science Foundation (ESF) and based on its previous survey in 2017 (described in the next section). The survey involved nine participating partners[7] (different to the ones in 2017) and surveyed doctoral graduates who completed programmes between 2016 to 2020. It achieved a response rate of 23% (range 11%-32%) amounting to 2,217 responses across institutions of varied sizes (range of populations between 337 and 5,360 graduates). In addition to the topics covered in ESF's previous survey, this survey had additional questions which were designed to shed light on doctoral skills training and skills use post-graduation, in line with the broader aims of the DocEnhance project. Individual universities managed their own data collection, and a generic web-link was included to be shared online, to increase the reach of the project. Similar shortcomings existed in the DocEnhance to the previous ESF tracking study: primarily, there was heterogeneity in the data due to key differences between the institutions, in terms of response rates, fields of study, and due to local economic and social contexts of the participating organisations. On the other hand, such diversity is also reflective of the reality of doctoral study. One particularly valuable outcome of the DocEnhance project is a series of guidelines for conducting researcher career tracking studies (Rusitory & Boman, 2022), which provide a wealth of useful practical information for others hoping to track doctorate careers.

---

[6] For example from the following EU data sources collected by Eurostat: Human Resources in Science & Technology, Research and development (R&D), Education and training

[7] Arctic University of Norway (Norway), Technical University of Munich (Germany), Aristotle University of Thessaloniki (Greece), Maastricht University (Netherlands), NOVA University Lisbon (Portugal), Matej Bel University (Slovakia), University of Alcalá (Spain), University of Sassari (Italy) and University of Chemistry and Industry Prague (Czech Republic).

European Science Foundation

The European Science Foundation (ESF) has been active in the area of researcher tracking for over a decade and has published extensively on the topic. In 2017, it published a report on a project to track the careers of doctoral graduates working in all sectors (Boman et al, 2017). In this study, nine institutions[8] surveyed their doctoral graduates from 2010 – 2016 on their educational background, initial post-graduation employment, intervening career trajectory, mobility, and demographics. The survey obtained a 23% response rate (ranging from 18% to 83% at different institutions) and obtained a total of 2046 responses. It should be noted that because participating organisations were self-selected there was a large degree of heterogeneity in the size of participating organisations (populations ranging from n=30 to n=4526) and the selected institutions varied in numerous other ways (e.g., nation, type of organisation etc.) which makes analysis of aggregated data from this study less reliable as an indicator of any general trends for doctoral graduates.

Survey of Earned Doctorates - USA

The Survey of Earned Doctorates (SED) annual census is funded by Federal science agencies, including the National Center for Science and Engineering Statistics (NCSES) within the National Science Foundation (NSF) and currently administered by a private research organisation, RTI International (NCSES, 2022) . It has run since 1957 and collects academic and demographic data along with career plans of graduates from all research doctoral degree holders from all fields and specialities via an online questionnaire. The survey link is initially sent to graduates via the institution they graduated from, and non-respondents are followed up, resulting in a 92% participation rate in 2022. The survey is run almost immediately (within 2 months) after graduation and gives an immediate snapshot of the initial career plans of doctorate holders. As with the UK's GO survey, the early completion of this survey provides little more than a useful baseline from which career paths can be developed in future surveys. It also sheds light on the preferences and intentions of graduates, which is of use when evaluating whether the careers of doctorate holders align with their preferences.

Survey of Doctorate Recipients - USA

The Survey of Doctorate Recipients (SDR) has run every other year since 1973 and is funded by the NCSES (within the NSF) and National Institutes of Health (NIH) (NCSES, 2023). It is a survey conducted on a subset of respondents[9] from the SED survey who completed a US doctoral degree in science, engineering, and health; the sample target is 10% of the eligible population - around 125,000 people – and it obtained a response rate of 65% in 2023). This longitudinal study tracks the same individuals every two years to collect data on their careers. Fields include: demographics, employment status, job details, role responsibilities, employer details (i.e., name, sector, location, size), details of postdoctoral positions, relevance of doctoral training to role, career satisfaction, salary information, working conditions, employment history, amongst others. Since 2010 it has included

---

[8] University of Maastricht, The Netherlands; Technical University of Munich, Germany; Goethe Research Academy for Early Career Researchers (GRADE) at Goethe University Frankfurt, Germany; University of Bucharest, Romania; University of Split, Croatia; University of Luxembourg, Luxembourg; Institute of Science and Technology, Austria; and the AXA Research Fund, France.
[9] 10,000 recent graduates are randomly added to the survey database at each collection point.

researchers working outside the USA, but not researchers working in the USA who graduated from non-US universities.

The SDR is used for workforce planning, policy development and understanding employment trends by government and private stakeholders. Its most recent iteration was in 2023 and was administered by a non-profit research organisation, NORC. Recently, dependent interviewing (DI) methods were introduced for some aspects of the survey to reduce the burden on respondents. This meant in practice that data that respondents had previously provided in other iterations of the survey were pre-populated in the survey and respondents were able to accept or amend it.

The SDR is a comprehensive source of valuable information on the careers of doctoral holders in science, engineering and health. It has inspired many other international approaches. Its methodology is one which should be carefully analysed, and its fixed panel design allows for the tracking of the same individual over time. Recent innovations like DI make it increasingly likely that the data quality will improve over time, as less burden for respondents often results in improved response rates. Obviously, one major drawback to the SDR is that it does not include researchers from the humanities and social sciences.

Early Career Doctorates Survey - USA

The Early Career Doctorates Survey (ECDS), funded by the NCSES and NIH in 2017, was a survey focused on doctoral graduates from all fields who had earned their doctorate within the ten years preceding the survey, including those who obtained their doctorate outside the USA (NCSES, 2017). Its target population was those who are working in the HE sector in the USA and it collected data on the demographics, career paths, job quality and satisfaction, work-life balance, and career plans of sampled respondents (around 15,500k people in 2017). Again, these topics overlap with the coverage of the CROS and CEDARS surveys in the UK. However, unlike CROS or CEDARS, the sample was designed to be a representative stratified sample of the broader population along key demographic variables across the entire academic system. The ECDS was administered by the same private research organisation which runs the SED survey and took the form of a web-based survey, RTI International. They obtained a response rate of 65% (around 9,000 respondents).

The survey arose because of acknowledged deficits in the US system of collecting career data on doctorate holder careers, mostly the lack of insights from non-STEM researchers (27% of those working in the US academic system), and those who received their doctorate abroad (13.4%) in the SDR. It was explicitly designed to shed light on postdoctoral researchers and allow for comparisons to be made between different types of roles within the academic context (i.e., faculty, non-faculty, administrative staff, etc.).

Council of Graduate Schools - PhD Career Pathways project - USA

The Council of Graduate Schools (CGS) Career Pathways project arose out of a perceived need for better data on doctoral graduates (especially those working beyond the academy) in the USA to improve researcher development initiatives (CGS, 2024; Allum, Kent & McCarthy, 2014). The project initially conducted a gap analysis of the doctoral career tracking system in the USA and then developed standardised survey tools for participating universities (75) to administer to their alumni. Data once collected is collated and aggregated findings allow for institutions to contextualise their findings and benchmark against others using a members-only data dashboard. The CGS produces numerous resources for member

institutions and a tool to allow for members to share case-studies and success stories with doctoral students (CGS, 2020). Essentially, the approach is to enable universities to collect high quality data on researcher careers in a systematic way.

Coalition for Next Generation Life Science – USA/International

Another interesting approach which involves equipping organisations with the means to perform their own career tracking is that of the Coalition for Next Generation Life Science (CNGLS) project (CNGLS, 2024a). Its 39 members are located in the USA, Canada and one in the UK (UCL), all of which commit to transparent, high-quality data collection on the post-graduation careers of their doctoral researchers. The coalition provides a framework for collecting employment data categorised into a standard taxonomy – by sector (Academia, Government, For-Profit, Non-Profit, Other, Unknown) and by job type (Primarily research Primarily teaching, Science related, not related to science, Further training or education (including postdocs), Unknown) (CNGLS, 2024b).

While the CNGLS's focus is only on life sciences graduates, its methods would equally be applicable for use for a wide variety of fields. Several of its member organisations collect data on all of their doctoral graduates (i.e. across all subjects). This approach has been successfully adopted at many premier institutions perhaps because its basic requirements are readily implemented, and data is quick to collect. On the other hand, the data lacks aspects which many organisations may wish to collect (e.g., salary information, skills use, mobility etc.), which means currently it is of limited use for many of the purposes we suggest may be valuable in researcher career tracking.

Graduate Outcomes Survey - Australia

Australia's Graduate Outcomes Survey (GOS), in place since 2016, is a national survey of participating colleges and (42) universities in Australia, which takes place 4-6 months after graduation to measure first career outcomes (Social Research Centre, 2024). Data on occupation, salary, skills use are collected from domestic and non-domestic graduates. In reporting, income data is added from the Australian Taxation office, using linkage of these datasets. Demographic information and academic information are provided by HEI administrative data. In tandem with the GO survey, the 'Graduate Outcomes Survey – Longitudinal' (GOS-L) is run, which aims to collect mid-term (graduation +3 years) employment outcomes of respondents to the GOS (QILT, 2023). The survey timings are parallel to those used in the UK for the DLHE/L-DLHE surveys that run until 2017. Response rates to the GOS are around 45% and to the GOS-L 20%. Along with the GOS, a further questionnaire, the Postgraduate Research Experience Questionnaire (PREQ) is administered, which is aimed at collecting graduate views and satisfaction with their experiences while completing their research degree. This is similar in its objectives to the UK's PRES survey administered by Advance HE in the UK.

Understanding PhD Career Pathways – Australia

Australia's Group of Eight (Go8), an organisation which comprises research intensive universities in Australia, announced a three-year project in 2018 entitled: "Understanding PhD Career Pathways". Its stated aim is to survey 20,000 PhD graduates on their careers at three-, eight-, and 15-years post defence. The project was designed produce findings which can be compared with the outcomes of a survey in the USA administered by the US Council of Graduate Schools (discussed above). The survey focuses on career outcomes, career

transitions, satisfaction with PhD, and its value in equipping them with the requisite skills for their careers. The survey was reported to be run by the Social Research Center, which also administers the Graduate Outcomes Survey and Graduate Outcomes Survey – Longitudinal for the Australian governmental Department of Education (discussed above). Further details of this project, or its outcomes, were not forthcoming during our desk research.

University of Toronto - Canada

The 2022 Career Outcomes Study University of Toronto uses the methods described in the 10,000 PhD students article (Reithmeier et al., 2019). It involved manual data collection about 16,000 PhDs who graduated between 2000 and 2021 and Postdoctoral Fellows who worked at the University of Toronto between 2008-2021 (5,268, of whom 88% were found, or 4647 people). The 90% success rate was obtained using a starting point of institutional data held on individuals, including: Year of graduation, Full legal name, Field of study, Thesis title, supervisor(s), Graduate school / department, Gender, Nationality. Rather than relying on a primary research method such as a survey, researchers adopted a systematic web search method, allowing for 15-30 minutes of time searching web resources per person. The web search involved Google Scholar and on-line publications, university and corporate websites and directories, personal websites and Linked-In. Data was included if it could be corroborated by at least one further reliable source (i.e., publications, university or company websites and staff directories). The intention was to track careers through a series of snapshots of what graduates are doing. The first cohort's career situation was updated in the second round of research, and recent graduates were added into the coverage.

Professional Insertion of Doctors survey – France

In 2018, the French Ministry of Higher Education, Research and Innovation (MESRI) implemented a national survey to track the professional careers of doctoral graduates in France (MESRI, 2021). The "IP Doc" / "Professional Insertion of Doctors" survey collects data from doctoral graduates from French HEIs one year and three years after graduation. The survey is administered by individual universities and doctoral schools but managed by MESRI. The target population for each iteration is all doctoral graduates (except medical, pharmacy and dental) from French universities regardless of their age, nationality and residence, (around 13,000 individuals). It is run every three years, in 2016, 2019, 2022. In 2016 the response rate was 54%. Information collected includes academic background, demographics, employment situation, manner of obtaining employment, career aspirations, sector, mobility, salary and working conditions, satisfaction with doctoral studies, relevance of doctorate for career.

Emploi – France

Between 2013 and 2023 Adoc has conducted the EMPLOI[10] longitudinal survey of doctoral graduates from nine universities in the Paris region in 2012. In each iteration, previous respondents were recontacted to update their information allowing for detailed tracking of the careers of those individuals who graduated in 2012 over a decade. The survey focuses on demographics and academic background, career trajectories, subjective information concerning career determinants and the added value of a doctorate, mobility, salary, working conditions etc. This dataset is unusual in that it permits highly detailed analysis of career

---

[10] https://www.adoc-tm.com/publications

progression in individuals over a decade. While the response rate is reduced after a decade, sufficient data was collected to allow for meaningful analysis.

National Academics Panel Study - Germany

Since 2018, the German Centre for Higher Education Research and Science Studies (DZHW) has run the National Academics Panel Study (NACAPS) funded by the German Ministry of Education and Research (BMBF) (DZHW, 2021). It aims to gain insight into careers in academia and outside it. This longitudinal multi-cohort panel study tracks more than 37,000[11] doctoral graduates from more than 50 German universities. It runs annually initially and then every other year it is planned to track individuals for 15 years. The cohort is added to every two years. The study collects data on academic background, personal details (including family situation, health, demographics), academic work, success and failures, career path, and mobility. Data is stored and managed by centrally but participating HEIs can access anonymised results.

Observations and consideration of options for the UK

As a reminder, having searched, reviewed and collated both published and other evidence on the approaches used to date to track the career pathways of researchers (and/or doctoral graduates), we now move on to how this knowledge can inform potential options for the UK to implement such tracking more systematically and sustainably.

Overall, since the DLHE and DLHE-L were replaced by the GO survey, the UKs ability to meaningfully track the careers of researchers has been diminished. Other sources of data such as the HESA staff record do not allow for analysis of many topics of interest. For example, insights into researchers working outside the academy, the motivations behind mobility to mention few. The RIWS survey lacks representativeness and is not optimised to shed light on many topics specifically of interest to stakeholders in the careers of doctors, for example the value of researcher development activities or developing alumni networks. Recent initiatives such as LEO which involve the linking of existing datasets are promising in principle, alone, they provide only partial insights into researcher careers. This is because much of the data which is of interest to research on post-doctoral careers is not publicly available.

Recent, more specific projects such as those run by NCUB are similarly valuable as they provide proof of concept for novel approaches to building diverse datasets. However, they are not currently considered feasible for upscaling to the larger scale populations needed for comprehensive coverage.

Given that there is a clear need for systematic tracking then we consider that there are potentially three types of potential solution, which we will briefly review in turn:

- Large-scale survey/s (new or revised);
- Use of existing data sources through linkages;
- Aggregation and facilitation of approaches.

---

[11] Exact participation figures have not been found during desk research.

Large-scale survey/s

The aims of the recent Government approach to developing greater understanding of the UK R&D workforce (via RIWS), overlap strongly with the sorts of information and understanding it is likely the UK will want from systematic researcher career tracking. Were the latter to be in place, and it to be effective, there might be no need for the R&I Workforce Survey. Thus, our question could become whether a national survey like the R&I Workforce Survey could be developed and, crucially, implemented effectively to produce the depth and range of data sought from the full range of researchers in scope, with a sufficiently high response rate for robustness.

Already in RIWS the tension has surfaced between the requirements for a sufficiently short and simple survey that could achieve the response rate necessary and the range and depth of information that it seeks to obtain. Despite what has been substantial investment (several hundreds of thousands of pounds, per survey), RIWS's reach has been very limited and participation patchy. In short, a future centralised, single national survey of researchers has little prospect of success in terms of practical deployment and runs the risk of very high cost while retaining a high risk that responses and coverage will not be sufficient. As a result, we simply choose to dismiss this option within our further discussion of potentially viable future options.

Use of existing datasets with linkages

There is a wealth of information available on the careers of researchers in existing databases and in a wide range of publicly available forms of data on the internet (and some which are not open to the public).

The LEO dataset in the UK demonstrates that it is possible to build informative tools to understand aspects post-graduation careers based on data in HESA and HMRC databases. We have no doubt that further progress could be made utilising such databases provided that they can be linked together sufficiently and robustly. On the other hand, the act of linking datasets is not a trivial process, legally or bureaucratically. In the case of LEO, a government act was required to be passed to allow for the linking of its administrative data (although Australia appears also to have managed this form of linking in their GOS).

Aside from data held by official sources, there is clearly a lot of data in public databases or placed into the public domain by graduates themselves. An inherent issue with harnessing data from such endeavours is ensuring that individuals are identified and linked correctly. Such a process requires unique persistent identifiers to be available in the datasets. Two possible candidates for such unique identifiers in the UK context are the UK National Insurance number, while another specifically for researchers is The Open Researcher and Contributor ID (ORCID) (ORCiD, 2024). The ORCID system involves a subset of International Standard Name Identifiers (ISNI) – unique identifier codes for scholarly researchers (ISNI International Agency, 2024). Such identifiers allow researchers to reliably identify themselves and their work for free by completing an ORCID record. Such records can contain personal information, contact details, affiliations, publications, and grants and awards; however, the amount of information made available to third parties can be controlled

by the researcher themselves. In the UK's recent review of academic bureaucracy[12], the importance of such persistent identifiers was highlighted.

Another issue with collecting data on researchers is identifying who they are to begin with. Doctoral graduates from the UK HEIs are recorded by HESA, but the identification of the individual student/graduate is currently closely guarded. Meanwhile the records held by HEIs about graduates is patchy and varies considerably, as they tend to be passed to alumni teams with the purpose of engaging alumni for fundraising. In our experience very partial records are held by doctoral research funders. One potential comprehensive source of useful data specifically about those who have done doctoral research is EthOS: since 2022 the British Library's E-Theses Online Service[13] (EThOS) project has collected metadata and descriptions of PhD thesis which have been awarded in the UK since 1787. It includes half-a-million theses from 140 UK HEIs. Most entries include information such as title, awardee, awarding institution and, in some cases, ORCID, DOI, and supervisor details. Some data from this dataset, if linked to other databases, could provide valuable academic insights, over and above that which could be available through HESA datasets.

Other potential sources of data which have arisen during this literature review include: LinkedIn profiles, Google Scholar pages, Institutional webpages, Organisational webpages, Company webpages, Personal webpages, Bibliometric databases (e.g., Web of Science, Scopus, PubMed etc.), research information aggregators such as ResearchGate and Academia.net, as well as ORCID pages and innovation-related databases such as KONFER. Each of these provides some valuable data of certain types, but there are clearly issues with coverage. Some sources such as LinkedIn are much richer sources of information than others and are potentially more attractive to those interested in researcher career tracking as they offer much more coverage of doctoral graduates working outside academia. Others like ORCID are primarily restricted to academics and unlikely to be used by those outside the academy (especially if they graduated more than a few years ago), while the type of information held is also limited. Topics such as career motivations, working conditions, perceptions about doctoral training, and use of skills, are all topics unavailable on such platforms.

Aside from data coverage, there are several technical issues with obtaining and using much publicly available data. In the first place, the companies hosting the data are often private companies and so are motivated to monetise their data assets. Often terms of service agreements limit the ways in which data obtained from their platforms may be used. To build a robust researcher career tracking system, such challenges would have to be addressed. Most platforms have APIs that allow customers to access data legitimately, but for a cost. Establishing the value of the data stored on such platforms would be required before negotiating access to it.

If API access is not used to obtain data from online sources there are two approaches to collating it. One is to manually collect the data in a systematic fashion. This is the approach taken by the researchers in the Toronto 10,000 PhD project and by our team in a tracking study for the British Academy. This is laborious and relatively time consuming, but it has the potential to collect data which would otherwise be unavailable through survey methods, and such data may be quite rich (but is not consistently so). It is particularly useful for tracking

---

[12] https://www.gov.uk/government/publications/review-of-research-bureaucracy
[13] EThOS has been unavailable since a ransomware attack on the British library in 2023.

individuals about whom basic data is known but who are not contactable, perhaps because of out-of-date contact details. Manual searching is also best employed in situations where the target pool is relatively small and specialised.

Another obvious approach to collecting publicly available data is data scraping, an approach used by the NCUB in a recent study. This approach involves using automated programs to iteratively move through websites and harvest some of the information they contain. While cheap and relatively easy to implement, their use is not always straightforward. Web scraping may be in contravention of the terms of use of target websites, and many have technical safeguards in place to interfere with or curtail such data harvesting activities. Given that one objective of the current project is to ensure that the researcher career tracking system is robust, it is also worth mentioning that web scraping techniques currently require close curation and regular updates to keep pace with routine changes in the source code of the websites they are targeting. Again, as with manual entry, automated methods of web scraping are promising for some aspects of researcher career tracking. However, neither alone are sufficient to collect the data needed for comprehensive researcher career tracking. Furthermore, bulk collection and subsequent storage of personal data from public sources would require GDPR considerations.

Our conclusion is that this option – use of elements of data about researchers held in different databases and linked together – could well have considerable merit in future, but currently is not believed to be feasible on any wide scale. However, a wise next step could be to spend time working out what could be feasible, and what would be needed to facilitate the necessary linkages in particular.

An 'aggregation and facilitation' approach

An alternative approach to the two above is a hybrid approach, which could include elements of both primary research through surveys and utilisation of data held in a variety of information sources. Realistically, at the current time and to balance the desires of varied stakeholders which are likely to change over time, a hybrid approach may be the best way forward at the current time.

Firstly, a modular conception of career tracking data would allow for us to start somewhere and work iteratively, progressively and flexibly towards a system which is as informative and as complete as possible while also being able to respond to future needs. Some data might be obtained via surveys by a variety of parties, some incorporated via administrative data linkage, and some via bespoke collection of publicly available data or licensed data sources. Clearly, persistent unique identifiers would be critical in order to combine elements of data, along with robust data security and GDPR controls. Access to whatever datasets result would have to be flexibly limited.

Once technical specifications have been established for development of a modular database, then populating it with data would require a standardised approach. A central organisation (perhaps an 'observatory; or a 'national centre') could develop and disseminate tools and protocols for HE institutions, funders, subject associations professional bodies and other relevant stakeholders to utilise in relevant surveys they run, and in return aggregate some of the data they collect. To an extent, this is the approach currently used by Vitae in facilitating the CEDARS survey and developing and publishing aggregate statistics, and AdvanceHE does much the same for the well-established PRES and PTES of postgraduate students in the UK. A significant role would be the engagement of those third parties and

negotiating with them to ensure that elements of the data they collect are sufficiently aligned for aggregation.

In turn, such an organisation, through its central position in relation to potential researcher career tracking and stakeholder support, would be in a better position than any single funder or institution to engage and undertake co-development work with HESA, HMRC, LinkedIn and others in order to utilise and link their datasets, cross-reference their data to other sources such as ORCID and incorporate NI numbers. In time, this could begin to make progress on a linkage-based solution, with decreasing reliance on surveys. Its activities should align with the protocols of the Research and Innovation Careers Observatory (ReICO) discussed above.

Critically, the benefits of centralising protocols, data management and security are matched by the advantages of HEIs and other research performing organisations being actively involved in reaching out to their alumni. They are the best placed to encourage alumni to actively engage in data collection processes, often being in possession of contact details. They are likely to be able to develop the meaningful and sustained alumni engagement systems that need to be better leveraged in the UK. A further benefit of such engagement would be for HEIs to be able to benchmark against one another – as they do for certain elements of data from PRES, CEDARS and GO – and for prospective students potentially also to be able to do so too, when selecting doctoral programmes.

It is also likely that a hybrid approach, supported by a central aggregation and facilitation body, will increase engagement of researchers in any provision or sharing of data sought from them. Researchers will be more likely to trust a third party (potentially a government-endorsed or -supported body) with their salary and employment data, where it is sought from them, whereas they might be more likely to provide useful feedback on researcher development activities to the HEI that trained them or to the body that funded them.

Next steps

We prefer the third option of those outlined above, because while the second (data linkage) is attractive we do not believe it is currently sufficiently attainable. Nonetheless, adoption and some progress of the third option could lead to the following steps in terms of further activities:

- Particular feasibility studies, such as piloting some alignment and aggregation of individual funder- or HEI-focused tracking studies, in order to develop common approaches to topics and methodologies.
- Development of guidelines for such parties planning "exit" or destination surveys of graduating doctoral students – this could assist in the collation of contact details, ORCID numbers, LinkedIn pages and other critical information about UK researchers, ensuring that any future tracking activities have corroborating data. This could also be a good opportunity to gain critical GDPR permissions for future activities;
- Re-kindling and focusing the idea of establishing a group of key individuals representing significant stakeholders, as a sounding board for further steps and to support those incremental steps forward;
- Further desk research and engagement to establish the specific data needs of different stakeholders and for different purposes, and requirements of different data asset holders should linkage be considered;
- Development of funding models for such future developments.

References

Allum, J., Kent, J. & McCarthy, M. (2014). *Understanding PhD Career Pathways for Program Improvement.* (A CGS Report). Washington, DC: Council of Graduate Schools

Auriol, L. (2010). *Careers of Doctorate Holders: Employment and Mobility Patterns.* OECD Science, Technology and Industry Working Papers, No. 2010/04. Retrieved from https://doi.org/10.1787/5kmh8phxvvf5-en

Auriol, L., Schaaper, M. & Felix, B. (2012). *Mapping Careers and Mobility of Doctorate Holders Draft Guidelines, Model Questionnaire and Indicators – Third Edition.* OECD Science, Technology and Industry Working Papers, No. 2012/07. Retrieved from https://doi.org/10.1787/18151965

Boman, J., Baginskaite, J., Sturtz, T. De Young Becker, E., Brečko, B., & Berzelak, J. (2017). *Career Tracking Survey of Doctorate Holders: Project Report.* European Science Foundation. Retrieved from https://www.esf.org/fileadmin/user_upload/esf/F-FINAL-Career_Tracking_Survey_2017__Project_Report.pdf

Boman, J., Beeson, H., Sanchez Barrioluengo, M., & Rusitoru, M.-V. (2021). *What comes after a PhD? Findings from the DocEnhance survey of doctorate holders on their employment situation, skills match, and the value of the doctorate.* European Science Foundation. Retrieved from https://doi.org/10.5281/zenodo.7188085

Coalition for Next Generation Life Science (CNGLS). (2024a). *Data for a Stronger Workforce.* Available at Data | NGLS Coalition

Coalition for Next Generation Life Science (CNGLS). (2024b). *Definitions.* Retrieved from Coalition-Career-Outcomes-Taxonomy.xlsx (live.com)

Council of Graduate Schools. (2020). *Shaping New Narratives about PhD Careers: A Communications Resource to Advocate for Career Diversity.* The Council of Graduate Schools. Retrieved from ShapingNewNarratives2020.pdf (cgsnet.org)

Council of Graduate Schools. (2024). *PhD Career Pathways initiative.* Available at: https://cgsnet.org/project/understanding-phd-career-pathways-for-program-improvement

Department of Education. (2024). Longitudinal Education Outcomes (LEO): collection. Available at Longitudinal Education Outcomes (LEO): collection - GOV.UK (www.gov.uk)

Department for Business, Energy & Industrial Strategy. (2021). *R&D People and Culture Strategy: People at the heart of R&D.* Retrieved from https://assets.publishing.service.gov.uk/media/60f804228fa8f50c768387c5/r_d-people-culture-strategy.pdf

Department for Science, Innovation and Technology. (2023). *Research and innovation (R&I) workforce survey report 2022.* Available at Research and innovation (R&I) workforce survey report, 2022 - GOV.UK (www.gov.uk)

Diamond, A., Ball, C., Vorley, T., Hughes, T., Moreton, R., Howe, P., & Nathwani, T. (2014). The impact of doctoral careers. *Final Report*, *130*.

DocEnhance. (2022). *DocEnhance Platform: Transferable Skills for Doctoral Education.* Available at: https://docenhance.eu

DZHW German Centre for Higher Education Research and Science Studies. (2019). *National Academics Panel Study (Nacaps)*. Berlin: DZHW German Centre for Higher Education Research and Science Studies. Available at: https://www.nacaps.de/en/studie

European Commission. (2021). *MORE4: support data collection and analysis concerning mobility patterns and career paths of researchers*. Available at https://data.europa.eu/doi/10.2777/645537

European Commission. (2024). *The Commission and the Organisation for Economic Co-operation and Development launch the Research and Innovation Careers Observatory.* Available at The Commission and the Organisation for Economic Co-operation and Development launch the Research and Innovation Careers Observatory - European Commission (europa.eu)

Ministère de l'Enseignement Supérieur de la Recherche. (2021). *Insertion professionnelle des diplômés de doctorat - données nationales sexuées par disciplines détaillées – Enquête IP Doc*. Available at Insertion professionnelle des diplômés de doctorat - données nationales sexuées par disciplines détaillées – Enquête IP Doc — Plateforme open data (données ouvertes) (enseignementsup-recherche.gouv.fr)

Gascoine Toss and Associates. (2012). *Career support for researchers: Understanding Needs and developing a best practice approach.* ACOLA Secretariat.

Group of Eight Australia. (2018). *Go8 Media Release: Go8 to Conduct Ground Breaking Survey of PhD Outcomes*. Available at Go8 Media Release: Go8 to Conduct Ground Breaking Survey of PhD Outcomes – Group of Eight

Higher Education Statistics Agency. (2017). *Destinations of Leavers from Higher Education Longitudinal survey*. Available at Destinations of Leavers from Higher Education Longitudinal survey | HESA

Higher Education Statistics Agency. (2018). *Destinations of Leavers from Higher Education 2016/17*. Available at Destinations of Leavers from Higher Education 2016/17 | HESA,

Higher Education Statistics Agency. (2024a). *Graduates Outcomes Survey*. Available at Home | Graduate Outcomes

Higher Education Statistics Agency. (2024b). *Higher Education Staff Data*. Available at HE Staff Data | HESA

Ipsos Mori. (2013). *Risks and Rewards: How PhD Students Choose Their Careers.* Wellcome Trust. Retrieved from https://wellcome.org/sites/default/files/wtp053947_0.pdf)

ISNI International Agency. (2024). *About ISNI*. Available at ISNI | Home Page

Medical Schools Council. (2024). *UKMED.* Available at UKMED | Medical Schools Council (medschools.ac.uk)

Mellors-Bourne, R., Metcalfe, J., & Pollar, E. (2018) *Royal Society Research Fellowships: Career Pathway Tracker.* Careers Research & Advisory Centre. Retrieved from https://royalsociety.org/-/media/grants/career-pathway-tracker/crac-data-report.pdf

National Center for Science and Engineering Statistics. (2017). *Early Career Doctorates Survey (ECDS), 2017*. Available at Early Career Doctorates Survey (ECDS) 2017 | NSF - National Science Foundation

National Center for Science and Engineering Statistics. (2022). *Doctorate Recipients from U.S. Universities: 2022*. Available at Doctorate Recipients from U.S. Universities: 2022 | NSF - National Science Foundation

National Center for Science and Engineering Statistics. (2023). *SURVEY OF DOCTORATE RECIPIENTS: Study information*. Available at SDR Study Information (nsfsdr.org)

National Centre for Universities and Business. (2021). *Pathways to Success: Supporting Researcher Mobility*. https://www.ncub.co.uk/wp-content/uploads/2021/07/6055_NCUB_Researcher_Career_Mobility_Taskforce_2pp.pdf

National Centre for Universities and Business. (2023). *Pathways to Success*; *Supporting Researcher Mobility*. Available at Pathways to Success - National Centre for Universities & Business (ncub.co.uk)

OECD. (2015). *Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities*. OECD Publishing: Paris. Retrieved vrom https://doi.org/10.1787/9789264239012-en.

OECD & Eurostat. (2018). *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities*. OECD Publishing: Paris/Eurostat: Luxembourg. Retrieved from https://doi.org/10.1787/9789264304604-en

OECD. (2024). *OECD Science, Technology and R&D Statistics*. Available at OECD Science, Technology and R&D Statistics | OECD iLibrary (oecd-ilibrary.org)

Office for National Statistics. (2024). *Labour Force Survey*. Available at Labour Force Survey - Office for National Statistics (ons.gov.uk)

ORCiD. (2024). *ORCID is for…* Available at ORCID

Ospina, J., & Rodriguez, M. (2023). *Building a data-driven picture of researcher intersectoral mobility in the UK*. [Report]. NCUB. Retrieved from https://www.ncub.co.uk/wp-content/uploads/2021/07/6060_NCUB_Data-Driven_Picture_Researcher_Mobility_in_the_UK_Report_V3.pdf

PPMI. (2019). *Mobility Patterns and Career Paths of EU Researchers*. Available at More4: Mobility Patterns and Career Paths of EU Researchers (more-4.eu)

Quality Indicators for Learning and Teaching (QILT). (2023). *Graduate Outcomes Survey – Longitudinal*. Available at Graduate Outcomes Survey - Longitudinal (qilt.edu.au)

Reithmeier, R., O'Leary, L., Zhu, X., Dales, C., Abdulkarim, A., Aguil, A., Brouillard, L., Chang, S., Miller, S., Shi, W., Vu, N. & Zou, C. (2019) The 10,000 PhDs project at the University of Toronto: Using employment outcome data to inform graduate education. *PLOS One*, 14(1). https://doi.org/10.1371/journal.pone.0209898

The Royal Society. (2018). *Career pathway tracker: 35 years of supporting early career research fellows.* Retrieved from https://royalsociety.org/-/media/grants/career-pathway-tracker/royal-society-commentary.pdf

Social Research Centre. (2024). *2023 Graduate Outcomes Survey: Methodological report*. Australian Government Department of Education.

Vitae. (2013) What do researchers do? Early career progression of doctoral graduates, CRAC/Vitae

Vitae. (2022). *What do researchers do?* CRAC/Vitae. https://www.vitae.ac.uk/impact-and-evaluation/what-do-researchers-do

Vitae. (2012) What do researchers want to do? The career intentions of doctoral researchers. CRAC/Vitae

Vitae. (2016). What do research staff do next? CRAC/Vitae

Warwick Institute for Employment Studies. (2021). *What is Futuretrack?* Available at Futuretrack - What is Futuretrack? (warwick.ac.uk)

Appendix – Other Doctoral Career Tracking Efforts

The above review of doctoral recent doctoral career tracking efforts is not intended to be comprehensive but rather informative. While reviewing the literature many approaches became apparent. We have selected to describe in detail those which were sizable, systematic, novel. On the other hand, we also believe that a collection of literature in this field which is as comprehensive as possible is inherently valuable. Therefore, this is included below. We intend to add to it as other initiatives are made known to us.

- Spain: Autonomous University of Madrid[14] (AUM)
- Italy: University of Turin[15]
- USA: Vanderbilt University[16]
- Switzerland: Universite Lausanne[17]
- Sweden: Institut Karolinska[18]
- Canada: PhD Detectives (2019)[19]
- Canada: TRaCE project[20]
- USA: Center for Innovation and Research in Graduate Education (CIRGE)
    - PhD Ten years Later[21] (life science, engineering, humanities, physical science, and social science. 61 US institutions, 6000 PhDs, 1983-1985))
    - Art History PhDs[22] – A decade later (U.S. art and architectural history PhDs 1985-1991 – 792 respondents – 66% response rate)
    - Social Science PhDs[23] – Five Years out (anthropology, communications, geography, history, political science, psychology, and sociology, PhDs, 65 US institutions, 1999-1999).

---

[14] https://alumni.uam.es/minisite/observatorio-de-empleabilidad/presentaci%C3%B3n-0

[15] https://www.phd.unito.it/do/home.pl/View?doc=After_the_PhD.html

[16] https://medschool.vanderbilt.edu/bret/outcomes/classifying-alumni-employment-records/

[17] https://www.unil.ch/graduatecampus/en/home/menuinst/carriere-avec-doctorat/enquete-devenir-docteures-unil.html

[18] https://medarbetare.ki.se/media/7745/download

[19] https://www.adoc-tm.ca/etudes

[20] https://tracephd.com/about-trace/

[21] https://www.education.uw.edu/cirge/phd-career-path-tracking/phd-holders-in-natural-sciencesengineering/

[22] https://www.education.uw.edu/cirge/phds-in-art-history-over-a-decade-later/

[23] https://www.education.uw.edu/cirge/phd-career-path-tracking/2261-2/

Appendix – Innovative approaches to analysing doctoral careers

- Edwards, K. A., Acheson-Field, H., Rennane, S., & Zaber, M. A. (2023). Mapping scientists' career trajectories in the survey of doctorate recipients using three statistical methods. *Scientific Reports*, 13(1).https://doi.org/10.1038/s41598-023-34809-1

- Krauss, A., Danús, L. & Sales-Pardo, M. (2023). Early-career factors largely determine the future impact of prominent researchers: evidence across eight scientific fields. *Scientific Reports*, 13(1). https://doi.org/10.1038/s41598-023-46050-x

- Vaccario, G., Verginer, L. & Schweitzer, F. (2021). Reproducing scientists' mobility: a data-driven model. *Scientific Reports,*11(1). https://doi.org/10.1038/s41598-021-90281-9

- Collins, T., Ramadoss, D., Layton, R.L., MacDonald, J., Wheeler, R., Bankston, A., Stayart, A., Hao, Y., Robinson-Hamm, J.N., Sinche, M., Burghart, S., Carlsen-Bryan, A., Eswara, P., Krasna, H., Xu, H. & Sullivan, M. (2021). Making Strides in Doctoral-Level Career Outcomes Reporting: Surveying the Landscape of Classification and Visualization Methodologies and Creating a Crosswalk Tool. *BioRxiv.* (Cold Spring Harbor Laboratory). doi: https://doi.org/10.1101/2021.07.12.451657

- Ullrich, L., Ogawa, J., Jones-London, M. (2024). A Retrospective Analysis of Career Outcomes in Neuroscience. *eNeuro*, 11(5). https://doi.org/10.1523/ENEURO.0054-24.2024