Technopolis Study of Researcher Careers

2007

Forfás

Foreword

The Strategy for Science, Technology and Innovation 2006-2013 (SSTI) has set targets to double the number of postgraduate researchers by 2013 and significantly increase the number of researchers employed in industry. A structured career path is necessary to attract and retain talent to this profession.

The Government Inter-Departmental Committee requested the Advisory Science Council (ASC) to examine, and come forward with proposals on a career structure for researchers, as set out in the Strategy for Science, Technology and Innovation 2006-2013 (SSTI). The ASC set up a Taskforce on Researcher Careers and published its findings in their report 'Towards a Framework for Researcher Careers[1]'.

Forfás, in providing the Secretariat support for the ASC Taskforce work, commissioned Technopolis to carry out a study examining the development of Researcher Careers in Ireland. This report provides an overview of research careers in Ireland, good practice in other countries and aims to identify and suggest ways to address barriers to the development of careers for researchers within the academic, public research and enterprise environment. It is based on a large-scale questionnaire and interview-based consultation with the Irish research community, desk research and studies of initiatives in the UK, Sweden and the Republic of Korea that aim directly or indirectly to improve research careers.

This report presents the Technopolis study on Researcher Careers.

Forfás wishes to acknowledge commitment and dedication of the Technopolis Team assigned to the study, especially Dr Erik Arnold (Director), Judith Eccles and Philippe Larrue with Neil Brown, Inga Hallgren, Edward Kitching, Shruti Rajan and Elizabeth Zaparucha.

[1] http://www.sciencecouncil.ie/reports/index.html

Executive Summary

Ireland, like other countries, aims to increase the knowledge-intensity of enterprise and hence the proportion of GDP spent on R&D. This cannot be done without increasing the size of the research community in academia and in industry. A key implication is that a smaller minority of PhD graduates will in future find careers in academia. Researcher training and careers must become more attractive and must change to face these new realities.

Context

The EU has long promoted researcher mobility and has increasingly emphasised the need for improved research careers since the launch of the European Research Area in 2000, which inter alia promotes the idea of a common European research labour market. In 2005, the Commission introduced the European Charter for Researchers, which amounts to a non-binding set of good practice guidelines. The Irish universities have signed the charter and the Irish Universities' Association (IUA) has become an important actor in supporting mobility and research careers by acting as the Irish node in the European mobility network, proposing research career pay scales and conference activities. Some other countries have slightly longer experience of increasing PhD production and trying to improve researcher careers, especially in their uncertain early stages. In the UK, a 'concordat' between research funders and universities has provided a framework for a number of initiatives to improve research careers. Finland has reformed research careers since it decided to expand PhD production in 1997. Sweden and Korea have adopted various relevant measures but taken less structured approaches than the UK and Finland.

Research careers

The consultation with the research community showed that people go into research largely for the love of their subject, and often with little clear idea of what they will do next but with a sense that a research career will provide recognition and good working conditions. Postgraduates who do not go into research tend to place higher priority on money and career than those who do and view the prospects in research as rather uncertain and long term. Within academic research, the first few years of a career tend to be spent in 'postdoc' contract research positions with little security. The work is hard and the hours are long. As people grow older, they increasingly prioritise security and family, and a number leave research for this reason. Early stage industrial researchers are as interested in their subjects as academics, but tend to be more conscious of career needs such as transferable skills.

In practice, academic researchers experience a number of disappointments early in their career, involving lack of autonomy, poor working conditions (in terms of pay and benefits like maternity pay and pensions) and insecurity, reinforcing wider perceptions of academic research jobs as insecure and poorly paid. Above all, Irish researchers complain (as researchers do in other countries) about the lack of a clear career structure.

Improving the organisation of research careers

The researchers' complaints about poor conditions and insecurity cause a loss of potential recruits to the research community, both in industry and in academia. Globally, however, the research community relies on postdoc mobility and competition. This promotes the maintenance of entrants to the research community, so the research community's response to postdoc complaints is not completely sympathetic.

Poor working and associated living conditions are, in effect, by-products of the fact that (a) postdocs are temporary contract workers, (b) there is no proper career or salary structure for them and (c) they are not given the same status or support as permanent faculty by the universities. It will not be possible to fully address all the problems identified to the extent that the academic community wishes to continue to recruit through the current kind of contract research apprenticeship system.

Since a growing majority of PhDs will work outside academia in future, there is a need to shift the pattern of skills they acquire towards transferable skills like project management, business planning and communication. This will in Ireland partly result from the new graduate programme initiatives and will be reinforced by public-private partnerships such as the competence centres.

Many people appear to enter research because of interest in their subject but with little idea of what a career means. Levels of knowledge about research careers need to be improved – both to encourage people to enter the profession and in order that they will have realistic expectations. Not least, in order to emerge from the apprenticeship relationship with the Principal Investigators, researchers need much more active support from their institutions and others in career planning. UK experience, however, suggests that an intervention outside the universities (UK Grad) that directly provides careers information, tools and training is a helpful complement that empowers researchers to take career planning into their own hands.

Ireland needs a more clearly articulated and modern research career structure, adapted to the needs of researchers in all parts of academia and consistent with preparing many of them to work elsewhere. The Higher Education Research Group (HERG) has made a good start on this. To manage and operate a clearer research career model in turn requires the more explicit involvement of university HR functions, building the common knowledge, courses and planning tools that cannot be developed if Principal Investigators continue to have the primary responsibility for research career development.

While not all researchers' concerns can be addressed, there are nonetheless things the universities can do, including offering contract researchers the same status and benefits as permanent staff and the ability to apply for research grants in their own name. This will require more transparent research management in the universities. While postdocs tend to want the same pension arrangements as permanent faculty, it may be useful to assess whether alternative arrangements (such as personal portable pensions) would be more useful.

The rapid proliferation of graduate school schemes in Ireland is a welcome development that may better align PhD skills with needs. It may be worth coordinating some common taught course elements relating to industry and commercialisation, in order to avoid fragmentation, generate scale economies and assure quality.

Ignorance about research careers should be tackled in part through improved science communications and improved careers information at all levels, including university careers' services.

Supporting postdoctoral researchers' career planning requires a combination of actions inside and outside the universities. Inside, Human Resource functions must better support Principal Investigators in developing junior researchers' careers. Externally, open training courses and information sources like the UK Grad scheme would support them further.

Improving absorptive capacity of enterprises

Irish industrial development will be blocked if industrial skill and qualification levels do not rise to include greater numbers of research-capable people. Getting increased skills into industry is difficult. It can entail persuading decision-makers to recruit people more highly qualified than them to do things they may find hard to imagine. There are nonetheless successful examples at both PhD and lower levels of raising company capabilities by hiring highly skilled individuals and therefore of triggering demand for growing levels of research training and skills in industry.

Ireland has significantly increased its investment in public-private research partnerships in recent years. These partnerships also tend to develop absorptive capacity in industry. This principle is accepted in Ireland and the instruments used are gradually increasing the extent to which industry has to be an active partner. In combination with policies to encourage PhD-level manpower into Irish firms, this should gradually raise the perceived need for research-capable industrial manpower.

Ireland has already taken the first steps to increase industrial PhD-intensity through IRCSET's Enterprise Partnership Scheme grants. It would be useful to look at ways to cluster these into graduate schools and to back this approach up by experimenting with a 'Docstart[2]' scheme aimed at companies without the resources or scale to co-fund doctoral training. Further measures to encourage short-term mobility between industry and the HE sector would be useful. Ireland has an established tradition of public-private partnerships in R&D. The key need here is to ensure that existing measures are exploited as widely as possible and that efforts focus on programmes that require active industrial participation in R&D.

[2] The 'Docstart' scheme in the UK is similar to 'Techstart' scheme in Ireland where graduates are placed in businesses and are paid a subvension to their salary by State enterprise agencies.

Mobility throughout the research career

Ireland has increasingly become an attractive place to do research and the expansion of the HE and research system has reduced the drive for people to leave the country in order to gain research training and experience. While in the past there was concern about brain drain, there now needs to be measures to ensure the international circulation of Irish researchers.

There are increasingly important barriers to researchers being able to return to academia following employment within industry, which is detrimental to both sectors. In particular, the academic world does not recognise the value of experience in industry.

In addition to continuing to exploit existing international mobility schemes, Irish research funders could usefully consider providing 'year abroad' options to PhD students, thereby ensuring international exposure while still encouraging them to return to Ireland to graduate (and by implication to work).

The HE institutions and industry (e.g. IBEC) together should consider and implement ways to recognise relevant experience outside their respective sectors for the purposes of recruitment, promotion and pay.

Ensuring the use of all available talent

While the stakeholder interviews revealed few concerns about gender, the data tells another story. This is of increasingly limited opportunities for women as they progress up the research career ladder. What we do not know is what happens to women who drop out of an academic career and whether they fare any better within industrial careers. However creating parity within the academic sphere is vital if the skills of good female researchers are not to be lost. In addition women are still under-represented in certain research sectors such as engineering. Ireland appears to have limited targeted strategies or policies for female researchers. Some other countries seem to be more pro-active in this regard and fare better in the proportions of women reaching higher academic positions.

Ireland has succeeded in attracting a good number of foreign researchers, in part owing to its strong infrastructure. Irish pay levels should make it attractive for many of those who initially come for a short period to stay longer term. Following the full implementation of the EU scientific visa in 2007, few obstacles remain to further recruitment from abroad. The key gap appears to be in measures that permit or encourage short-stay research workers and PhD students to remain in Ireland at the end of their contract or research training.

The under-use of women's talent in the Irish research system is significant by international comparison. Measures to encourage the presence of a critical mass of women researchers at all levels of research are needed and especially at higher levels. The research funders and universities should collectively decide upon a transitional period during which special women's grants and accompanying measures are put in place.

Ensuring that spouses of foreign contract research workers also have work permits is one way to ensure that Ireland is an attractive destination. A mechanism that would (whether automatically or selectively) provide a green card to foreign students on completion of their PhD would further strengthen the Irish research workforce. Such a scheme is available for those who have secured employment.

Some of the potential economic and social value of humanities and social sciences research and researcher education appears to go unrealised. This potential social value needs to be more closely investigated, to enable consideration of increased PhD and research funding.

Better information is needed so that the public, future potential researchers and policymakers alike are equipped to make good decisions about research careers. Ireland needs to participate in international statistical studies of research careers, such as those of the OECD, and on a national basis to collect more quantitative and qualitative information about the PhD and researcher cadre, including its destinations. Work by the HEA, IUA and the Expert Group on Future Skills Needs provide good foundations. Information collected should also be used in wider efforts to inform the public about research and research careers.

Systemic implementation issues

Early stage researchers lack a champion in the system of governance for research. The Higher Education Authority may be best positioned to take on this role, as Higher Education Funding Council for England (HEFCE) has done in England.

Ireland has wider reasons for incorporating a more structured research strand into academic careers. In particular, this is likely to be necessary, in order to accommodate larger research-focused departments with heavy external funding. These may resemble research institutes internal to the universities.

Establishing a more structured, higher status and better-supported research career is not something that is in the gift of any single Irish actor. Agreement will be needed among the universities, the research funders and the responsible government departments. This requires a greater level of coordination than is evident today. Once salary scales are established, the Research Councils and other funders may need to reconsider the role of price competition ('value for money') in research funding and how to partially decouple the cost of contract research staff from other assessment criteria in considering proposals.

The implications of modernising research careers within the universities are far reaching:

- Universities will need to take clear and active responsibility for managing the human resources represented by contract researchers
- If contract researchers acquire the right to act as Principal Investigators, universities will need to manage access to internal resources, such as space and equipment

- Measures will have to be built into research careers that create competition, otherwise the system will build lock-ins that limit entry and reduce quality

Examining research careers in Ireland has led us to identify two related questions about how research is funded that – while strictly beyond our scope – might usefully be investigated at a later date. First, the lack of a full economic costing model means that universities must manage their exposure to external grants carefully. This in turn constrains research and research careers. Second, lack of clarity about the division of university block grants between teaching and research constrains the ability of universities to establish research strategies. This means in effect that – unlike in many other countries - universities do not really have the discretion to invest their own funds in research; so it is hard for them to implement strategy or to take measures such as speculatively hiring contract research workers.

Contents

1 Introduction

This is a background report, commissioned by Forfás in February 2007 to help support the work of the Research Careers Task Force set up by the Advisory Science Council (ASC). The study aims to identify and suggest ways to address barriers to the development of careers for researchers within the academic, public research and enterprise environment.

1.1 Why Research Careers Matter

Research careers are important for economic and social development and not only for the abstract pursuit of knowledge (itself an honourable goal), both in Ireland and internationally. The early stages of academic research careers have always been precarious. However, little attention was paid to this internationally until economically advanced countries started efforts to increase national investments in R&D and therefore to recognise (a) the need to train many more PhDs, (b) that this meant the PhD would become a starting point for all sorts of research careers, not just academic ones, and indeed that the majority of research careers should culminate outside academia, and (c) that in this context, it might no longer be viable to rely on researchers' sense of vocation to outweigh the negative effects of existing fragmented, inconsistent and poor employment conditions. We would date this realisation to about 2000, when Ireland embarked on its ambitious project to increase the size of its research system; and when the European Commission launched the idea of a European Research Area that fed into the Lisbon competitiveness declaration; and the Barcelona goal that the EU should spend 3 percent of its GDP on R&D.

Our study therefore deals with a problem that is well known and broadly recognised, but that in practice has not been resolved. As far as we are able to determine, no one has yet devised the 'magic bullet' for improving the early stages of research careers. We speculate that this is partly due to an inherent tension: namely, that while young researchers working on fixed-term academic contracts (as many do in the early stages of their careers) have an interest in getting permanent jobs, the Principal Investigators, the Universities and arguably perhaps even the research system itself benefit from the existence of a substantial labour pool within which there is intense competition and from which only a few emerge as winners in the competition for 'proper jobs' in university faculties.

Other activities taking place within Ireland will complement the results of this study and vice versa. The Higher Education Research Group (HERG) was recently established as a key implementation structure for the national Strategy for Science Technology and Innovation. The HERG is working to develop solutions that address the barriers that may hinder progress in the attainment of the objectives of the strategy. In April 2007, it drew up terms of reference for a Research Careers Working Group to focus on career progression within the Higher Education (HE) sector.

There are clear complementarities and some potential overlap between the work of the ASC Task Force, Technopolis and the HERG group. The Research Careers Working Group has a remit covering career advancement opportunities within the HE sector whereas this study is broader and will cover research careers in the public and private sector, has a greater emphasis on the links between

academia and industry, considers mobility between sectors and international practices in these areas. One of the original objectives of this study was to make recommendations to the ASC on the format and implementation of a career structure for researchers working in the HEIs. This has been taken forward by HERG's Research Careers Working Group, hence we have – at the direction of the Task Force – not prioritised this question in our study but tackled a broader range of issues.

1.2 Methodology

This study was conducted as a series of modules:

- We met the ASC Research Careers Task Force at all its meetings between January and July 2007, discussing and refining our brief and reporting findings
- We did a series of interviews with key stakeholders and a handful of industrialists, to try to ensure that we understood the specifics of Irish research careers and what was already being done to tackle these. In all, we did 32 interviews at this stage, including 9 with senior company managers
- We collected statistics and documentation relevant to the topic and used them in this report
- Originally, we had been asked to survey PhD-trained researchers in Ireland, to understand how they experienced research careers and to learn from them what might be needed to improve those careers. However, it turned out that (a) there was no appropriate data set providing an adequate 'universe' from which we could sample[3] and that (b) separately from our study, Irish representatives were agreeing to participate in a forthcoming OECD survey that would have such a statistical basis, but that results would not be forthcoming before 2008 or 2009. We therefore agreed with the Task Force to organise a mass consultation of the Irish research community using a web-based questionnaire and to do a number of case studies of individuals, to try to identify archetypes in people's experience that could be connected back to policy development. Forfás placed advertisements in leading Irish newspapers, asking researchers to complete a web questionnaire, and we have analysed the answers in this report
- Rather than looking internationally in a fragmented or general way for good international practice to study, in discussion with the Task Force we agreed to look in some detail at measures aimed at tackling issues relevant to research careers in the UK and Sweden, and in less detail at the Republic of Korea and Finland. We did this through a mix of secondary sources, telephone and face-to-face interviews with people in the countries concerned and have exploited examples of policies and programmes in the text of this report.

List of interviewees, the questionnaires and checklists used are given in the Appendices.

[3] Through our interviews with researcher association representatives in several universities, it appears that several initiatives are under way to organise a better system of information regarding the local communities of researchers.

1.3 The online consultation

An online consultation provided us with direct access to more than a thousand researchers. The aims of the survey included mapping out the career paths of postgraduates and post-doctoral research worker who completed their postgraduate studies or their postdoctoral experience in one of the seven Universities of Ireland or in an Institute of Technology from 1997 onwards. We designed the questionnaire in discussion with the Task Force and Forfás. The questionnaire was in part inspired by an OECD survey guideline ("Careers of Doctorate Holders Core model questionnaire" version 8th of May 2006) but also provided opportunities for respondents to comment qualitatively. The open comments we received represented more than 60 pages of text.

Advertisements asking for survey responses were taken out twice in The Irish Times, The Independent and The Examiner newspapers directing potential respondents to a dedicated web page. Participants were encouraged to persuade other colleagues to respond, especially those not residing in Ireland and we contacted several universities to communicate about the questionnaire and encourage staff to respond. In response to interest from people who wanted to contribute, we made two modifications to the scope of the consultation during the two-week period:

- Responses were accepted from those who graduated earlier than 1997
- Responses were accepted from those currently taking their Masters or PhD degrees

In the absence of a sampling universe, the representativeness of the responses cannot be completely guaranteed, as we cannot compare the population of respondents to the structure of the overall population. Correspondingly, it is not possible to give a response rate. However, the absolute number of people who responded is large and the messages from the consultation are consistent both with those from our qualitative work in Ireland and with other Irish studies, as well as views from abroad dealing with similar career systems. The findings of the consultation therefore need to be taken seriously.

We ran the online consultation between 29th March and 17th April 2007. However, the success of the consultation meant that additional respondents were given the opportunity to submit written comments until 30th April using a template with two open questions that was specifically produced for this purpose. We received 1,344 responses (a 1st batch of 214 responses, then a 2nd batch of 1130 responses following a reminder). After cleaning the database of responses, the number of usable responses totalled 1,056.

Although it was important to understand as part of the survey why some students do not undertake a PhD, it was also more difficult to access non-PhD respondents, who are likely to be less interested in a survey regarding research careers. In the event, the responses were biased toward PhDs rather than Masters (who accounted for 171 of the responses).

For similar reasons, the survey was more successful in collecting responses from PhDs who have chosen to remain in the public research sector rather than those who have either left research or became a researcher in the private sector. Publicising the survey through direct contacts within

University associations or Institute networks will also have biased the response towards those working in the public sector.

The gender split of respondents was almost even, though there were marginally more responses from women (54 percent), while the majority (88 percent) of respondents were aged between 20 and 39. In total, 885 respondents held a PhD (84 percent) and 171 (16 percent) held a Master as their highest degree. As is shown in

Exhibit 1, most respondents started their careers as researchers or are currently working as such, primarily in the public sector. The fall-off between 'first' and 'current' positions shown in the exhibit is due to responses from people for whom their current position is their first position.

Exhibit 1 First and Current Positions of Respondents

	First position	Current position
Researcher in the public sector	640 (61 percent)	540 (51 percent)
Researcher in the private sector	81 (8 percent)	50 (5 percent)
Non researcher	216 (20 percent)	160 (15 percent)
No response	119 (11 percent)	306 (29 percent)

The majority of respondents were Irish (79 percent). Of the remainder, most were from the UK (24 percent of non-Irish respondents), Germany (12 percent), France (7 percent), India (6 percent), and Italy (5 percent).

In order to gain a better understanding of research careers and be able to interpret the results of the survey, we conducted over thirty interviews with the same population as was targeted by the survey[4]. During the interviews, we reconstructed the interviewees' careers to date, with the aim of understanding why they had made career choices. We systematically asked for each stage of their career what the other options they considered were, what their level of knowledge about the various options was (including the one they finally chose) and the reasons for choosing an option. We also asked about their satisfaction and their plans for the future. Therefore, although the interviews covered similar areas to the on-line survey, they also allowed us to access more qualitative and dynamic information. In order to preserve the anonymity of respondents, the list of interviewees is not provided. Some of them could too easily be recognised from their 'short stories'.

[4] Some of the interviewees were also survey respondents. In these cases their survey responses were used as a basis for the interview.

1.4 A road map

The next chapter of this report aims to set the context. It discusses the issue of research careers internationally and locates the Irish issues within that wider framework. It also gives an account of research careers in Ireland, based on the consultation exercise. Chapter 3 explores the issues raised by the consultation and our contextual interviews in greater detail, in many cases giving examples of both Irish and foreign policy interventions aimed at resolving the issues. Where appropriate, we give recommendations. The final Chapter draws together some conclusions and summarises the recommendations. Methodological details are shown in the Appendices.

Our interview checklists, the questionnaire we used for the research community consultation and the names of our interview partners are shown in Appendices E and F.

2 Research Careers in Context

This Chapter sets the context for the subsequent discussions of issues and recommendations. It begins by looking at research careers from an EU perspective, showing that the issue has been seen as deserving priority in the time since the European Research Area was launched (2000). We then look at strategies and studies in Ireland over the last few years concerning research careers. Third, we look outside Ireland to confirm that research career studies provide similar diagnoses to those emerging at the EU and Irish levels. Finally, we look at what the research community consultation tells us overall about research careers in Ireland. This descriptively sets the scene for the analyses of issues in the subsequent chapter.

2.1 Research Careers in the EU

The European Commission has been promoting researcher mobility via the Marie Curie scheme for some decades now, but a new emphasis on mobility appeared with the Communication[5] proposing a European Research Area in 2000. This identified a need to introduce a European dimension into research careers, making special reference to the need for researcher mobility and to make better use of women's under-exploited talents in research. In the following years, the Lisbon and Barcelona declarations by the Council of Ministers confirmed the EU's desire to invest more in innovation and research and underpin significant expansions in both PhD education and the numbers of researchers needed in society. In particular, the Barcelona Goal of spending 3 percent of Europe's GDP on R&D – of which 2 percent is to be spent in industry – requires a dramatic increase in research capacity not only in academia but also in industry, with the majority of PhDs ultimately finding careers outside academic research. Of course, some countries (such as Sweden) had already started measures to increase the PhD-intensity of industry, but the Barcelona Goal marks the adoption of this principle at the continental level.

A 2003 Communication[6] was explicit about the implications for careers of the increased need for researchers across society and launched a series of studies, strengthening of the Researchers' Mobility Portal (of which the Irish Universities Association (IUA) is the Irish node) and other measures – of which the most important for this study is probably the European Charter[7] for Researchers, which was launched in 2005.

The Charter sets out the need for research freedom provided it is conducted ethically, responsibly and professionally. Employers should obey employment law and relevant laws on intellectual property, in their dealings with researchers. Researchers are accountable to society. They should follow good practice and disseminate their results scientifically, commercially and publicly. They should be part of a proper system of research supervision and benefit from continuing professional development. Researchers should be recognised and treated as professionals, not be subject to discrimination and enjoy a good working environment and employment conditions. They should, as

[5] COM(2000) 6 final, Towards a European Research Area
[6] COM(2003) 436 final, Researchers in the European Research Area: One Profession, Multiple Careers
[7] European Commission, The European Charter for Researchers and The Code of Conduct for the Recruitment of Researchers, Brussels: EC, DG-Research, 2005

far as possible, have stable employment conditions in line with the Directive on Fixed Term Workers 2003 Act. They should enjoy comparable salaries to permanent faculty; there should be a good gender balance; and researchers should benefit from structured career development with opportunities for mobility as well as training and careers advice. Their contributions to research should be recognised via co-authorships, they should be properly supervised, and benefit from the opportunity to teach, while not being over-burdened by teaching loads. They should be regularly and reasonably evaluated but there should also be an appeals process. They should be 'citizens' of the institutions in which they work, with the same rights to representation in governance as other staff.

Employers should ensure the recruitment standards and processes are fair and transparent with appropriate recognition given to mobility and to CVs where experience is accumulated in unconventional ways or sequences. There should be a time limit on post-doctoral contract employment.

2.2 Ireland

The need for this study has emerged as a result of significant changes to the research landscape in Ireland. The National Development Plan 2000-2006 saw a shift in public policy, with a €2.5 billion investment in Research, Technological Development and Innovation (RTDI) and a corresponding need for increased research training capacity and a much greater number of scientists. The major initiatives that emerged were the creation of Science Foundation Ireland (SFI) in February 2000 and the expansion of the Higher Education Authority (HEA) Programme for Research in Third Level Institutions (PRTLI), which had originally been launched in 1998. The PRTLI provides integrated financial support for institutional strategies, programmes and infrastructure and aims to ensure that institutions have the capacity and incentives to formulate and implement research strategies. There has also been increased funding for Marine, Agricultural and Health research, and the establishment of two research councils – the Irish Council for Science, Engineering and Technology (IRCSET) and the Irish Research Council for Humanities and Social Sciences (IRCHSS). These organisations have responsibility for funding postgraduate research across a broad range of disciplines. Funding for the research councils is channelled through the HEA via the Department for Education and Science.

The Strategy for Science, Technology and Innovation, 2006-2013 (SSTI) sets out a vision that 'Ireland by 2013 will be internationally renowned for the excellence of its research, and will be at the forefront in generating and using new knowledge for economic and social progress, within an innovation driven culture.' It therefore proposed targets to increase the number of researchers at all levels, including Principal Investigators, Researchers (PhD+), Research Assistants, Technicians – and especially PhD Student Places (Exhibit 2). Though the targets are for modest increases in the other categories, the goal involves doubling the 2003 output of PhDs by the year 2013.

This study was prompted by concern that achievement of this target may be hampered by the lack of an attractive career structure for researchers in Ireland and the problems this may cause in attracting people into an early stage research career or attracting researchers from overseas. In practice, many respondents and interview partners were astonished at the SSTI strategy of doubling

the number of PhDs whilst they themselves struggle to find jobs. Others thought that Say's Law would apply over time, so that supply would create its own demand, stimulating innovation across society.

Exhibit 2 Target Growth of PhD Graduations

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013
SET PhD Graduates	543	606	660	724	801	881	919	958	997
HSS Output* PhD Graduates/Post-docs	187	284	234	285	282	300	306	306	315
*In the same period, 1,815 additional post-docs will have undertaken four years of study in supported research teams ** HSS data groups PhDs and Post-docs as Post-doc awards are an integral part of the completion cycle in HSS									

In practice, Ireland appears broadly to be on track so far to meet the targets set out in the Strategy for Science, Technology and Innovation. Exhibit 3 shows the growth in the number of PhD enrolments in Ireland. It shows that enrolments have increased by 1540 between 01/02 and 05/06.

Exhibit 3 Growth in the number of PhD enrolments - Ireland[8]

	00/01-01/02	02/'03	03/'04	04/'05	05/'06
FT PhD	2687	3173	3625	3998	4151
PT PhD	556	489	505	876	632
Total PhD	3243	3662	4130	4874	4783

While much has been written about the issue of research careers in Ireland and elsewhere, there is still a lack of real data for Ireland or comparative data about some of the concerns raised in this report. For example, little is known at the moment about the whereabouts of Irish researchers, their mobility levels and their career motivations. The survey carried out as part of this study will provide some data, as will the longitudinal study being carried out by the Geary Institute on behalf of the Irish Universities Association. The OECD is attempting to harmonise indicators on the careers and mobility of doctorate holders and is undertaking an international survey in which Ireland will participate, although results will available after the Researcher Careers Task Force deliberations. We have therefore drawn conclusions about research careers on the basis of a mixture of qualitative and quantitative data.

[8] Source: Higher education: key facts and figures 2005/06, HEA

Submissions made to the HERG working group covered many of the issues that this study has also considered. They outline the current situation in relation to contract researchers, including the current career structure, issues related to career development and life-lifelong learning, and recognition of the roles of contract researchers. It also made a series of recommendations relating to research careers and the identified issues.

Recent ASC work has also highlighted the need for research career structures in Ireland. Its report on health research[9] argued the need in the health research sector. The latest report on industry-higher education linkages[10] points to the low absorptive capacity of much of Irish industry[11]. It argues that there is a need to reinforce national applied research strengths in order both to serve and to help develop industry. It endorses the intentions set out in the national science strategy both to strengthen applied research and to establish an Irish variant on the 'competence centre' form of joint industry-higher education joint centres of excellence as well as stressing the importance of researcher mobility – both among Irish-based institutions and internationally. This is consistent with the recommendations in the 2004 evaluation[12] of the RTDI for Collaboration programme.

The Irish Universities Association (formerly CHIU) has produced significant contributions to the debate about research careers in Ireland. Its work on the future of the PhD, reflected in conference proceedings[13], points out that the first destination of new PhDs were evenly divided among academic and other jobs in the HEA's 2002 statistics and that the increasing need for PhDs outside higher education increasingly meant that their career orientations and expectations should be adjusted accordingly. This implied a need for more diverse and flexible PhD education. The 2005 conference[14] on post-doctoral work set out a wide range of policy proposals for ameliorating the conditions of post-doctoral workers in Ireland, especially in relation to clearer career definitions for contract researchers and the creation of 'tenure track' positions in the universities.

The seven university members of the IUA have all signed the European Charter for Researchers. In 2002, the IUA also developed recommended salary scales for contract research workers and, in doing so, de facto proposed the four-level career path from Research Assistant, through Post-Doctorate Researcher, to Research Fellow and Senior Research Fellow. However, these scales have never been other than voluntary and depend upon a level of agreement and coordination among the universities and funders that has not been forthcoming. Recently, it appears that the IUA has changed its position[15] and decided that there should not be a research career path separate from the lecturer trajectory.

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[9] Advisory Council for Science, Technology and Innovation, *Towards Better Health: Achieving a Step Change in Health Research in Ireland*, Dublin: Forfás, 2006

[10] Advisory Council for Science, Technology and Innovation, *Promoting Enterprise-Higher Education Relationships*, Dublin: Forfás, 2007

[11] For a more detailed study, see Erik Arnold, Rebecca Allinson, Alessandro Muscio and Philip Sowden, *Making Technological Knowledge Work: A Study of Absorptive Capacity in Irish SMEs*, Dublin: Forfás, 2005

[12] Erik Arnold, Sophie Bussillet, Philip Sowden, James Stroyan, Shaun Whitehouse and Rapela Zaman with Staffan Hjorth, Jari Romanainen and Dorothea Sturn, *An Evaluation of the RTDI for Collaboration Programme*, Dublin: Forfás, 2004

[13] The Future of the PhD in Ireland Proceedings of a Conference held by CHIU, 49/10 November, 2004, Dublin: IUA, available at www.iua.ie

[14] *Building Research Careers: The Postdoctoral Experience*, Proceedings of a Conference held by CHIU, 4/5 May, 2005, Dublin: IUA, available at www.iua.ie

[15] Conor O'Carrol, IUA at a workshop held in Dublin on 16 July 2007, in connection with the work of the ASC Research Careers Task Force

IRCSET ran a symposium on the Postdoctoral Research Experience in Ireland in November 2006, which concluded[16] that

"The Postdoctoral Research Experience in Ireland" would be enhanced by addressing the following key issues:

- Providing increased Continuity of Employment, whether by means of permanent contract research positions or long term (five to seven year) research contracts
- Implementation of pension provision for contract researchers
- Standardising titles for contract researchers
- Providing structured development and support for researchers in regard to:
- Induction of new researchers
- Development of transferable, generic skills such as communication, entrepreneurship, project and financial management, IP issues
- Implementation of a regular system of performance reviews to help researchers develop and to optimize their performance
- Encouraging increased industrial contacts and collaboration
- Devise new instruments for maintaining contacts with funded researchers (wherever located) and for making them aware of career opportunities in Ireland or with Irish enterprise
- Ensuring that the work being done by different parties on research careers (e.g. European Research Network on Research Careers (DFG led), IUA, IRCSET, Advisory Science Council etc.) should be codified and more generally publicized
- Securing increased knowledge and awareness of the IUQB recommendations on supervision of PhD students

It was also recommended that a census of the research community be conducted in order to provide basic data to allow planning of development and other activities.

The IUA's Researcher Mobility Network has conducted a study of foreign researchers' motivations for coming to Ireland[17] suggesting that – despite the career difficulties discussed elsewhere – Ireland is a very attractive destination, with its attractions being (in order) -

- Quality of the research environment
- Funding opportunity
- Career development
- Standard of living
- Experience of a new country
- Opportunity to learn English

[16] IRCSET, *Report on "The Post-Doctoral Experience in Ireland,"* held on 27 November 2006, Dublin: IRCSET, 2006

[17] Jennifer Cleary and Nina McGuiness, *Survey to monitor and assess trends in the population of mobile researchers entering and leaving Ireland*, Dublin: Researcher Mobility Network Ireland, Irish Universities Association, 2006

- Family in Ireland (other than partner)
- Partner in Ireland.

The only completed study of research career conditions in Ireland that we were able to identify is one by the Trinity Research Staff Association[18] from 2006. Exhibit 4 summarises major findings from that report. (We understand the Galway Research Staff Association has a similar study under way.)

Exhibit 4 Trinity Research Staff Association

Trinity Research Staff Association (TRSA) published a survey about the working and career conditions of contract researchers in the university in 2006.

Among the 162 college contract researchers, 69 percent are between 26 and 34 years old but 10 percent are older than 40. 60 percent of them have had 1 to 4 years experience after graduation and 13 percent more than 7 years experience as a contract researcher. Some 13 percent of them have had more than 5 contracts with Trinity. The duration of the contracts is between 1 and 4 years for the longest (60 percent), and less than 10 months for the shortest (41 percent). 30 percent have had a contract of less than 3 months and 26 percent have never had a contract lasting over 6 months. 73 percent of respondents think they have no or few future opportunities in the college, and 57 percent think the same about Ireland as a whole.

The salary of 72 percent of respondents is entirely dependant on a research grant. The same proportion had not applied for a grant in their own name. However, almost 50 percent had applied in collaboration with a more senior colleague.

Wage levels depend on the field of research: humanities are less paid than SET. Salary does not increase with age, and is independent of the hours worked. 34 percent of those surveyed work more than 50 hours per week. 67 percent of respondents work sometimes or often during the week end. Only one third of respondents' salary is covered between grants. Two thirds have no pension scheme. 52 percent of respondents don't know about their entitlements to sick leave, 64 percent about their entitlements to parental leave, and surprisingly 45 percent about their entitlements to annual leave.

2.3 Evidence on Research Careers outside Ireland

[18] Trinity Research Staff Association, Contract Researchers in Trinity: A Frontline Perspective, Dublin: Trinity Research Staff Association, 2006

Our focus outside Ireland in this study was on the UK, Finland, Sweden and the Republic of Korea. The former two have been very active in reviewing and to some degree reforming research careers, whereas actions in the latter two appear more ad hoc.

In the UK, a 'Concordat' was signed in 1996 between the universities and the research funding agencies intended to promote personnel and career management of research staff, and recognition of the importance of regular review and career guidance. The key principles of the Concordat were

- Promoting the active personnel and career management of contract researchers, recognising the important contribution they make to the success of their employing institutions, including the dissemination of research results and new techniques
- Acceptance by the universities and colleges of the importance of regular review and career guidance for contract researchers, to ensure that they receive appropriate and timely advice, support, and encouragement to develop their careers and to take responsibility for so doing
- An understanding between the funding bodies and the universities and colleges of their respective roles and responsibilities
- In meeting the costs associated with management of these staff, including career guidance and retraining or other appropriate arrangements to realise broader career opportunities upon the expiry of the contract researcher's fixed-term appointment
- In keeping under review funding levels for personal or longer-term forms of support in academic research.

A key part of the detailed specification of how the Concordat should work was:

> "Rewards and other terms and conditions of service for contract research staff (for example, rates of pay, provisions for leave and sick leave, pensions, access to facilities) which are in line with those for established staff, thus avoiding the tendency for contract researchers to feel isolated from, and disadvantaged in relation to those groups of employees. A key element is an assurance of equal opportunities and the elimination of practices linked to the short-term nature of contracts which indirectly discriminate against women. Maternity leave and pay provisions for contract staff should be in line with the provisions for established staff, subject to the fixed-term period of the employment contract."[19]

A review of the situation in 2003 found that job insecurity, lack of a career structure, low status and under-resourcing of research remained major problems in research careers at the 17 UK institutions studied and developed a set of guidelines for improving research careers, as follows:

External

[19] A Concordat To Provide A Framework For The Career Management Of Contract Research Staff In Universities And Colleges, 1996; downloaded from www.universitiesuk.ac.uk/ activities/RCIdownloads/rciconcordat.pdf

- Current funding conditions, including the ineligibility of research staff to apply for their own grants
- The key role of funders
- Employment law (including the EU Directive on Fixed Term Work)

Institutional

- Lack of visible support from principal investigators and heads of department, and from the 'centre' of institutions is common although, where support does exist, research staff feel more valued and are better motivated
- Existing policies and practices are not always properly implemented or monitored
- Lack of obvious, visible career paths can lead to insecurity amongst research staff
- There appears to be a general perception in HE and the wider research community that non-research paths are not as valid as research only paths

Individual

- The short term nature of contracts can lead to insecurity, with some researchers leaving before the end of a project
- Principal investigators focus more on research outputs, the RAE and future bids, and not enough on the development of research staff
- A perceived lack of development opportunities (or inadequate publicising of such opportunities within institutions) is common, with time often cited as a reason for non-attendance
- There can be lack of openness with research staff by principal investigators
- There is little recognition or status for research staff within some departments, leading to feelings of being undervalued
- Good people management skills are lacking among the principal investigator group[20]

A study of research careers in Scotland[21] in 2001 had found many similar problems, and noted that 56 percent of the contract researchers surveyed had never heard of the concordat and less than half thought any progress had been made towards implementing it. (There are equivalent messages from our Irish researcher consultation. The seven university members of the IUA have all signed the European Charter for Researchers. However, this was a voluntary agreement and the same gap between intention and implementation exists as with the 'concordat'.

Career development issues

- Most universities offered staff development and training programmes and 80 per cent of contract research staff were aware of such opportunities. Only 68 were aware of training specifically for contract research staff and only 30 per cent had attended such a course. Those who attend such courses tend to regard them as useful.

[20] Julie Campbell, Tony Crook, Leela Damodaran, Bernard Kellett, Rosie Valerio, *Supporting research Staff: Making a Difference*, Report of a study commissioned by HEFCE as part of its Good Management strategy, University of Sheffield, 2003

[21] Chris Hasluk, Jane Pitcher and Claire Simm, *Academic Research Careers in Scotland: A Longitudinal Study of Academic Contract Research Staff, their Jobs and Career Patterns*, Edinburgh: SHEFC, 2001

- Only 35 per cent of contract research staff was aware of their employer having a formal appraisal and performance review system. A similar proportion had been formally appraised but half felt they gained nothing from the exercise.
- Informal supervision and mentoring was common with 60 per cent of contract research staff reporting such arrangements. Even here a third felt such review meetings were not useful (usually where they were infrequent).
- Only 12 per cent of contract research staff had received any form of formal careers guidance or advice. Three quarters were unaware of any network to support contract research staff.
- Career appraisals and informal feedback on job performance were key priorities for contract research staff. More training would seem to be required for those managing contract research staff, particularly in personnel issues.

Career aspirations and orientation

- Around 40 per cent of contract research staff was actively seeking their next post.
- The proportion was lower when the preferred next post was in contract research.
- Contract research staff valued job content over other aspects of their job. Despite this, 70 per cent felt that obtaining employment on a permanent contract was either 'very important' or 'important'.
- The most important factors leading to an exit from contract research were job insecurity (by a wide margin), poor promotion prospects and low pay. The factor that might temp ex-contract research staff to return to academic research would be the prospect of interesting and innovative research opportunities.
- Four types of research careers were identified: career starters, career researchers, career returnees and job starters.

Contract research issues identified for the future included

- The insecurity of academic research careers and the impact of such insecurity for the individuals and institutions concerned.
- The alienation of many contract researchers who felt isolated from their permanently employed colleagues and treated as 'second class citizens' by their employers.
- The generally inadequate and ineffectual appraisal of contract research staff.
- The need to develop research careers, including matters of job grades, progression, staff development and, ultimately, a change in the culture of academic research.

Unlike most discussions of contract research, this study raised the issue of the existence of a large group of staff who were pursuing a long-term career in academic research and for whom contract research was not just a short-term transition to some other career. In the UK and elsewhere there are parts of the higher education research system where contract research is a way of life. For example, the Science Policy Research Unit at Sussex University primarily employed people (initially up to 85 percent of the faculty; more recently a smaller majority) on a contract basis, many of them for decades, within a system of grades similar to the one proposed by the IUA and long-term human resource management policies. The report – written by people at the Warwick Institute for Employment Research, which works in a similar way – argues that the challenge is for higher education to meet the career aspirations of such staff.

Sir Gareth Roberts chaired a review[22] of science and engineering skills in the UK in 2001-2, focusing on the need to increase the supply of research-trained people in these subjects. In addition to the need to change the way these subjects are taught from early school days in order to increase the supply of people with relevant education, the review identified three distinct concerns for people considering doing a PhD in the UK:

- The low level of PhD grants in the UK;
- Uncertainty about being able to complete a PhD within the three-year grant;
- Inadequate training during the PhD that left people with no new transferable skills and therefore provided no incentives for employers to pay PhD graduates more than those with lower degrees.

The review says that one third of UK PhDs go on to an academic post-doctoral position, where they should be developing the skills to establish and lead projects but where in practice – despite the Research Careers Initiative – they rarely receive much supervision, training or careers advice, but live in uncertainty on short-term contracts. "The Review believes that enabling the individual to establish a clear career path and a development plan to take them along it are critical to improving the attractiveness of postdoctoral research. The Review therefore recommends that HEIs take responsibility for ensuring that all their contract researchers have a clear career development plan and have access to appropriate training opportunities – for example, of at least two weeks per year. The Review further recommends that all relevant funding from HEFCE and the Research Councils be made conditional on HEIs' implementing these recommendations." It also proposed that post-doctoral starting salaries be raised to about £20,000 (€30,000).

The Review also criticised industrial employers for providing poor wages and careers for R&D workers and offering them little chance to stay up to date in their fields or to achieve promotion within technical areas, as opposed to moving into more general management. It called for better university-industry links both through individual relationships and partnerships like the UK Faraday Institutes.

Prompted by the national Science and Technology Policy Council[23] Finland has been working to reform research careers since 1997, when a postdoctoral system was established, graduate schools were expanded and a principle was adopted that 'teacher-researchers' should have fixed term contracts in their early years, in order to encourage mobility. The Ministry of Education established a research careers working group in 2000-2005, as a result of which the Academy of Finland increased the number of its postdoctoral grants to individuals with the aim that 20 percent of the 1,400 people graduating with a PhD each year should be able to move into an academic research position.

[22] Sir Gareth Roberts, SET for Success: The supply of people with science, technology, engineering and mathematics skills, London: HM Treasury, 2002

23 Science and Technology Policy Council of Finland, Finland: A Knowledge-based Society, Helsinki, 1996; Review 2000: The Challenge of Knowledge and Know-how, Helsinki, 2000; Knowledge, Innovation and Internationalisation, Helsinki, 2003

Exhibit 5 Established Research career, Finland[24]

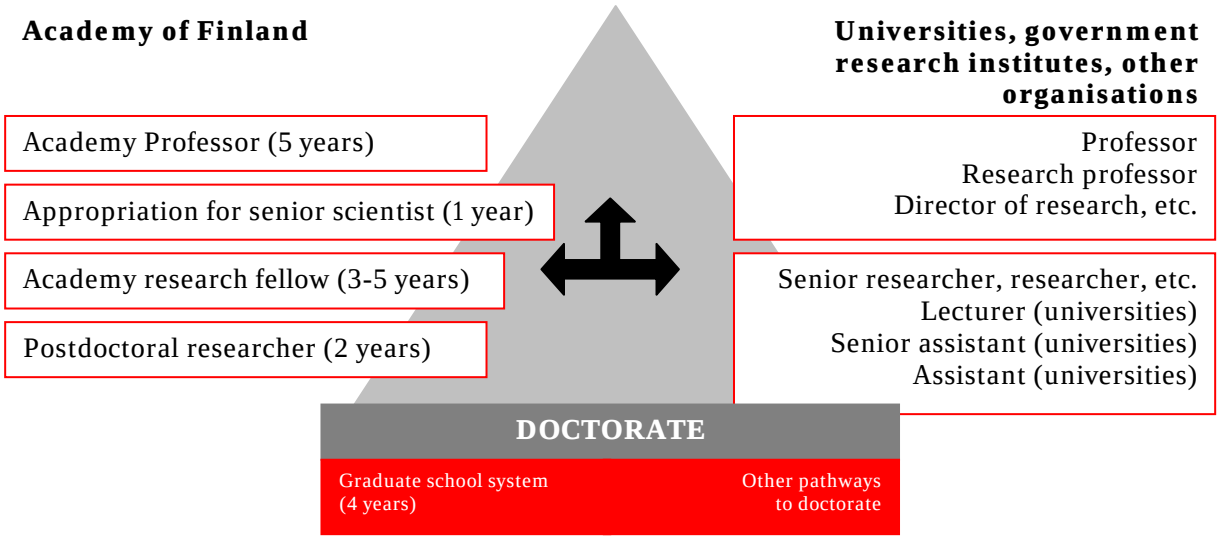


Exhibit outlines the current career structure for researchers who remain within the university and public research sector. The current education path for a researcher in Finland normally involves a three-year undergraduate bachelors and a one-year master's course before moving onto a four to five year PhD.

In 2006, two working groups reported back, one on the development of doctoral education and the other on research careers. In light of these the Ministry of Education has launched a 4-stage career structure. The careers group said that:

> "The committee sees that the greatest challenges of research careers are short terms of employment, obstacles to inter-sectoral mobility, difficulties in combining external research funding and career development, career advancement of women researchers, a low degree of international mobility, a small number of foreign researchers in Finland, attractiveness of research career, economic position of researchers, and the volume of researcher training.
>
> The committee puts forward that a four-stage research career system should be developed in Finland. This system encompasses research career in universities and public research institutes as well as in other sectors when applicable. It is based on the parallel development of the funding instruments of the Academy of Finland, Tekes, the Finnish Funding Agency for Technology and Innovation, and as widely as possible also of foundations, and on the reform of research post structures in universities and research institutes. The premise is that different stages of research career are clarified, nomenclature is simplified, and career evaluation is based on the external assessment according to uniform criteria. The research career system is

[24] Scientific Research in Finland – A Review of its Quality and Impact in the Early 2000s – Academy of Finland (2003)

financed jointly, which the committee sees the only way to get the resources needed to develop the new system. In addition, the committee puts forth that the Academy and universities are allocated supplementary finance."

The new, jointly funded research career system can be implemented mainly by exploiting and re-allocating the existing resources. The committee presumes that the target of raising R&D investment to four per cent of GDP already agreed on by the government creates prerequisites for funding the system. Supplementary funding is needed especially for extending the Academy's postdoctoral researcher system, increasing the number of Academy Research Fellows, founding posts for University Researchers in universities as well as for funding continued terms of Academy Research Fellows' and University Researchers' posts jointly by the Academy and universities. Furthermore, the committee proposes a raise in the Academy's overheads share.

The committee puts forward several actions to increase internationalisation, remove obstacles to women's research career, develop postdoctoral researcher training, and to improve the database of research careers. It also proposes that a permanent and broadly-based working group which represents wide expertise of various actors should be established to follow the implementation and impact of the recommendations made by the committee." [25]

The four stages of the planned research career path are:

1 Early stage researcher (PhD student);

2 Post-doctoral Researcher (Approx five years after the PhD);

3 University Researcher (or Academy Research Fellow in case the funding comes from the Academy of Finland);

4 Professor.

Sweden and Korea do not appear to have run studies or reviews of research careers in the same way that the UK and Finland have done. About one third of Swedish PhDs go on to a postdoctoral position – two thirds of these funded via the universities and the other third by the Swedish Science Council, so the funding solution is similar to the Finnish one.

[25] Committee on the development of a Research Career (chair Eero Vuorio), Tutkijanuratyöryhmän loppuraportti (Report of the committee on the development of research career), Helsinki: Ministry of Education, 2006

2.4 The shape of research careers in Ireland

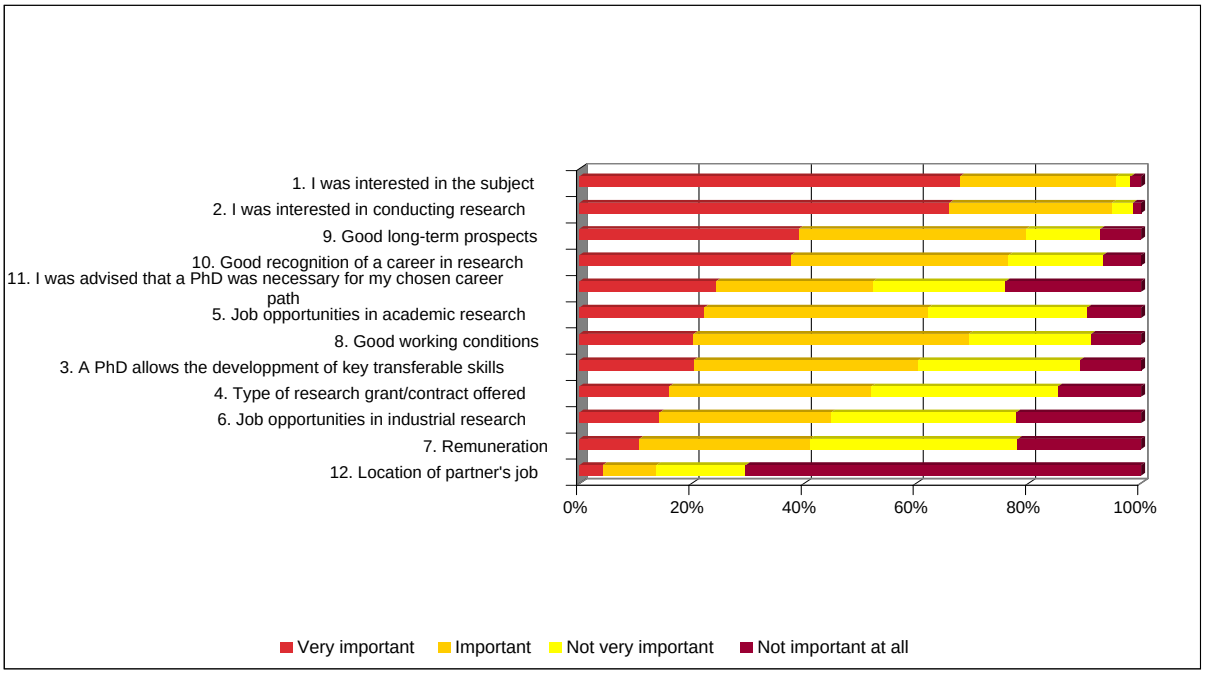
This section reports results from the survey of the Irish research community. We divided respondents between those with Masters and those with PhDs as their highest degree and asked them partly different questions. Those with Masters degrees were therefore asked why they chose not to take a PhD, while those with PhDs were asked about the rationale for their decision to take a PhD.

2.4.1 Why Researchers Do a PhD…

People who do a PhD do so for the love of the subject. The prospect of an academic career is an important motivation for them, though an increasing proportion of more recent generations expect to have non-research careers. The two most important factors in the decision to take a PhD were related to the nature or the topic of research activity conducted during the PhD. More than 90 percent of respondents considered this as "important" or "very important". Expectations of a long-term well-recognised career and of good working conditions also ranked highly, with 80 percent and 70 percent respectively stating that these were "very important" or "important".

Factors that were least often considered as important determinants in starting a PhD were related to the location of a partner's job and remuneration[26]. Only a small number of respondents reported that they had undertaken a PhD thinking about job opportunities in industrial research (only 14 percent considered this "very important").

Exhibit 6 Factors in PhD-holders' Decision to Take a PhD



[26] Many comments were received indicating that ranking remuneration as "not important" did not mean that remuneration was not important for them, but that they knew before engaging in research that they would not be paid as much as in other jobs

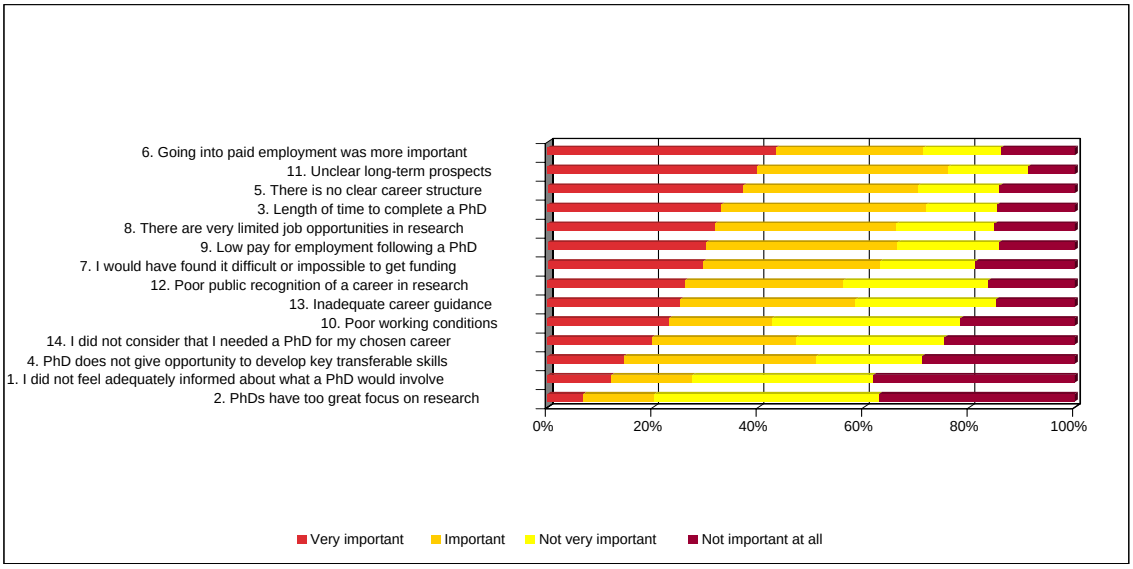
Reasons to take a PhD vary significantly by the date of graduation. For all generations, the interest in conducting research remains the most important motivation to undertake a PhD degree. However, the proportion of respondents considering this is a "very important" reason for their choice decreases from 80 percent of PhDs who graduated before 1997 to 67 percent of PhDs who graduated between 1997 and 2000 and 59 percent of PhDs who graduated since 2001. All generations were highly motivated by job opportunities in academic research (around 60 percent in general). However, recently graduated PhDs placed more importance on good long-term prospects than their elders: 44 percent of recently graduated PhDs state this was "very important", compared with only 28 percent of PhDs graduated before 1997.

2.4.2 Why Masters-holders decided not to do a PhD …

Masters holders who chose not to do a doctorate are concerned with the need to earn money immediately and are put off by the uncertainties and limited job opportunities associated with research (Exhibit 7). The five most important reasons for not taking a PhD were:

- The need to go directly into paid employment
- The unclear long-term prospects for researchers
- The unclear career structure for a PhD
- The length of time to complete a PhD
- The very limited job opportunities in research

Exhibit 7 Factors in Masters-holders' Decision Not to Undertake a PhD

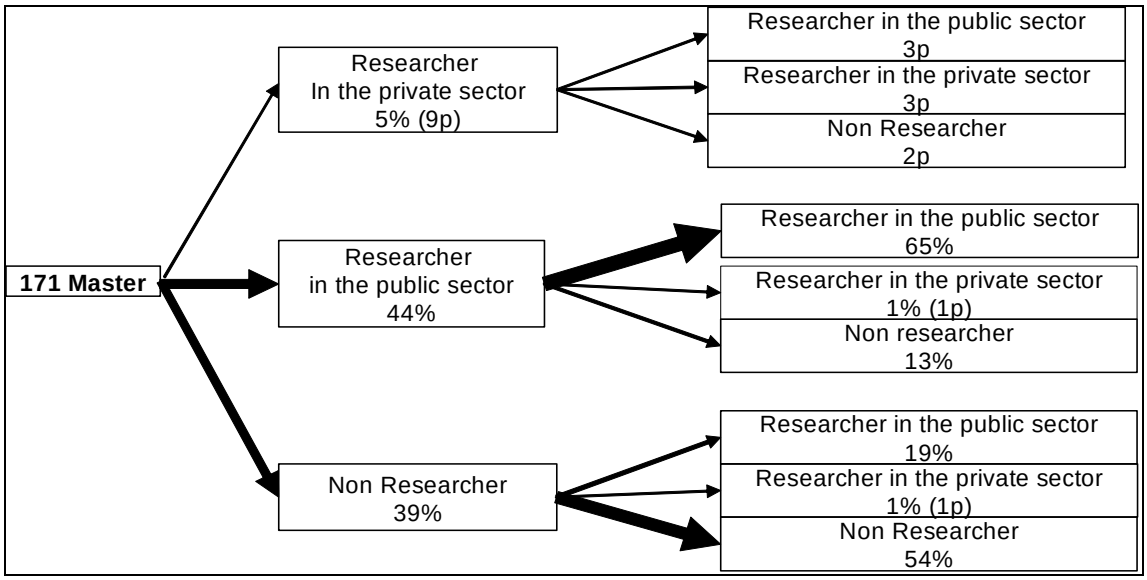


2.4.3 Career trajectories of Masters

We suspect that the Masters-level respondents to the questionnaire may be a somewhat unusual group, attracted by the newspaper advertisements' questions about research and that their responses therefore tell us more about Masters-holders who are or have been engaged in academic research than they do about Masters-holders more generally, many of whom will have gone directly form university into industry and will be holding a range of technical and other skilled jobs (including design and development).

Among the 171 respondents holding a Masters as highest degree, the biggest group (44 percent) started as researchers in the public sector and 65 percent of them remained there, so one third of all respondents with a Masters degree started and continue to have a career in public sector research. Another large group, 39 percent started their professional career in a position not related to research, of which, 19 percent subsequently took a position as a public researcher. The other main trajectory of respondents is to undertake a different kind of activity to research after their Master degree. Exhibit 8 maps out the career paths of the Masters-level respondents.

Exhibit 8 Mapping of Master degrees' career structure



Note: Percentages do not add to 100 percent owing to missing responses in the first column and to the fact that some respondents were in their first job and therefore ineligible to be in the second column, which represents second jobs.

2.4.4 Career trajectories of PhD-holders

Many more PhD holders completed the questionnaire; therefore the PhD degree trajectories presented here are more reliable. Public sector research was the dominant career choice of the PhD holders consulted. Most respondents who started in public sector research remain there. Those who went into private sector research tended either to move on into public sector research or to leave research entirely.

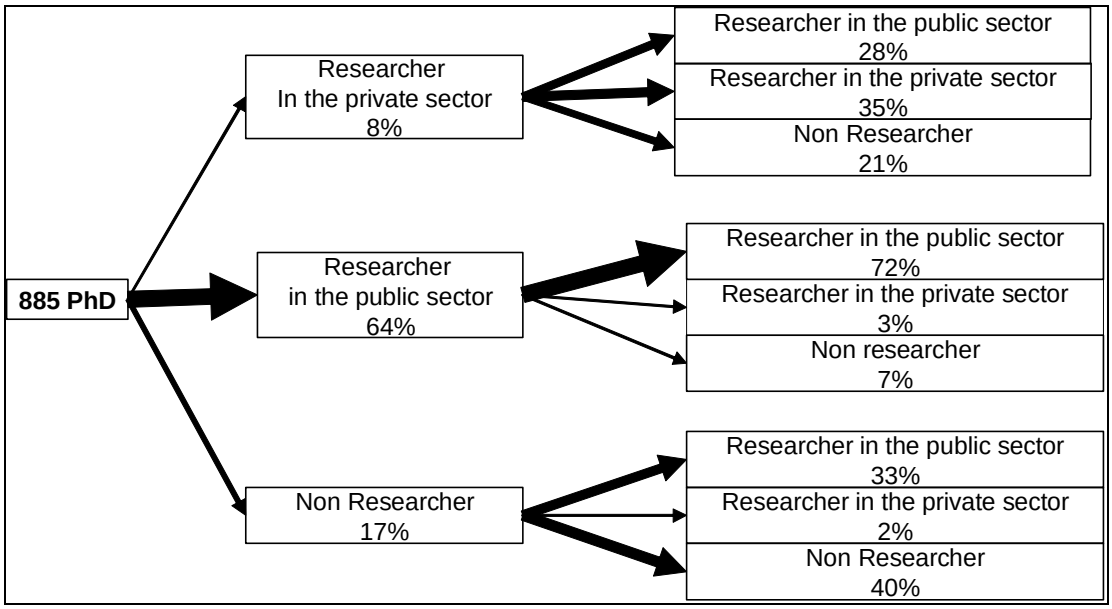
The great majority of PhDs followed the "typical path" leading from a doctorate to a career in public research. Currently, 46 percent of PhDs responding have a public sector research career. Even those who started outside research (17 percent) often came back to public research in their current positions (33 percent).

Although one should be careful with the interpretation of these results since they certainly underestimate the number of PhDs outside the public research area, it is noticeable that the mobility appears to be very low. Very few PhDs moved from public to private research or even

"transited" through private research (2 percent of responding PhDs went through private research to public research).

One of the major differences between private and public research careers is that the majority in private research move to other positions, whilst three-quarters of responding researchers beginning a public research career remain there. From a broader perspective, taking together public and private research, very few PhDs abandoned research activities.

Exhibit 9 Mapping PhD Career Structures



Note: Percentages do not add to 100 percent owing to missing responses in the first column and to the fact that some respondents were in their first job and therefore ineligible to be in the second column, which represents second jobs.

2.4.5 Factors influencing the career decisions of post-graduates and post-docs

We asked why people chose their first and current jobs, and also their levels of satisfaction with them, compared with their expectations. The typical response was, "I wanted to be a researcher." Irrespective of whether they work in the public or private sector, researchers chose the job because of its intrinsic nature. Those in industry are more interested in career and transferable skills, but there is little else to distinguish the two choices. Like those who choose not to do a PhD, those exiting the research field after their PhD move for money and better career opportunities. People for whom childcare and other family-friendly aspects of employment matter a great deal appear to select themselves out of research.

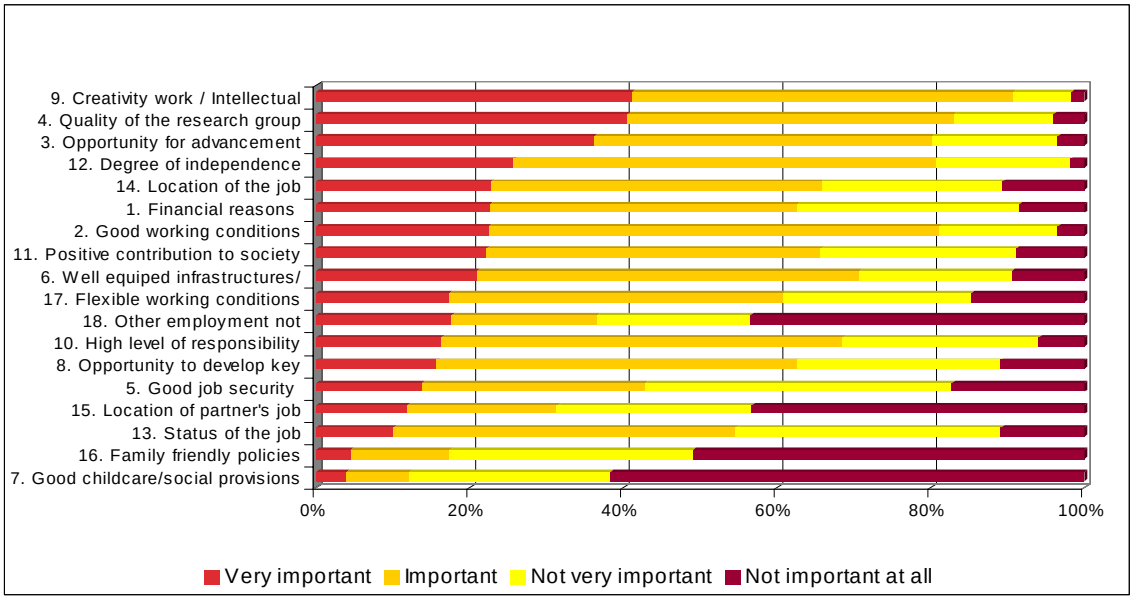
The rationales for choosing a position as a public researcher are clearly related to the nature of the activity. "I would not like to waste my life doing something that did not have real value." The creativity of the work and the intellectual challenge it entails are the main motive. The quality of the research group is also ranked as very important by a high proportion of respondents.

Surprisingly, opportunity for advancement is also ranked high, although the lack of prospects and opportunities is said (in interviews and open comments) to be a major weakness of the public research area. The reasons that are ranked as "not important at all" pertain primarily to social conditions and environment such as the availability of good child-care or social provisions as well as family support policies and measures. This is quite different from what respondents say in the free comments, which might suggest that people who want or need such facilities and policies already know that they cannot find them in an academic position and therefore select themselves out of research careers. 129 of the 211 free comments (61 percent) explained that at the time of getting their first job, "I was single, with no children; therefore child-care was irrelevant at that time. That is not the case any more."

Lack of alternative work does not seem to be a factor in choosing to do research. Public research is not generally where you end up when you have nowhere to go. It results from an active choice motivated by the very nature of this activity and its human environment. However, there are exceptions:

> "Like many people who have finished a PhD in the humanities or social sciences, I found it impossible to gain work outside of the university sector. Correspondingly, I had no choice but to take up a badly paid position in a university."

Exhibit 10 Reasons for Choosing First Position as Public Researcher

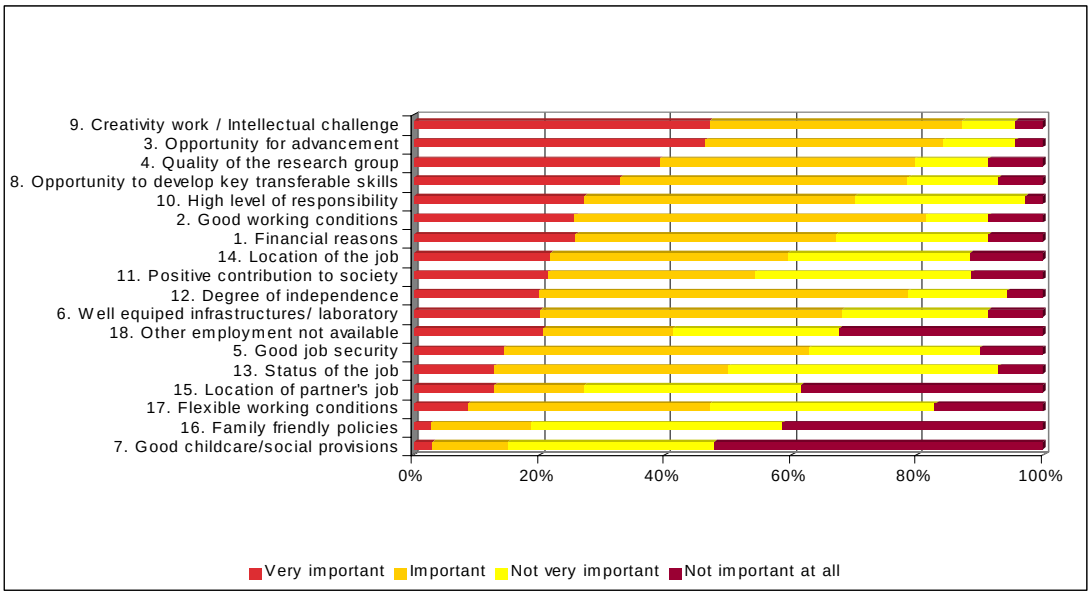


Private sector researchers display a similar response profile, with creative work, opportunities for advancement and quality of the research group ranking highly. Childcare facilities, family friendly policies and partner's job location are not important reasons for taking or finding satisfaction in a private research position.

It is also worthwhile noting that private sector researchers do not point to financial factors as more important than public researchers do. These appear in 6th position in both cases. Degree of independence ranks lower in the case of private researcher as a reason for choosing their position.

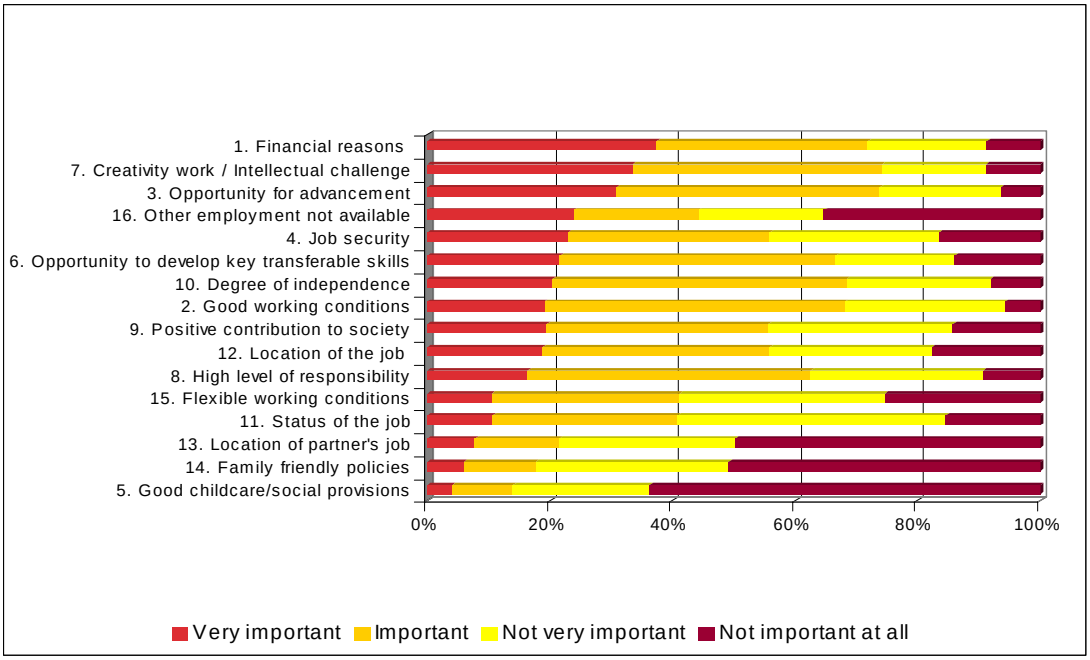
> "After working at university for 2 years, I looked around at the best possible next step for me and applied to a well-known biomedical company. The interview process was lengthy but the opportunities are unlimited. Once accepted, they match your skill set with a list of departments of interest to find an appropriate project. You make decisions about the type of research you want to do and there is a lot of give and take. You get a mentor who guides your day-to-day activities and if your research is good you get status and recognition internally and externally."

Exhibit 11 Reasons for Choosing First Position as Private Researcher



Most respondents who chose a first job outside research said this was for "financial reasons" (72 percent said this was an "important" or "very important" factor), which is quite different from researcher respondents. The majority did not choose a job outside research on the grounds that they saw no research job opportunities. ("Other employment not available" is not an important reason for 65 percent of non-research first position respondents.) In general, non-researcher respondents express less of a vocation: they have fewer strong reasons for their career choices than the researchers. It is also worth noting that non-researchers said financial motives and job security were much more important than public and private researchers did.

Exhibit 12 Reasons for Choosing First Position outside Research



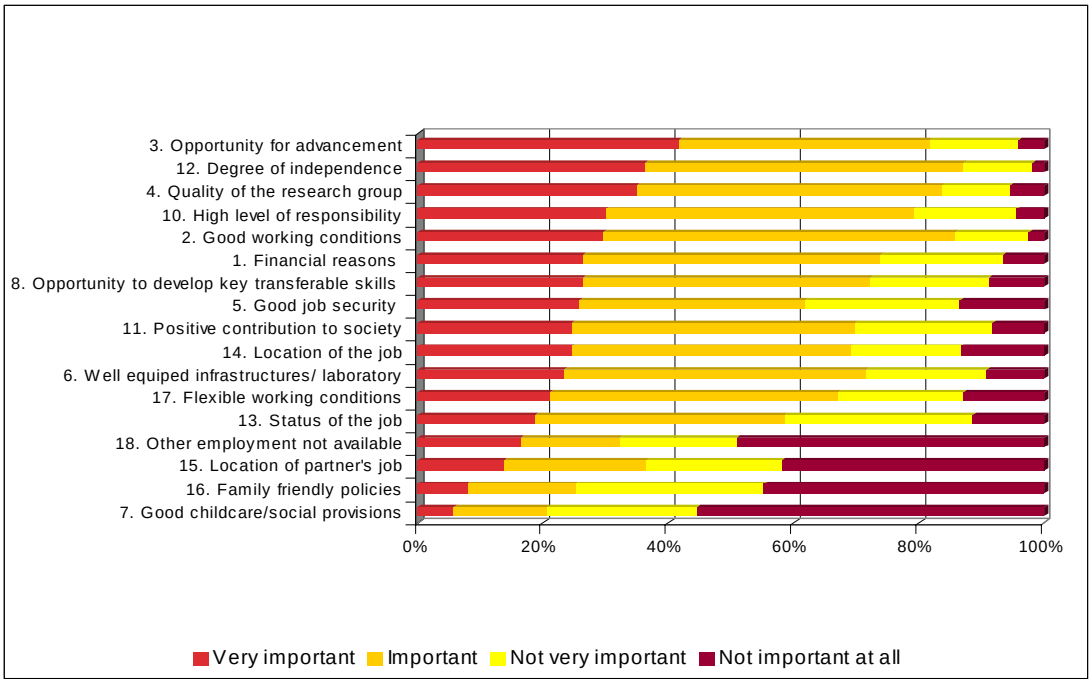
2.4.6 Reasons for choosing the current job

Overall, respondents' reasons for choice of and satisfaction with their first and their current jobs are very similar. Comparing the way public researchers see their current job as compared with their first position, it is clear that career and family considerations become increasingly important over time. The current position of public researchers appears to be more strongly determined by opportunities for advancement and job security. These two responses may indicate that after the first career path job, the position should offer clear prospects to be attractive. A significant difference is to be found in the location of the job, which is ranked much higher as a motivation for the current position. As researchers become more established in life the location obviously becomes more important. This appears clearly in the phone interviews we had with researchers.

> "I was interested in working in academia as I could continue research with academic freedom and a good quality of life. The main motivation for my first post-doc position was to gain further experience and develop research techniques. However, now that I have four years of experience, my main motivation in choosing a position is job stability and compensation."

Because of the low number of respondents working as researchers in the private sector, no significant graphs displaying the reasons for choosing current position as private researcher can be shown.

Exhibit 13 Reasons for Choosing Current Position as Public Researcher

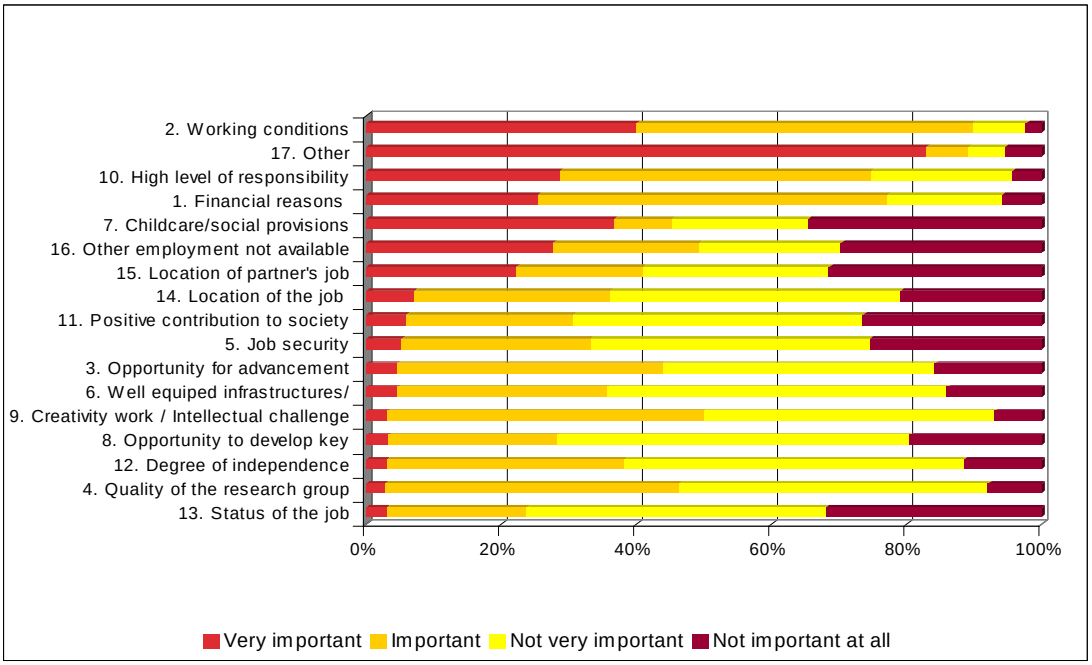


As with the first career path job, those not currently in research positions chose this for financial and traditional career reasons.

2.4.7 Levels of career achievement and satisfaction with chosen career paths

People in first jobs in public research find their greatest satisfaction in their working conditions and level of responsibility. Creative work, quality of the research group and opportunity for advancement, which were the main reasons to choose a first position in public research, are not considered sources of satisfaction: less than 5 percent of respondents said that they are “very satisfied” with them. Academia may sometimes be a bit of a disappointment.

Exhibit 14 Satisfaction with First Job as a Public Researcher



The importance of satisfaction with childcare facilities, social provisions and location of partner's job is interesting. Respondents have extreme opinions, with approximately equal numbers being "very satisfied" and "not satisfied at all". The difference is presumably driven by personal circumstances. Responses suggest people get little in the way of status, job security or the opportunity to develop transferable skills.

Private researchers and non-researchers have similar responses for satisfaction and motivation levels about their first job. Money is "important" but not "very important" for satisfaction at this stage.

Exhibit 15 Satisfaction with First Job as a Private Researcher

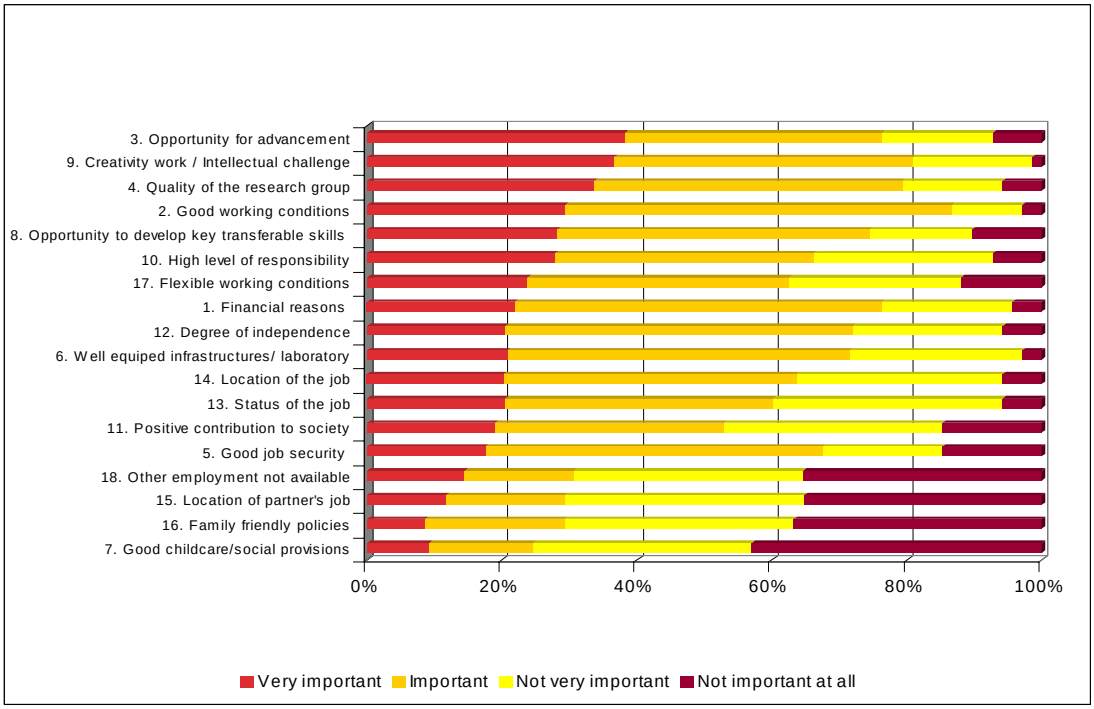
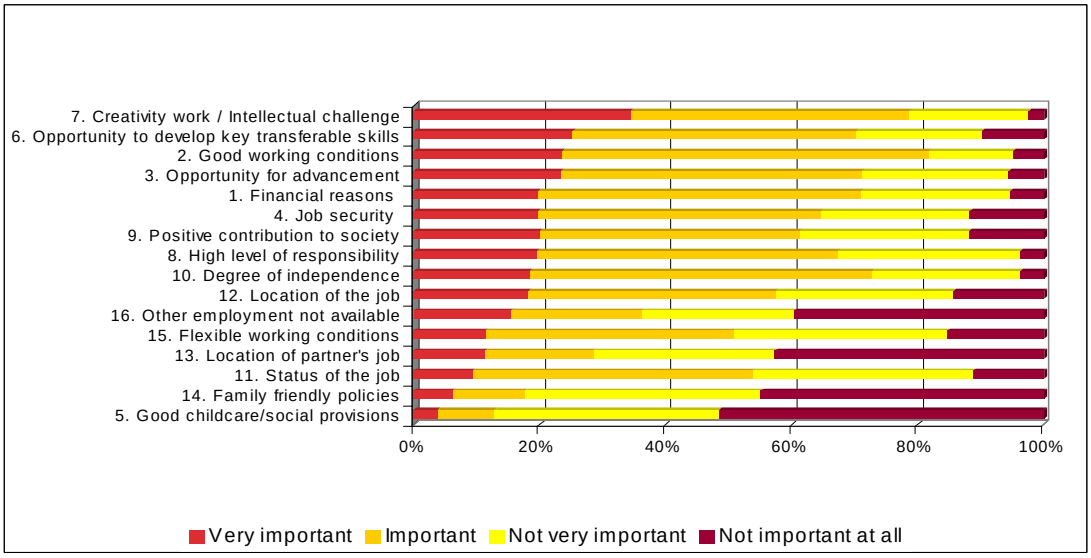


Exhibit 16 Satisfaction with First Job as a Non-researcher



2.4.8 Current job

While people in many cases fail to find the level and type of satisfaction they had expected in their first public research job, respondents are more satisfied with their current public sector research jobs. Objectively, their working conditions are likely to improve over time as they become more senior. Non-researchers derive more satisfaction from job security and money but are less likely to see their own jobs as creative.

Exhibit 17 Satisfaction with Current Job as a Public Researcher

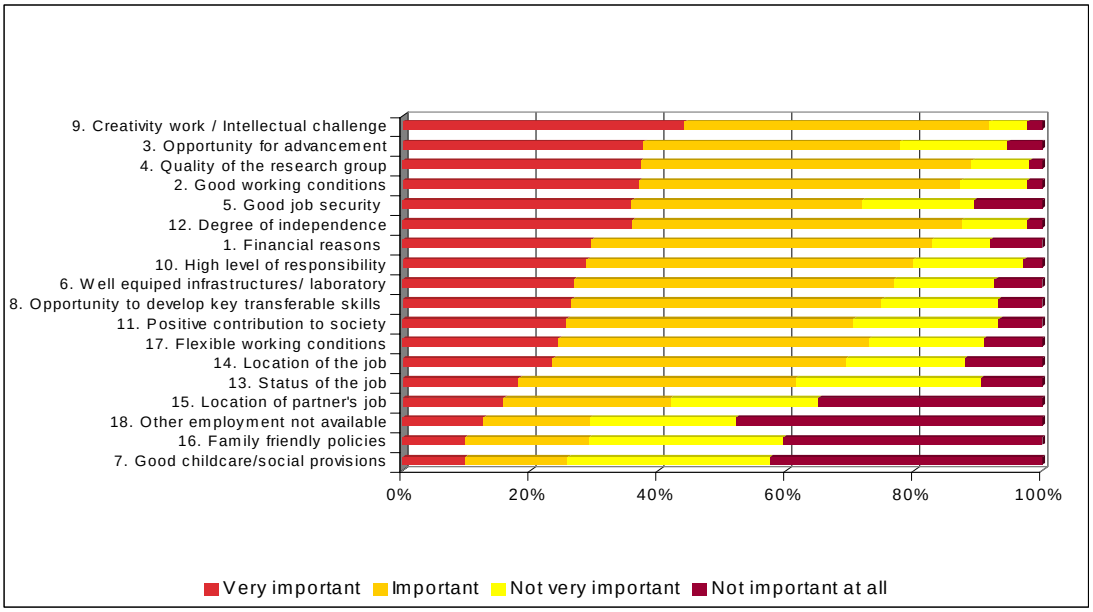
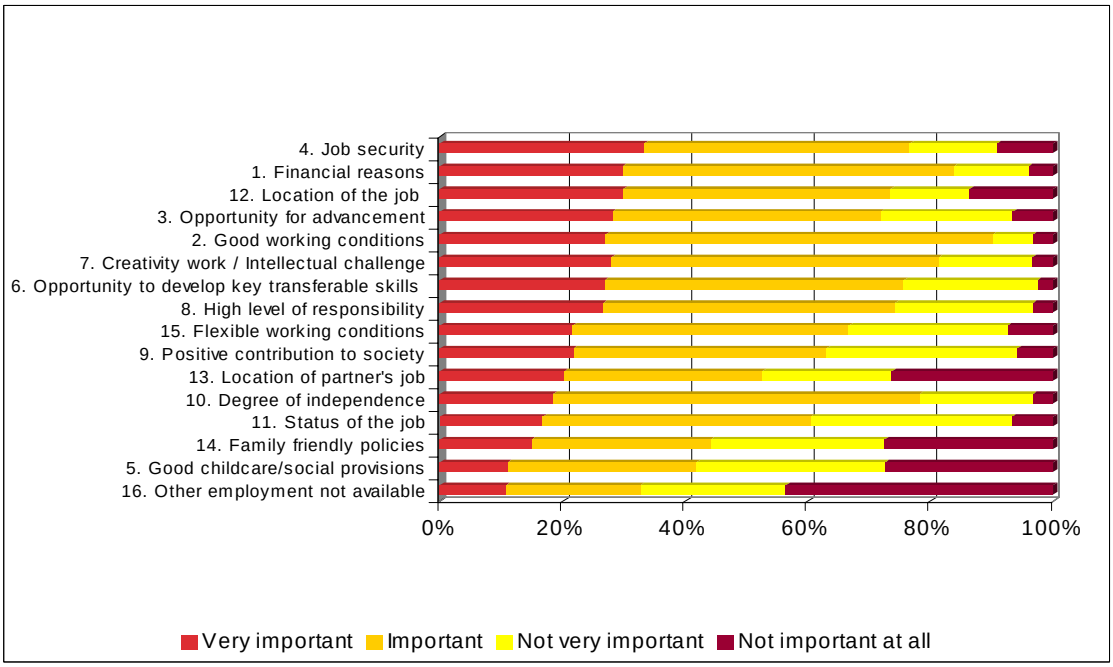


Exhibit 18 Satisfaction with Current Job as a Non-researcher



2.4.9 Comparing motivation and satisfaction

In order to explore in a more systematic way the differences between respondents' reasons for taking their job and the satisfaction they obtain, we have created indices of 'motivation' and 'satisfaction' and calculated the differences. This analysis highlights a significant degree of disappointment with public research jobs that centres on their failure to live up to idealised notions of the value of public research and intellectual freedoms.

We have created motivation and satisfaction indexes as weighted means of rankings: "very important" "important", "not very important", and "not at all important" responses being weighted

respectively 1, 0.75, 0.25, and 0. In order to allow comparisons across questions and controlling for the number of respondents in each category (public researchers, private researchers and non researchers) we have normalised indexes by dividing each index by the sum of all indexes. We can then calculate the difference between satisfaction and motivation indices for each category. For any dimension (financial reason, job security…), a positive "gap" indicates that the level of satisfaction is ranked higher than the importance of this item in making a choice to work in the current job. A negative gap highlights areas of 'disappointment.'

Exhibit shows that the gap between motivation and satisfaction is greatest for public sector researchers. Public research careers are those for which the gap is the highest. This means that respondents have found better working conditions, remuneration, responsibility, child care facilities and social provision than they expected in academia. However, this is principally because they had low expectations in these areas.

Exhibit 19 Differences Between Satisfaction and Motivation Indexes

	Relative GAP Public researchers	Relative GAP Private researchers	Relative GAP Non researchers
1. Financial aspects	3.45	0.31	-0.67
10. High level of responsibility	3.06	-0.43	-0.21
11. Positive contribution to society	-1.55	-0.33	0.60
12. Degree of independence	-1.50	-0.47	-0.17
13. Status of the job	-1.48	0.59	0.56
14. Location of the job	-1.16	0.35	0.02
15. Location of partner's job	1.02	0.09	0.52
18. Other employment not available	1.17	-1.01	-1.33
2. Good working conditions	3.97	0.32	0.69
3. Opportunity for advancement	-1.55	-0.71	-0.74
4. Quality of the research group	-1.23	-0.14	0.26
5. Good job security	-0.19	0.06	0.11
6. Well equipped infrastructures/ laboratory	-1.03	0.17	0.12
7. Good child care/social provisions	2.53	0.76	0.05
8. Opportunity to develop key transferable skills	-1.24	-0.64	0.08
9. Creativity work / Intellectual challenge	-1.39	-0.67	0.11

On the other hand, they find in public research careers neither the satisfaction of making the positive contribution to society nor the creative work they were expecting, reflecting perhaps an idealistic image of science and research in academia that is in stark contrast to the lack of recognition of professional achievement of contract researchers indicated in respondents' free-text comments. Lack of independence, opportunity for advancement and job status, which are also clear

subjects for dissatisfaction further underline this lack of recognition of the work done by contract researchers.

2.5 Researcher Case Studies

In this section, we give some examples of research careers, derived from our interviews. The idea is to identify more precisely and in a more lively way – in the way the researchers themselves described them – the barriers and opportunities that have determined their career path. We have grouped those under four archetypes:

- 'The elite', who have established themselves;
- 'From post-doc to post-doc', for people who move from contract to contract without yet finding a permanent research job;
- 'Private-public link' for those who manage to cross the divide;
- 'Internationally experienced' researchers.

Five of the people who provided case studies are women. One decided that research was incompatible with having children, 'The other' career is constrained by her husband's permanent job.

2.5.1 "The elite"

Case study 01 - 34 years old, graduated in 2002

I did a Masters in the UK, as I didn't know enough about research to go directly into a PhD. Industry was still an option. The Masters was a perfect way to get a taste of research because I had to conduct a 6-month research project. I looked for a recently established laboratory in Ireland because I thought it would be a more dynamic place to conduct doctoral research, but it was rather dull and I also had to teach to increase my small stipend.

I was initially uncertain about what to do next but decided to give research another chance. I wasn't interested in a post-doc position in Ireland because I knew I'd have to go abroad to get a permanent position later. There is no good incentive system in Ireland for PhDs and contract researchers. Everything has to go through the Principal Investigator (PI). I devoted a lot of time to selecting a fairly new lab in North America that would publish a lot. I replied to an advertisement and got a contract. I stayed there for 4 years, applying for successive 6 months contracts. The main difference with Ireland is that after a couple of years I secured my own financing independently from any PI.

I did not want to come back to Ireland but during my holidays I noticed a lot of changes at my former university: new buildings, equipment, awards for young scientists… Because my North American research project was nearly completed, I applied for a very prestigious and selective award in Ireland. I got it. It supported me to establish a team. Since then, I've had discussions with the university about a permanent position, but it is still very informal. I really would like to see something more concrete at the end of the road.

Case study 02 - 46 years old, graduated before 1997 (outside of Ireland)

I spent some time in the US as an undergraduate. After a German PhD in biochemistry, I spent 4 years as a post-doc in the USA.

I wanted to go back to Europe, but to obtain a position of assistant in Germany I needed a "Zulassung", a kind of formal authorisation. Juniors have no access to permanent positions; this is a problem. I stayed 4 years in Berlin as a research fellow. The research funding in Germany was very bad, just like everywhere else.

I applied for a position in an Irish University. Ireland is very attractive for foreigners at the chair level. Funding agencies are very dynamic. I was awarded a special 5-year grant. If you get one of those, it is like several million euros for 5 years. You don't get that in France or Germany.

Case study 03 - 37 year's old, Medical degree before 1997

I'm a medical doctor and prefer to have patient contact. I didn't want to have a research career with no position, no money, and no prospects. It's also too far from clinical research for me. I preferred to do some oncology research rather than basic and fundamental research. Therefore, a PhD degree was simply not relevant for my medical career. At that point I had little idea about what it meant to do a PhD.

After my medical degree, I spent 5 years in Ireland specialising in irradiation oncology, a few years in a prestigious university in UK, 2 years of fellowship in Canada and 2 more years at the Medical Research Council (MRC, UK) where I brought my clinical knowledge into research. MRC has a well-structured training courses programme. This is almost 10 years with 1-year contracts. I would have appreciated mid-term contracts, like 5-years contracts, which would allow have me to conduct better research and it would be more attractive to younger researchers.

Last September I got a permanent medical position in a hospital in Dublin, which allows me to do some research. This suits me well: good wages, a chance to teach, to conduct some independent research and still be close to the patients. I'm quite happy. But PhDs and general research careers still aren't attractively paid, far from it, though in recent years the Irish research system has become more international and better funded.

2.5.2 "From post-doc to post-doc"

Case study 11

I completed a PhD in microbiology along with a Masters. I got one of the two grants allocated to undergraduate students from my class, which allowed me to survive (not live!). I wanted a career in research, even though the prospects were unclear. The PhD went fine. It was interesting. As my funding ran out, I started to work part time for different research projects. After I completed my PhD, it became almost naturally full-time. The problem is that I am dependent on my P.I. I cannot put my name on any application and therefore, have no possibility to build a track record. Since then, I've had three different funding sources in 6 years and I am about to apply for a fourth one. 6 months before the end my colleagues and I usually start writing new proposals and then we give

them to the PI for him to sign. Usually at the same time I start considering job applications in industry, just in case… So far I've been lucky enough to find positions in academia.

Case study 12

I was passionate about genetics. I knew little about research. In fact, I didn't worry about my career because I didn't know I should worry about it! I conducted a 4-year doctoral project from 1995, funded by the Wellcome Trust, which is a prestigious grant.

Before the end of my PhD, I was offered a research position on the same topic. Gradually, I started thinking about a research career. I had 3 different contracts with 3 different funding sources. I'm treated like a permanent researcher by my supervisor, but not by the university which offers me no recognition. My supervisor always bridges contracts so I don't even see the gap.

As my husband's got a permanent position, I can't move far away. I know that if I'd left for somewhere else, I would only have to move again in one or two years to get another position. So I prefer to stay. I have to ask my supervisor each time for wage increments, which is awkward though.

The problem is that I am tied to him and he is approaching retirement. I have improved my skills in many domains, from research to project supervision but I have nothing on paper. I am now about to start a new 3-year contract. After that, who knows?

Case study 13 - 41 years old, currently taking a PhD

I worked for 10 years as a research assistant. I was reasonably well paid with short-term contracts from one month but never more than a year. Once I was asked by the University to take a break because otherwise I would have been eligible for a permanent position. I decided to leave the work because the only way to progress was to obtain a lectureship, which is not likely to happen without a PhD. Therefore for 3 more years I worked there for a PhD. It was hard. My girlfriend and I (also taking a PhD) were living in very poor conditions.

I was offered a temporary lecturing position. It was well paid and flexible, so I could pursue my PhD at the same time. My current contract position will become a permanent one. It will probably be advertised before I complete my PhD, which means I won't be able to apply. I hope to find a way to stay in research though.

Case study 14 - 34 years old, graduated in 2003

I decided to go for a PhD because everybody said that in this field you had to have one. In fact, it has turned out to be a hindrance. My first position was in the UK because there were none for me in Ireland. There was another option in New Zealand but I preferred the UK. In the UK, the wages were good with an annual increment and a non-contributory pension. I applied for various positions before coming back to Ireland. Now, I'm in the last 2 months of a 20-month research contract. I've already applied for three different grants and have 2 industrial partners. This situation is

demoralising. There is no job security and I'm expecting a baby. I'm seriously considering leaving research.

Case study 15 - 47 years old, graduated in 1998

I was a research assistant for 10 years abroad. Research is my passion. I never had another kind of job. I enjoy it. I saved because I wanted to complete a PhD. I approached a researcher I knew who had a good reputation both as a scientist and as a supervisor. A few months after I began my PhD research, he won a 3-year grant and then I was very happy not to have to pursue my research at my own expense.

Currently, I am still working in the same laboratory after three 1-year and one 4-year contracts. In theory, the university is supposed to provide a pension but I've never had one. I took out a private pension plan of my own. If I fell ill, the PI would have a big problem. There is also no salary structure. The Irish University Association has already given guidelines for salary and pensions, but they are not followed. This is a real shame. If I want a pay rise I still have to ask my supervisor. I am completely dependent on my PI. I did it two years ago, but probably won't do it again; it was too humiliating.

I'm living on my own which is why I could develop a real research career. It would have been different if I had a family to support. I don't want to have a neglected child because of my career, so I decided not to have children.

Once, the college did not want to give me the research fellowship I had been promised. This kind of contract is not more money but it is a kind of promotion. The board of the college said me: "take the ordinary contract or leave". I was shocked. When I complained to my boss, he said that this was a problem between me and the university and didn't support me at all so I had to go to the union, which has made the college give me a proper contract. When the PI found out, he was angry with me. Whatever, I feel that he exploits my expertise and knowledge but that he would be equally happy if I left.

I feel unhappy not to have a permanent position because of the lack of job security. I have no lectureship, and will probably never be a Principal Investigator. I also have no international collaboration, which could be good but can only be considered when you have a permanent position. It was so tiring applying to so many jobs and funders. But I don't plan my career.

The very first thing that needs to change in order to improve the Irish research system is to change people's mentality. Post-docs and I struggle to consider ourselves as research professionals. Dependence on the PI and the lack of recognition of being a university staff member limit feelings of professionalism.

2.5.3 The private-public link

Case study 04 - 30 years old, graduated in 2004

I decided to go for a PhD as I got very interested in a research project during my BSc. and I got a grant. There were not that many jobs in my domain in Ireland at that time. I didn't know when starting a PhD that there were so few positions in academia. We have this joke among my friends; the only way to get a permanent job is to drop a bomb on the research centre.

After completing my PhD, I had a research fellowship abroad sponsored by a big company. The grant for research was substantial. I wanted to see a bit more of the world other than my university. I was overqualified for positions in the private sector. There are lots of positions in the pharmaceutical industry but they are quality control jobs that I wasn't interested in.

I do intend to come back to Ireland one day. I think I would like to go into industry. I don't think I'll be an academic because if you want to buy a house and get a pension, you don't go into academia. And there are no jobs in academia.

Case study 05 - 29 years old, graduated in 2005

I conducted doctoral research in chemistry in an Irish University from 2000 to 2005. My knowledge about what a PhD and a research career meant was very limited. It was left to the student to look for information. I didn't give a lot of thought to other options. I wouldn't have felt "fulfilled". I also worked in a pharmaceutical company before; I knew that, even in industry, to get the kind of job I wanted, I needed a PhD.

My PhD was a positive experience, although I got too little supervision during the first half and had to reorient my topic after a year. During this period, my supervisor founded a start-up business carrying out activities related to my topic. I took a year out of my PhD to work in this new company. After some hesitation, I decided to stay in industry for a while. Academia is still an option. I think it will be easier to find a position in public research after one in the private sector than to find a job in industry after 3 or 4 post-docs. I know that my skills acquired in industry will not be recognised in academia since industry is still not very well considered there… But there are only few opportunities in academia. I feel a bit frustrated though because what I'm doing in industry is less interesting than research. Companies are mostly in Ireland for large-scale production, not for research.

Case study 06 - 34 years old, graduated in 2002

After my bachelor degree in chemistry, I decided to go straight into a PhD without doing a Masters degree. A PhD is a pre-requisite in chemistry if you don't want to do a boring job like quality control. At university, it's quite easy to find some information about PhDs. Basically, I've been accepted by a supervisor and he secured the grant. You don't choose the grant to apply to yourself.

My PhD took 4 years with a major change at the beginning of the third year: my supervisor found a better job at a British university. I followed him there. British universities are better funded, better equipped and supervisors there are of a much higher quality. My British funding was a bit higher

than my Irish funding, but still not much and neither are enough money to live comfortably on. Dublin is too expensive to buy or rent a house alone and so you have to rent with other people.

The subject of my research is not of direct relevance to industry, but some companies were interested in the methodology developed by my supervisor's group. They supplied equipment and travel expenses to the group.

After my graduation, I had a 2-year research position in New Zealand that the professor of my Bristol research group had recommended to me. I couldn't stay there longer as the local "green card" lasted only 2 years. In Ireland, there are very few research jobs. In chemistry, manufacturers offer positions more in development than really in research. It is a kind of "step backwards" from the academic point of view, but not really from mine. My activities are very diverse - communication, quality insurance, process development for example and I'm in constant touch with the other company sites abroad. The main risk is that the company could decide to export to an Asian country.

Case study 07 - 38 years old, graduated in 1998

I completed a PhD in biotechnology but I had no career plan. I was interested in research, that's all. I also liked the cachet of being a doctor. I was selected to get a grant from the County Council based on my performance as a student. I also got a stipend for my research from Enterprise Ireland, paid to my supervisor.

At the end of my doctoral research programme, I still didn't know what to do. However, after 4 years with very little money, I would have been very happy with whatever came along! I accepted a temporary lectureship position in the same university. That was a great opportunity but I didn't feel comfortable with teaching in a field which was not exactly mine.

I was offered a position by a company in the UK with a much higher salary which I took but I soon wanted to come back to Ireland for personal reasons. The company suggested that I set up a research unit in my former laboratory, renting some space in the university. That was great for a while until the company went through a restructuring plan and wanted me back in the UK. So I quit and I stayed in my lab, working as a contract researcher on a small project. Then one of my colleagues took me on as a research fellow as he secured a large funding grant from SFI. I'm now one of the very few contract researchers who are Principal Investigators.

2.5.4 The Internationally Experienced

Case study 08

I did a Masters and a PhD in applied mathematics at the same time. I was especially interested in the American PhD system where you have 2 years to choose your subject. I wanted to explore the subject in depth and I like the academic life. I learned a lot in the USA, although you are alone most of the time as the Professors are busy.

I had to come back to Ireland because my visa expired. I went to my former lab just to say hello to old connections and left the lab with a request to give a seminar. Soon, I was offered a 2-year research job, employed by the department on funding from the HEA (PRTLI). I could work on any topic I wanted to, since the funding is not linked to a particular research project.

However, for personal reasons, I want to go back to the USA. Although the situation in Ireland is improving, it's still not clear whether you can get a permanent position. You can have many contract jobs before anything happens. In the US, it's the opposite. More than two contract positions hinder your research career path. You have a probationary period during which you have to work very hard, but at the end you feel you've made it.

Case study 09 - 31 years old, graduated in 2005

I wanted to work in research so I applied for several PhDs. One was in the USA, but I had to wait for a year before taking up the position.

I decided to start a post-doc before the official end of my PhD. I went to the UK for a year and a half because a particular PI was very good. I basically chose him because of his publication record. My PhD supervisor also knew him. After the UK I went to Singapore because it was investing massively into my research field. I think research in Ireland is not really limited by what experiments you want to do but by what experiments you can afford to do.

My current job was not a permanent position at the beginning. I didn't want just a 1 or 2-year position. You need 5 years to produce a quality paper. My supervisor couldn't offer me that type of position at the beginning but he said he'd find a way to keep good researchers. I got a permanent position last December, which is extremely unusual.

Case study 10 - 31 years old, graduated in 2001

After a BSc, I went directly into to a PhD because I wanted to do pure research. I was told that I could also get into industry with a PhD. I had a public grant for my PhD but I worked as well. I was very involved in University life.

After my PhD, I got a 3-year research contract, which was very good in terms of duration but the salary didn't change over the 3 years. Therefore inflation cut my purchasing power. Besides, I was entirely dependent upon my PI's good will. After this first post-doc position, I was offered another one. It just paid a thousand euros more than the first one and there was still no job security, no rights, no career structure.

I was also in touch with a recruitment agency but basically they said I had no experience in industry and therefore I would be hired at the BSc. level. I have decided to leave research and to leave Ireland.

2.6 Conclusions

The current debate about research careers has a European context. This means that Ireland is by no means alone in tackling problems of increasing the scale of PhD education and employment in academic research while at the same time moving the centre of gravity of PhD production towards developing people who will work in industry rather than in academia. It also provides an opportunity for Ireland to come into line with developing European practice, for example through the Charter for researchers.

Surveys and conferences about research careers in Ireland highlight a similar set of problems in research careers to those found elsewhere (UK and Finland), focusing especially on the issues that arise during postdoctoral; research, when people tend to work on short, project-related contracts. The difficulties of causing change in the UK indicate the improving research careers is not a simple matter. Finland has worked explicitly with creating a set of research career steps and lining up a mixture of university and funding agency (Academy of Finland) measures to fund them. Others appear not to have got that far.

Oddly, however, almost everywhere the discussion of research careers takes place as if postdoctoral research is a career stage and that the only natural career structure culminates in a traditional academic teaching and research post, ultimately a chair. The discussion ignores the long-standing research career structures in university-based research institutes – of which the IUA four-step career structure is a good representation.

The discussion of career stages in this chapter, together with the case studies, highlight four groups of issues, which will be further explored in the next Chapter -

1. Improving the organisation of academic research careers: especially the need to define and support institutionally career paths; the poor status and employment conditions and lack of independence of contract research workers; the need to shift the skill set of PhDs and postdoctoral researchers towards the type of skills needed in industry; and the need for the researchers themselves to understand and plan their careers – and to be institutionally supported in doing so;
2. The need to increase demand for PhDs from industry: partly by placing PhDs into companies, so as to increase absorptive capacity and in turn demand for more PhDs; and the need to support academic-industrial collaboration, in order to help raise understanding of needs and capabilities on both sides of the academic-industrial divide;
3. The need to further reinforce mobility between countries and between academia and industry; and
4. The need to capture and exploit all relevant talents by ending the systemic blockages to women's research careers in the system, making better use of international talent, involving domains outside the natural sciences and education to a greater extent and increase understanding of the nature and value of research.

3 Resolving the Issues

This Chapter discusses issues raised by the desk study, consultation and stakeholder interviews. It tackles in turn the need to improve academic research careers, industrial absorptive capacity, mobility and the degree to which all the available talent is made use of in research. We have sub-divided most of these issues and each sub-section in this Chapter first discusses an issue based on available evidence (whose nature varies), describes what is already being done in Ireland that might resolve the issue, draws on foreign examples from the four countries that are in scope and then sets out conclusions and implications for action.

3.1 Improving the Organisation of Academic Research Careers

3.1.1 A career path for researchers

The profile and career situation of PhDs in Ireland

The fact that in the consultation, only half (51 percent) of the 720 respondents answered "yes" to the question, "Would you recommend a career in research?" reinforces the stakeholders' general belief that Irish research career arrangements need improvement.

In recent years there has been a considerable increase in the number of PhD students enrolled at Irish universities, from 2276 in 2000 to 4151 in 2006[27]. Stakeholders believe that the average age of someone who is one or two years into a post-doc in Ireland is about 26 or 27, indicating that Ireland follows the Anglo-Saxon rather than the continental model of PhD education. Many more PhD graduates are now remaining in Ireland to take up post-doctoral positions than in the past. Indeed, ten years ago, post-doc positions were very rare in Ireland.

Absence of a clear career structure

Our respondents and interviewees were almost unanimous in demanding a well-defined career path for researchers. The frequency of that recommendation gives it a particular importance. When asked to rate a list of problems associated with research careers, respondents focused on the lack of a career structure, limited opportunities, poor pay and low status (Exhibit 20). Lack of research jobs in industry, the need for better mobility between academia and industry and for recognition of experience developed outside academia were also important concerns.

The current situation prevents most researchers from planning their professional and personal life in the medium or long term, reduces motivation and leaves many questioning the value of the competition and stress researchers feel they must endure in order to progress. Many wanted to see an increase in the number of permanent research jobs in Irish academia, while at the same time holding the view that. "You cannot get a permanent research position. They don't exist." While a

[27] HEA Statistics Office, available at: http://www.hea.ie/index.cfm/page/sub/id/710

'job for life' would be nice, it was more important to have some 'Planungssicherheit' (a reliable basis for planning).

Exhibit 20 Which of the Following Do You Think Applies to a Research Career in Ireland?

	N	% obs.
Lack of defined research career structure	535	51%
Lack of positions in academia	499	47%
Lack of proper remuneration	486	46%
Lack of status	364	34%
Not easy to transfer between industry and academia	322	30%
Lack of positions in industry	323	31%
Lack of positions in public sector	303	29%
Lack of recognition of experience developed outside academia	300	28%
Lack of opportunity to develop key transferable skills (communication, project management etc.)	234	22%
Not easy to transfer between universities	126	12%
Other (please specify)	119	11%

Note : Multiple responses are possible

Short contracts, insecure jobs

A submission to the HERG working group points out that currently less than 30 percent of contract researchers end up with a tenured position in a HEI and as the number of contract researchers increases in line with the SSTI this proportion will decrease further. Those who do continue their career in academia following completion of a PhD, appear to obtain a series of postdoc research contracts. Contract lengths are determined by available grant funding, as universities do not have funding to give permanent positions to post-doctoral researchers. Commonly, contract researchers find it difficult to find permanent positions in academia, often cycling in and out of short-term contractual positions for as long as seven or eight years. Funding contracts usually last for two years, according to one interviewee, to avoid making the researcher eligible for the benefits that accrue to permanent employees.

There is consensus that this career stage is characterised by lack of security, lack of standardisation of remuneration, employment benefits, job roles and titles. There is also a feeling among stakeholders that owing to a combination of a lack of knowledge about the possibilities of a research career, and the perceived and actual difficulties of such a career, that only the truly dedicated would choose to pursue it. This is clearly positive for maintaining quality and dedication among researchers but damaging if the supply is to be increased and careers in research are to become more commonplace.

An increasingly common demand is for a limit to the duration of the contract research period. At present, researchers can remain status-less for periods of up to 10 years. This makes it impossible for them to plan anything long-term. Respondents propose that research contracts should be for a

minimum of 3 years, preferably 5 years. It should of course be possible to terminate the contract if the person is not performing the job adequately. Researchers stress that positions should be open to experienced contract researchers, who are excluded from applying for most of the postdoctoral funding schemes available. Many researchers also objected to the fact that, if they did obtain a university appointment, it would require them to teach as well as to do research. As with other jobs, the ability to work part-time should be available. This would promote mobility between academia and other socio-economic sectors.

> "I feel my expectations are much the same as any other professional. I would like a secure job with the opportunity to advance through a defined career path and to get the basic entitlements that almost all other workers in the other area of society has with a similar level of qualifications."

One stakeholder, however, felt the commonly-held perception that researchers live from grant to grant might now be somewhat outdated and that universities can make provisions to retain good quality researchers before their current contracts expire. The increased size of some grants in the Irish system is large enough to allow some medium-term planning. However, it was not clear that universities were taking the new research and employment management opportunities thereby generated.

By no means had everyone seen the insecurity of contract postdoc positions as undesirable. There was a degree of consensus among established academics that, while long periods of contract funding were detrimental to the individual researcher, a certain amount of 'churn' in the pool of researchers was necessary for a healthy research environment. Competition helps to avoid stagnation, where less skilled researchers are kept within the system. One key stakeholder commented:

> "We do not need a situation like the French research labs (CNRS) where stagnation and lack of competitiveness is a real issue due to long researcher contracts."

Career Pressure Points

There are several points at which interviewees felt that there were likely to be greater rates of attrition or researchers would find progression blocked. After completion of a PhD or a first post-doctoral contract for example were considered to be points at which it would be more likely for individuals to leave a research career.

There are generally fewer opportunities for researchers the further along the career path they progress. Usually a transition to a permanent position is very difficult to obtain. After post-doctoral positions, there was a view from interviewees that some researchers seem to 'fall off a cliff.' They often remain at one university and reach a ceiling where they are over-qualified and are eventually replaced by younger and cheaper workers.

Salary

Rates of pay for researchers in the post-doc system are not standardised. Salaries for science postdocs tend to be based on what funding the lab has and how the Principal Investigator (PI) chooses to distribute the funds. The Irish Universities Association has produced guidelines for a salary scale and points system (originally for the Wellcome Trust), but there was disagreement among interviewees as to the extent to which universities actually adhered to these guidelines and in the absence of an agreement with the research funding agencies, universities do not feel bound by them. Several stakeholders commented on the fragmented nature of the funding structure in that two researchers working on the same project could be paid different wages if they are funded from different sources. A study[28] carried out by the Trinity Research Staff Association found that salaries for Contract Researchers do not increase relative to either age or years of experience after the age of 29 and there is no consistency between the salary of people with similar qualifications and experience and no recognition of prior service.

Better pay and promotion were the main features of respondents' future plans (Exhibit 21). These responses differ little by cohort. About a quarter of those graduating after 2001 plan to obtain a promotion, compared with a third in earlier cohorts. Some 9-10 percent of the recent cohorts planned to leave research, compared with 5 percent of those who obtained their PhDs before 1997, presumably reflecting the differing seniority and real prospects of people in the different cohorts.

Exhibit 21 Respondents' Future Plans

	No	% obs.
Get a job with a higher salary	382	36%
Get promoted in active research / administration	319	30%
Change employer	172	16%
Change specific job	140	13%
Take a job abroad	123	12%
Other (please specify)	105	10%
Leave research	91	9%
Change working hours	67	6%
Get a job with good child care facilities	63	6%
No plans	61	6%
Re-enter research	54	5%
Take a career break	35	3%
Re-enter study in public sector	17	2%
Re-enter study in private sector	14	1%

Note: Multiple answers possible

[28] Trinity Research Staff Association, Contract researchers in Trinity - a Frontline Perspective. October 2006

There appear to be no comprehensive surveys of what postdocs actually earn in academia. The Trinity Research Staff Association's internal survey found that most contract researchers at the college were earning in the range €30- €44,000.

Data are available about the earnings of graduates in their first jobs (Exhibit 22). The HEA survey on which this is based covers both industrial and academic jobs. The top salary band used in the survey is 'above €33,000' so it is difficult to make adequate statistical comparisons, but it is clear (despite the claims sometimes made in the research community that doing a doctorate brings no reward in the form of a higher salary) that higher levels of education command a salary premium. The starting point on the 2007 IUA postdoc scale is €37,866 so it is likely that postdoc and industrial salaries are at least comparable.

Exhibit 22 First Destination in Ireland, Graduate Starting Pay, Class of 2004: Percentage of Graduates Earning More than €33,000[29], Selected Disciplines

Discipline	Bachelors	Taught Masters	PhD
Electrical and Electronic Engineering	8.9%	17.6%	81.3%
Chemistry	6.7%	33.3%	64.7%
Humanities	3.0%	19.0%	52.9%
Commerce and Business Studies	5.1%	18.0%	84.6%
Agricultural Science	5.9%	13.3%	85.7%

Organisation of the HEI

Respondents suggested that separate structures in university administrations be set up to deal with contract research positions and career advice. Normalising employment relations between universities and contract researchers would also help create a contract research labour market and raise mobility among the Irish universities.

Irish Initiatives

For those wishing to undertake a PhD in Ireland the levels of funding are much better than they were before 2000, and there are now many more researchers in the system. Earlier, many researchers struggled to get funding for a PhD. Now, it is much easier to secure funding for the PhD and at least the first post doc. A 4-year funding scheme for PhDs will start shortly. Opportunities to gain generic research and transferable skills are also being developed for new PhD students coming through the system as part of the "4th Level Ireland" project, organised by the IUA. The HRB PhD Scholars programme, HEA's PRTLI 4 and the Research Councils' Graduate Research Education Programme all in various ways address opportunities to improve PhD education by creating graduate schools.

[29] Comparative Starting Salaries and Career Progression of Graduates in Science, Engineering and Technology (SET), Dublin: Forfás, 2006

Some policies have been implemented for Contract Researchers. A submission to the HERG working group draws attention to a number of initiatives from HEIs. For example, a Doctoral Studies and Postdoctoral Training Office recently setup in University College Dublin (UCD) and transferable skill training initiatives being developed in TCD. The issue of titles is also under discussion, with a number of HEIs looking at reforming the current usage of titles applied to contract researchers. While there is a lack of long-term funding opportunities for contract researchers, a 7-year grant has been developed by the Department of Communications, Marine and Natural Resources, which provides time for contract researchers to establish themselves and their research and to develop into fully independent researchers. In many instances the CR is not covered under the FTWA as the HEI is not deemed to be the employer.

The IUA proposes the use of four levels of research titles to distinguish CRs. as the cornerstone for building better-structured research careers:

- LEVEL 1 - Research Assistant – A researcher with a primary or Masters Degree, usually without a PhD qualification
- LEVEL 2 - Post-Doctoral Researcher – A researcher who has completed their doctorate within the last 2-3 years
- LEVEL 3 - Research Fellow – An experienced researcher who has a track record of peer-reviewed publications
- LEVEL 4 - Senior Research Fellow – An experienced researcher with substantial experience in research, post-graduate supervision, project management, international collaboration, who has a track record of obtaining funding and high quality peer-reviewed publications

International examples

In the UK the 1996 Concordat among universities and research funders seems not to have had the desired major effect on contract researcher tenure, probably owing to its voluntary nature. The EC Directive on Fixed Term Workers appears to have been more effective in changing employment practices. Where the UK has been most successful is in establishing career frameworks and putting in place web and conference-based support to postgraduate and postdoctoral researchers. The main achievements a report monitoring the Concordat could identify related to improved HR practices in some UK Higher Education Institutions. For example, the University of Sheffield has developed a framework aimed to facilitate support for research staff careers – the framework for career support processes. It sets out a four-stage process through the research contract where different levels and structures of support should be offered to the researcher. Mechanisms for support include are outlined below.

Exhibit 23 Framework for the Careers Support Process[30]

Time-frame	Support activities and purpose
First 3 months	Induction Process to include: Staff Review Meeting Planning of development
Core Research Time	Regular Staff Review Meetings (Implementing / monitoring of project and personal development) Research and Employability skills development and recording of skills and development Using: Research Career Builder & Employability Skills Handbooks
4-6 months before Contract End	Pre-end of Contract Review: To act as a 'safety net' and flag up any major skills gaps to concentrate on in last few months
Contract End	Exit mechanism: To collect data on next destination, and reasons for leaving Useful for tracking purposes and for universities to monitor the effectiveness of policies and procedures

The UK Grad programme has generated a strong set of courses and web-based materials to help PhD and postdoctoral researchers think about and develop their careers. However, the focus of the programme is on the researchers themselves – to a degree substituting for, rather than provoking, institutional changes in university HR functions.

In 2001 the UK Research Councils in collaboration with UK Grad Programme and the HE sector developed the Joint Statement of Skills Training Requirements of Research Postgraduates. This identifies the skills that a postgraduate researcher should have or develop during the course of their PhD degree programme. The statement covers seven sections: research skills and techniques, research environment, research management, personal effectiveness, communication skills, team working and networking skills, career management.

While the Roberts Report led to increased pay for postdocs, it also took the position that contract research in universities was fundamentally transitional in character. Hence, UK policy has continued to be more concerned with how researchers can make best use of this transition in career development than with supporting the idea of university-based contract research per se. How this coexists with the contract research business model of various intra-university institutes in the UK is not explored.

[30] University of Sheffield (2003) "Supporting Research Staff – Making a Difference".

Finnish Universities have had a system of graduate schools since 1995. They were introduced to shorten the time it takes doctoral students to write their thesis and to increase international cooperation. At the beginning of 2006 the system comprised 124 graduate schools with over 4000 graduate students working full time on their doctoral dissertations. It is considered that these schools have made postgraduate education more systematic and efficient. They are particularly important in terms of increasing levels of mobility among Finnish academic institutions, but are also successful in other areas such as diversifying researcher skills and counteracting feelings of isolation, which can blight early stage research careers. However they are not relevant to many of the post doctoral issues faced in Finland (or Ireland) as they do not cover that period in a researcher's career.

There are two main models of Graduate School in Finland:

- The inter-university/subject focused model. This brings together researchers and academics working across the country working on different aspects on a single discipline. These schools are subject related but also offer transferable skills training though the inclusion of a number of departments/faculties/universities that will each have their own unique way of approaching the topic being researched;
- The intra-university/interdisciplinary model. These cut across disciplines and subjects at a range of levels within a single university with a major training focus on transferable skills within the research area.

Some characteristics of the graduate school system have been absorbed into mainstream university PhD courses. Several modules and courses have been transferred across the schools including research methods and research ethics. In addition, some of the students at universities are sitting in on some of the modules offered by the graduate schools. This indicates a certain validation of the system as it is having a noticeable impact on the more traditional delivery methods of the PhD in the established universities.

Conclusions

Objectively, the early stages of academic research careers lack structure and are insecure as well as being somewhat poorly paid and under-supported by academic institutions. This is true in Ireland as in other countries.

It is clear that the lack of a structured career is one of the reasons why numbers of people in Ireland find research unattractive or leave academic research for other jobs. There continues to be a willing (and growing) supply of people dedicated to the idea of research who (to some degree unthinkingly) enter the profession but there is no evidence that tells us whether better candidates have been frightened off by the lack of career structure.

The established academic research community shares the contract researchers' interests only to the extent that this does not reduce competition in the early-stage research labour market. The UK has been more explicit than some countries in continuing to regard postdoctoral research as a transition and focusing reforms on making this transition as humane and well informed as possible, rather than trying to increase job security. A key part of the transition for most PhDs, whether or not they do

postdoctoral research, must be to move from academy to industry, government or another highly skilled occupation. As the arithmetic of academic jobs and increasing industrial R&D-intensity means that a growing majority of research-trained people will not work in universities, the importance of transparent career planning and preparation for non-academic life increases.

Curiously, the view of contract research in universities as essentially a transitional early career phase co-exists with a reality – not least in the UK – where there are also organisations that function as intra-university contract research institutes, and which have long-established career structures similar to that set out in the IUA's guideline pay scales. These institutes often have teaching responsibilities, but in a proportion that marks them out as clearly different from mainstream university departments. In Ireland, the Tyndall Institute would fall into this category. There are clear opportunities to build on the experience of these kinds of organisations to integrate research careers into the mainstream of university life. Clearer and better recognised research carers would help to enable both 'transition' postdoc work and mobility among research-performing sectors, including these internal institutes.

Implications

- Ireland needs a more clearly articulated and modern research career structure, adapted to the needs of researchers in all parts of academia and consistent with preparing many of them to work elsewhere. The HERG has made a good start on this and it would be rational to build upon the emerging HERG model.
- To manage and operate a clearer research career model in turn requires the more explicit involvement of university HR functions, building the common knowledge, courses and planning tools that cannot be developed if Principal Investigators continue to have the primary responsibility for research career development.

3.1.2 Poor status and employment conditions for contract researchers

Motivation and Satisfaction

The comparison we made in the analysis of the research community consultation between people's reasons for taking a job in public research and their experience highlights a significant degree of disappointment with public research jobs that centres on their failure to live up to idealised notions of the social worth of public research and the intellectual freedom widely associated with academic life. We have analysed the attitudes of successive cohorts of PhD graduates to working in academic research. This analysis makes it clear that almost half of public research workers are unhappy with their job prospects, while younger people in this category are more concerned about pay and job security than more senior ones.

Good working conditions are more highly valued by the older cohort than the younger ones: 45 percent of those graduating before 1997 rated this as a "very important" factor in job choice, compared with 27 percent of those graduating since 2001. However, 10 percent more of the young cohort is dissatisfied with the working conditions in their current job. Apparently, people acquire more choices about working conditions as they age. However, there is an important change in attitude between the pre-1997 and post-2001 cohorts. Some 65 percent of the early cohort regards the availability of childcare as unimportant in choosing a job, while only 25 percent of the post-

2001 cohort feels the same way. The availability of childcare is (reasonably enough) more important to the younger cohort than the older ones.

Opportunity for advancement

Opportunity for advancement is one of the main reasons for choosing a research career in the public sector. Its importance is stable over time and is similar in all three cohorts. Some 37 percent of public researcher respondents considered it as a very important reason to choose public research as a first job. More than 45 percent consider it very important in choosing their current job. However, only a few isolated people are very satisfied by the opportunities for advancement that they actually encounter.

Job security

Job security is another of the major reasons for choosing a job in public research, though this is more important for young PhDs than their elders. One respondent expressed the common feeling quite well. "There is no job security at all, so asking if it is important is a bit strange – of course it is, but it is not a realistic option. "Respondents also think that job security is more important in their current job than in their first one, suggesting that this consideration grows in importance with age. Only isolated respondents declared that they were very satisfied with the job security in their first job (a contract position for all of them). Some 45 percent of respondents who obtained their PhD before 2001 were satisfied with the level of security in their current job, compared with 25 percent of those who graduated later.

Working Conditions

Researchers generally said they wanted more responsibility, greater freedom to initiate their own research and to reduce the relationship of dependency they often had with their principal investigator. Academic researchers' additional duties (lecturing, supervising students, writing grants application, and managing the lab) should also count towards promotion. Researchers need to be recognised as equally, like any other staff members in the University.

In terms of the lack of stability, the opportunity to gain more long-term funding (beyond 2 years in duration) would be of considerable benefit to contract researchers. The submission to the HERG working group highlights that the opportunity for contract researchers to apply for funding in their own name needs to be investigated, as this is a requirement for a senior contract research position. At present, contract researchers have limited opportunities to do so.

Remuneration

Money is a less important motivation for public than private sector researchers. However, the importance of pay rises in the younger cohorts: 13 percent of PhDs graduating before 1997 think this is a very important motive for choosing their current job compared to 21 percent of those who graduated after 2001. The proportion of respondents thinking this is "not important at all" decreases from 15 percent to only a few isolated people across the same period. It seems that while most public researchers still think of their work as a vocation, a growing minority see it as a profession.

Competition for research grants means that contract researchers' wages are constantly under pressure. Researchers say they need a proper, nationally defined salary scale in line with their experience and an appropriate system of appraisal. There should be annual increments – as in other positions within the public and private sectors – and overtime pay, all indexed to inflation. Today, actual salaries paid vary among funding agencies. The IUA guidelines have helped establish expectations about post-doc salary levels but are by no means always implemented, according to many respondents. The situation should be reviewed at national level -

> "Many people fall into the post-doc way of life because they feel that there is nothing else out there for them. The salary is very poor (friends of mine with no third level education earn more than I do as secretaries or PAs). There are no benefits i.e. no pensions, healthcare etc and no permanent contracts, to be had."

Pensions and Social Benefits

Respondents frequently referred to the lack of pension arrangements and other social benefits attached to contract research. In addition to being unfair, this also tended to discourage people from starting research careers. It could contribute to keep Masters Graduates away from research careers. It would even be better if pension schemes were transferable between Universities and other organisations in Ireland, but also between Ireland and other EU countries -

> "The college (despite taking a 20 percent provision from the grant I was working for) has never provided me with access to a pension despite repeated attempts on my part."

As contract workers, postdocs do not enjoy the same social benefits as permanent workers, lacking proper access to maternity and sickness pay. The lack of maternity rights has clear implications for female researchers and women researchers underlined that contract positions are really not suitable for someone who has a family to support -

> No childcare provision. "As a post-doc, I was refused access to university crêche as it was reserved for students."
>
> Research is underpaid and very insecure. "It's best not to do it if you are the breadwinner of a family."

Living conditions

Accommodation and childcare were major concerns for researchers. Rapid house price inflation in Ireland – especially Dublin, where the majority of research jobs are located – was a major problem. Half a PhD's wages can be spent on housing in Dublin, often in shared rented accommodation. Contract researchers are little better off. The banks regard working as a postdoc in Irish universities as a very unstable job, making it impossible to purchase a house. The banks will not give a mortgage to someone who only works on 1-year contracts, many researchers explained. They were therefore looking for additional housing subsidy, bank guarantees or access to university-owned accommodation. Such accommodation should be close to the institution, be available for single researchers but also for those having a family.

Some stakeholders suggested ways in which the consequences of short-term contracts such as difficulties in obtaining loans for mortgages could be mitigated. One stakeholder for example suggested the possibility of universities providing loans for researchers to help them get on the property ladder. Although this may now be fairly difficult to implement, universities could enter into an equity share agreement with researchers so they could take a share of the profit when the house is sold.

The Fixed Term Workers' Act 2003

There were mixed feelings towards the Fixed Term Workers Act (FTWA) 2003. It was seen by some academics as a hindrance to the development of a highly skilled researcher base within academia. Some stakeholders argued that the first two or three years of post-doctoral experience should be classified as training rather than employment. This would mean that the Fixed Term Workers' Act would then only come into force in the later stages of a researcher's career. This would encourage only the best researchers to remain within academia. Some felt that it could be useful for addressing some of the insecurities experienced by Post-docs, but that its implementation is ad-hoc due to some Post-docs not being deemed employees and therefore not covered by the Act.

There was also some uncertainty about the effects of the FTWA. It was regarded by a number of stakeholders as legislation that, while theoretically protecting the rights of workers on short-term contracts, tended to have the opposite effect by encouraging employers to part company with contact researchers whom they would otherwise have retained, so as to avoid them acquiring permanent employment rights.

Tthere are currently two different routes through which contract researchers are hired. The first is via a Programme grant where funding is given to the PI who then hires a contract researcher. The HEI is stipulated as the employer and the contract researcher is covered under the FTWA. The second is for the contract researcher to gain Fellowship funding as an individual (as in the case of the Research Councils). In many instances the CR is not covered under the FTWA as the HEI is not deemed to be the employer.

Irish and Foreign Initiatives

At a voluntary level, the universities have undertaken to try to tackle many of these issues, having signed the European Charter for Researchers. However, the results of our consultation with researchers and discussions with stakeholders suggest that the effects are patchy. The HEA has reportedly[31] been trying to put together a single pension scheme but this has yet to be finalised. Elsewhere in Europe, the Charter appears to have the same effect of moral encouragement as in Ireland, but there is little evidence that it has had a major effect on working conditions or of much other reform.

[31] IUA, e-mail dated 20 July 2007

Conclusions

Poor working and associated living conditions are, in effect, by-products of the fact that (a) postdocs are temporary contract workers, (b) there is no proper career or salary structure for them and (c) they are not given the same status or support as permanent faculty by the universities. To the extent that the academic community wishes to continue to recruit through the current kind of contract research apprenticeship system and, it will not be possible to address all the problems identified.

Implications

There are nonetheless things the university system can do. It would be especially useful to investigate whether postdocs should be offered membership in university pension schemes or whether – given that many of them will not make their career within academia – an alternative arrangement (such as personal, portable pensions) would be more beneficial for the researchers.

To increase researchers' ability to control their own destiny, and in order to secure the benefits of competition in allocating grants, it is important that they be entitled to make applications to external funders. In the absence of UK-style Full Economic Costing, however, every additional research grant won imposes a cost penalty on the university. Therefore (and because research also requires access to resources) contract researchers need to apply for grants with the agreement of their host universities, which therefore should develop or extend their existing research management systems to make this possible. This is another area where the IUA could usefully play a role, since that would help standardise processes across the university sector, encouraging mobility and cooperation.

Adequate and consistent pay scales across the university contract research sector would not only reduce some of the problems of career and working conditions so far discussed but also support mobility and cooperation among the Irish universities. At present, given price competition ('value for money') as an element in research proposal assessment and the fact that the universities do not have funds from which to pay postdocs according to the grade they should be on, adequate and consistent pay scales cannot be implemented without reform of research funding. The funders and the universities should therefore together devise a scheme to enable this that is acceptable to the funding Departments. Neither party can achieve reform in isolation.

3.1.3 Researchers need industrial exposure and skills

Increasing the knowledge-intensity and competitiveness of Irish industry in line with national and EU objectives entails raising the skill and qualification levels of workers in industry, not least raising the absolute amount and the proportion of industrial R&D done by PhDs.

According to the OECD statistics[32], Ireland spends 1.2 percent of GDP on R&D, of which 65 percent is spent by industry. Some 56 percent of research workers in Ireland are in industry but very few of these hold PhDs. As in other countries, the bulk of industry's spending is for development and not research. Our interviewees argued that the research base within Irish industry is weak and that this is a major factor in the lack of PhD recruitment into industry. A recent ASC report looking at relationships between enterprise and higher education[33] reported that while levels of business sector R&D performance (BERD) have been growing rapidly in the past they still remain below the EU average and this is a major contributor to the low levels of interaction with HE researchers. So not only does the weak research base hamper recruitment of researchers into industry, it also creates a barrier to academic-industrial collaborations.

Improving Researcher Skills

Improving the skills of researchers was felt to be important in order that they can become more attractive to industry. A greater emphasis on generic skills was suggested, such as business development, financial, marketing and selling skills. One stakeholder put it thus -

> "We need to give PhD/Post-docs wider ranging skills to help them if they do leave the academic sphere for industry. The funnel affect of academic research careers need not mean that individuals leave research all together; we should equip them with the skills to pursue a research career in industry."

Interviewees also argued that potential researchers needed to take more ownership of their own skills and career development. One stakeholder commented

> "PhDs must be more active in looking to gain the skills that will be attractive to industry and must learn that positions in universities are limited – there is a life after academia. They must train themselves to look to industry and realise that they will not find a job where they will work at the bench for 30 years. They must acquire skills such as team working, time keeping, looking at the bottom line, management etc."

Many of the employers consulted felt that research employees did not initially possess key practical skills necessary for their role because of the way in which PhDs are taught, with little focus on business and work skills. (This echoes employers' views internationally.) One larger employer pointed out -

> "With engineers, they do quite a lot of theoretical work, and practical work in their final year, but this practical element had not moved with the times and is quite behind the reality in industry."

Companies therefore preferred to recruit people with industrial experience.

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[32] 2004 data from Main Science and Technology Indicators 2006, Paris: OECD, 2006

[33] Promoting Enterprise-Higher Education Relationships. Forfas. Advisory Council for Science Technology and Innovation. March 2007

Exhibit 24 Relevant Findings from the SFI Evaluation

Technopolis undertook a study for Forfás in March 2005, which examined industry views on SFI[34]. Commentators had a good deal to say about attracting the right human capital into industry that continues to resonate today. There was concern that the training provided for researchers within academia did not, in most cases include any industrial component and that this would reduce the attractiveness of the trained researchers to industry. Several of the companies consulted said that they would not consider employing PhDs or even Masters-level people with no industry experience; they would not be able to use them. Most stated that they struggled to find good people who combined good scientific knowledge with the ability to apply that knowledge in a commercial environment. Businesses are really looking for people who can help turn science into technology or technology into business. The bottom line for many companies is that they need good technologists much more than they need good scientists. Whatever happens at the upper end of the scale, most employment, even within high tech businesses, will continue to be at the graduate level, and so that is where most businesses would like to see national training resource and effort being concentrated.

It was argued that there should be as much focus on the flow of good science graduates as good PhDs. The overriding message was that industry saw no obvious potential for a step change in demand for postdoctoral researchers, but lots of (unmet) demand for good graduates with the right technical background attained on courses, and within institutions, with a strong industrial logic in the curriculum.

The research community shared the view of the stakeholders that PhDs should be taught more industry-relevant skills. Many suggested complementing PhD degrees with business training. Respondents felt that PhD degrees should have more emphasis on the development of communication and transferable skills. These skills should also be taught in undergraduate courses so that graduates are better prepared to deal with research careers. If industrial experience were needed, it seemed more efficient to make it a component of the Masters degree.

One solution raised involved the incorporation of a mini MBA in PhD courses (or at least some modules) to give researchers a greater knowledge of business basics including: Finance, Human Resources, Marketing, and even how to start a company. This may also increase the number of companies spun out by researchers, creating a greater absorptive capacity in the SME sector for further researchers. Transferable skill training initiatives are already being developed in TCD and through the wider university system as part of the 4th Level Network project.

Perceptions

[34] Industry views on Science Foundation Ireland. Technopolis report to the SFI Evaluation Panel, Dublin: Forfás. March 2005

Both companies and other key stakeholders we interviewed felt that there was a clear problem with academic perceptions and awareness of a research career in industry. Research careers in industry are perceived to be inferior to those in academia, the latter offering greater security with fewer negative aspects such as adherence to deadlines and managerial structures. Many researchers are simply unaware of possible alternative career paths in industry. As one company put it -

Researchers who do want to get out of the academic structure are sometimes just not aware of how to do this and where to look. Their knowledge is too specific to universities and they sometimes have problems trying to change their frame of mind to a more industry-based perspective.

Link academia – other socio-economic sectors

Researchers are particularly interested in strengthening the links between academia and the private sector and feel that more public-private R&D partnerships should be funded. Some respondents suggest providing incentives so that multinationals set up industrial R&D laboratories and employ researchers. The creation of new jobs in the private sector depends upon growth and setting up innovative SMEs as well as increasing PhD employment in established companies. However, opportunities for PhD level researchers in industry seem to be limited due to the structure of companies in Ireland.

Irish initiatives

At the PhD training level, a cross-university network 'Fourth Level Ireland' is beginning to put in place cross-university training aspects of higher degrees that should address some of the issues identified about researchers being inadequately prepared to think about their careers as well as introducing some of the transferable skills relevant to industrial employment that have hitherto been lacking in postgraduate training. The HRB PhD Scholars programme, HEA's PRTLI 4 and the Research Councils' Graduate Research Education Programme (GREP) are intended to (inter alia) to have similar effects.

GREP

GREP is a new approach to postgraduate and doctoral training in the humanities, sciences, engineering and technology. Higher Education Institutions (HEIs) are invited to apply for multi-annual funding on a collaborative basis. The total funding available under the GREP 2007 Scheme will be €6 - 10 million. The idea behind Graduate Research Education Programmes is that they will -

- Bring together groupings of expertise focussed on high quality research
- Provide a more formalised and structured approach to research education and career formation for doctoral and masters scholars
- Equip Ireland's Higher Education Institutions and researchers to participate in the type of world class programmes which Ireland requires to compete in the international research and enterprise environments

Foreign initiatives

Research funders in Sweden launched a range of initiatives to tackle similar problems in the mid-1990s, in response to a national perception that there were far too few PhDs in industry. The Knowledge Foundation has run Industrial Graduate Schools since 1997, which recruit PhD students from both industry and university, who have to spend at least 20 percent of their time working in-company on interdisciplinary topics. The costs are shared equally between the Foundation and the companies. Retention rates in the companies are high and the companies tend to be satisfied with their investment. Generally, large companies are involved, but the Foundation has operated a variant for SMEs since 1999.

The Swedish Competence Centres Programme is a long-term effort to strengthen the link between university research and industrial R&D, raising industry's ability to tackle for fundamental research questions and therefore more radical innovations. The aim is to achieve a stronger industrial impact and concentration of resources by creating multidisciplinary university-based research environments in which industrial companies participate actively. Competence centres not only achieve these goals but also – because of their engagement with industrial co-workers – produce PhD graduates who are almost immediately useful in industry[35]. While Enterprise Ireland has very recently launched a programme called 'Competence Centres' there are important differences in the balance of power and therefore the likely style of cooperation between industry and academia, compared with the foreign exemplars (of which the Swedish programme is only one). Experience of such programmes suggests that considerable day-to-day exposure of researchers to cooperation with industry is needed in order to have an impact on skills.

Conclusions

Since a growing majority of PhDs will work outside academia in future, there is a need to shift the pattern of skills they acquire towards transferable skills like project management, business planning and communication. This will in Ireland partly result from the new graduate programme initiatives and will be reinforced by public-private partnerships such as the competence centres.

Implications

The rapid proliferation of graduate school schemes – we identified four –is a welcome development that may better align PhD skills with needs. It may be worth coordinating some common taught course elements relating to industry and commercialisation, in order to avoid fragmentation, generate scale economies and assure quality.

3.1.4 Researchers need actively to plan their careers

One stakeholder estimated that 80 percent of those taking PhDs are uncertain about what they will do next, and this impression is largely borne out by the researcher consultation exercise. Respondents saw an overall need to educate both students and society that a career in research is a valuable and attractive career option within the wider career market. There is a need to market

[35] Erik Arnold, John Clark and Sophie Bussillet, Impacts of the Swedish Competence Centres, Report to VINNOVA and the Swedish Energy Agency, Stockholm: VINNOVA, 2004

PhDs around the message that undertaking a PhD will provide you with a competitive advantage. It follows that there is a need for information about PhD research and what kind of job and life perspectives it offers. There should be attempts in Ireland to profile researchers and articulate what a career in research (either academic or industrial) actually looks like. Real life examples of what current researchers have gone through to get to where they are today need to be drawn up so that people from the 2nd and 3rd level can see what is possible. As one industry interviewee put it -

> "The image of an old man in a white coat is totally outdated and there needs to be a total perception change of what a career in research is actually like."

Better quantitative data are needed about Irish research job careers in order to tempt more students into a research career. A web site presenting relevant information about current opportunities and likely future trends would be a good idea.

Improving Careers Guidance and Course Content

Improvements in careers guidance were felt to be vital in improving and broadening the perception of research careers. In addition to careers in industry, individuals also need to be aware of other career opportunities outside academia, for example within public agencies based on technology such as the Irish Medicines Board. Stakeholders talked about a need to improve careers guidance to post-graduates so that they had more information about their options and how to improve their skills by moving between institutions. Students at the third level could be targeted with presentations by researchers who have achieved a career in academic research or taken a perceived non-traditional path in industrial research. To help improve the perception of research as a career, better careers guidance or outreach within schools should be provided.

Commentators also fed back that there needs to be a change in the unrealistic expectations of a career in research, or indeed a career for life in any sphere -

> "There are hundreds of young people who think that they will get permanency. While it's true that we need a certain number of 100 percent researchers, we don't need that many and we have to get the balance right and manage expectations."

As well as the need to equip PhD students with transferable skills, contract researchers also need to be furnished with attributes that make them attractive to employers outside of academia and should be eligible to attend the courses being developed for PhD students. The availability of alternative skill training also needs to be investigated to ensure that multiple career options are available to contract researchers who do not stay in academia. It also recommends that the implementation of an annual career/research development plan developed in collaboration with the PI would help contract researchers structure their research and career and identify any skill areas that need further development. Leadership training and support for PIs in this role needs to be available to ensure professional mentoring for contract researchers. This could be facilitated if funding agencies included a provision of funding for training in their grants.

Stakeholders interviewed agreed that the implementation of annual career/research development planning and professional mentoring by PIs as the responsibility of the HEIs and would be monitored by funding agencies through the grant review process. Other stakeholders interviewed shared this view.

Irish Initiatives

The newly launched Graduate Research Education Programme and the other new graduate schools in Ireland may go some way to offering a more formalised and structured approach to research education and career formation for doctoral and masters scholars.

International examples

Some of the UK Grad programme activities are designed to address issues of careers guidance and changing perceptions of research careers. It operates outside individual HEIs and is therefore in principle accessible to everyone. Careers workshops are run for individual sectors, and even for jobs in academia, in order to close the knowledge gap about what these are really like. Improvements have also been made within HEI careers services where there are now dedicated individuals focused on research staff and what the options are for researchers once they have completed PhDs. The Grad programme offers courses for postgraduate researchers and 'train the trainer' courses for training providers and management development programmes for employees. The programme is also working through their regional hubs to encourage HEIs to embed personal development and generic skills in PhD courses, and providing support to those responsible for cohorts of students to assist them in providing advice on career development. While this is for PhD students, a similar model could be applied to contract researchers. This is particularly relevant given the view that PIs involved in postdoc career development planning will need support from the HEIs and leadership training to ensure that they are equipped to be a good mentor and are able to support the professional development needs of contract researchers.

During the PhD process the "lambs tend to get trampled" and therefore it is very important that they can take ownership and management of their career. PhDs and postdocs tend to be very passive and there is a victim culture to a certain extent. There needs to be a greater realisation that undertaking a PhD or being employed as a postdoc is to all intents and purposes being self-employed and individuals need to be able to market themselves. This group, more than any other, should be able to manage themselves. Courses are quite unique in that volunteers are used to deliver them. There is clear and convincing evidence of benefits to participants – both students and volunteers. 94 percent of researchers believe they are more employable, and 95 percent have become more aware of their skills and attributes.

The fact that tutors have given up their time generates credibility, and respect from researchers. Tutors, because they have often come from a research background themselves, can connect well with course participants. National courses are also beneficial in that participants can benchmark themselves against their peers from all over the country.

Conclusions

Many people appear to enter research because of interest in their subject but with little idea of what a career means. Levels of ignorance about research careers need to be reduced – both to encourage people to enter the profession and in order that they will have realistic expectations. Not least in order to emerge from the apprenticeship relation with the Principal Investigators, researchers need much more active support from their institutions and others in career planning. UK experience, however, suggests that an intervention outside the universities (UK Grad) that directly provides careers information, tools and training is a helpful complement that empowers researchers better to take career planning into their own hands.

Implications

Ignorance about research careers should be tackled in part through improved science communications and improved careers information at all levels, including university careers' services.

Supporting postdoctoral researchers' career planning requires a combination of actions inside and outside the universities. First, the university HR functions need to take responsibility for the task, which means that that (preferably common) processes should be designed across the university sector and responsibility allocated to HR. It is not realistic to expect systematic and continuous career development support from principal investigators unless there is a managed system of appraisal and development to which they have to contribute. Second, the kind of external, open career development information and support provided by UK Grad is needed. This might be provided by establishing an Irish variant of the programme – or might better be handled by the HEA buying into the UK grad programme.

3.2 Enterprise and Absorptive Capacity

3.2.1 Inadequate industrial demand for PhDs

PhD Recruitment by Industry

Irish industry today has a rather low propensity to employ PhDs. This needs to increase, if Irish industry is to remain competitive.

Some of the findings from the Technopolis study examining industry views on SFI remain relevant for this study. Many of those interviewed as part of the study argued that even in those areas where industry is doing leading-edge development work that would require postgraduate researchers, it is unlikely that anyone will be recruiting in significant numbers in the short term. Where companies do try to recruit highly specialised researchers they will often be in ones or twos and they will try to pick the best people from around the world. Recruitment strategies will not automatically be restricted to Ireland. Any strategy that supposes industry will be able to make use of large numbers of highly specialised academic researchers at any point in the foreseeable future is not one that gains much support, at least not among the business leaders who were consulted. These views are consistent with what was found through our industry interviews.

At present, respondents to the consultation said that having a PhD can even be a disadvantage when looking for a job in industry, claiming that, for example, an entry-level engineer is paid more than a

PhD chemist. Contract researchers have no better status in the private sector than in the universities and sometimes are considered as academics with "dreamy aspirations". Their professional research and transferable skills are forgotten or unknown -

> "I didn't even receive PFOs from the companies I applied to. I was informed by a colleague to remove my PhD qualification from my CV and I was subsequently offered 2 industrial positions."

There was nonetheless optimism among stakeholders that a great deal of potential exists in the future for employment of individuals with PhDs in research-focused companies, and there are signs that the situation is changing. IBM for example is setting up in Dublin and Google is hiring PhDs.

Interviewees generally believed that SMEs are most unlikely to recruit PhD graduates. This may be partly because too little has been done to foster R&D within the SME sector, a view expressed by several stakeholders. It was an even greater challenge for smaller companies than large ones to appear attractive to researchers and especially costly to appear attractive to foreign researchers. Retention of researchers in SMEs can also be problematic, as individuals tend to leave smaller companies after a few years in search of greater perceived job security in larger organisations.

One solution proposed by both stakeholders and industry employers was to increase the number of Industry led PhDs with a greater input into the course from industry members. Included in these courses could be the opportunity for placements or employment contracts to continue the research within the organisation on completion of the PhD qualification. This would improve the links between sectors through the obvious knowledge transfer implications but also through the longer-term networking links of the researchers embedded within these organisations. Industry-led PhD courses or Industrial Placements on PhD courses could improve the mobility of future researchers between the two sectors. This would also help strengthen the linkages between universities and industry with the possibility of a dual input into PhD topics and knowledge sharing of the output.

Retention of Researchers in Industry

Retention of researchers was a common problem for the employers consulted. One company reported having a high turnover of research staff because of a lack of a career structure within the organisation. Another organisation felt that the next step up the career ladder into company management could be a fairly unattractive proposition for some researchers who would prefer to retain some involvement in research activities. Despite having a large number of employees, the company lacks opportunities for researchers to undertake new challenges and carry out international projects. A third organisation felt that it had been successful in retaining employees because they had good opportunities to pursue alternative career paths in management roles. One smaller company where retention was also an issue considered that it was because employees do not wish to remain in a research career. In industry a technical role is not regarded as highly (or rewarded as highly financially) as a management role.

Large companies can often best be encouraged to become more research intensive through partnerships with the knowledge infrastructure of universities and research institutes. It can be

especially hard to raise capabilities in smaller companies that may lack the knowledge and understanding needed to interact with the knowledge infrastructure. Many stakeholders we consulted believed that the involvement and creation of demand within SMEs is key to strengthening industrial research capabilities and increasing the opportunities for research careers within industry.

In the past, Ireland has run an excellent scheme – Techstart – for encouraging technological capabilities at the engineer level into companies. Helping companies establish or increase their research capacity is a tougher proposition, but the logic of placing people into the company who create the capacity to expand the research function is proven. Internationally, there are schemes that share the cost of PhD training with industry and encourage mobility between the knowledge infrastructure and industry. These are discussed in the next section.

Incentives for Irish industry to take PhD students on placement are currently lacking. There are also few incentives for universities to accept industry employees to undertake PhDs. One stakeholder drew attention to the fact that in the past Enterprise Ireland grants used to fund workers in industry to take PhDs. Universities were keen to take advantage of this additional source of income. Now, with so many funding opportunities, universities are less easily motivated by it.

There was support from Irish stakeholders for policies and programmes that would allow PhD students to spend a significant time (over three months) in industry. The cost of these placements could be shared by both parties and may also include some industry input to the final thesis topic, although the IP implications this would raise needed to be agreed on. It was suggested that PhDs fully funded by industry could help not only attract individuals into a research career in industry, but also create a network of academic and industrial researchers within the overall research system in Ireland.

Irish Initiatives

IRCSET has established a variant of its postgraduate and postdoctoral grants where companies co-fund and co-supervise PhD and postdoctoral research. At the time of writing, six companies were involved and a total of 14 were looking for candidates[36]. The majority of the companies involved are multinationals.

International Initiatives

The UK's Industrial Case programme enables companies to take the lead in defining and arranging projects with an academic partner of their choice. This programme is designed to encourage greater levels of joint research between industry and academia and it provides companies with exposure to an academic environment, which they may not have had before.

[36] www.ircset.ie

In Sweden, industrial graduate schools have been in operation since 1997. An industrial graduate school is established in cooperation between companies and one or more universities and provides cross-disciplinary education at doctorate level. The objective is to increase the number of research trained employees in Swedish industry. New possibilities for Swedish research are created at the same time. The education is based on industrial problems and the companies normally employ the PhD students.

The rationale behind this instrument is that Swedish companies, by international standards, have tended to have a low proportion of research-trained employees. Through an increase of the number of research-trained people in industry, the companies are intended to get easier access to new research knowledge. The PhD students are recruited from companies as well as universities. In addition to advanced courses in their special fields of research they take courses in for example project management, marketing and entrepreneurship.

A typical industrial graduate school has as on average 13 PhD students, studying for four to five years. The students study part time. A minimum of 80 percent of full time is the requirement. Twenty percent or more of the study time has to be spent at a company. The intention is that the PhDs after their graduation will be active in industry.

The Knowledge Foundation (KK) in Sweden funds up to 50 percent of the costs of the doctorand (average total cost of a doctorand is €87,000/year) over four years, on the condition that the companies play an active role and contribute a corresponding amount. KK has so far funded 21 industrial graduate schools. Presently two of them are completed as far as funding from KK is concerned; the rest are still running. Evaluations of the schemes have been very positive.

A similar instrument exists for SMEs– SME Doctorands. This began operation in 1999. The basic rationale behind this instrument is that many small and medium sized companies, with 250 employees or less, do not have any employees with a PhD degree. In order to increase their competence level KK has given financial support to so called SME doctorands. The individual doctorand is employed by the company and is active as a PhD student at one of the new universities or university colleges. Through this arrangement the company is believed to develop a better capacity to absorb new research results. Denmark, in fact, has operated an "Industrial PhD Initiative" of this type since 1970, which was positively evaluated (most recently in 1995).

Another interesting Swedish instrument for fostering R&D interest in SMEs, which will then move them up the value chain and thus increase their demand for researchers, is Forska & Växs. This is a new and somewhat unorthodox VINNOVA programme primarily aimed at addressing the low R&D absorption capacity of most SMEs, in order to stimulate their growth. Forska & Växs literally means "Research and Grow" In Forska & Växs, SMEs can apply for financial support in three different forms: R&D projects, preparation for R&D projects and identification of R&D needs in a specific area. The companies are required to co-fund at least 50 percent of the cost about €65m in total is allocated to Forska & Växs. VINNOVA found that the grants have already resulted in increased employment in beneficiary companies.

Conclusions

Irish industrial development will be blocked if industrial skill and qualification levels do not rise to include greater numbers of research-capable people. However, absorbing increased skills into industry is difficult. It generally entails persuading decision-makers to recruit people more highly qualified than themselves to do things they may find hard to imagine. Nonetheless, the Irish experience of Techstart – which is mirrored internationally[37] – is that such people tend to prove their value and are normally retained by beneficiary companies once the subsidy period ends. They then start themselves to recruit more highly skilled people.

The lack of industry-based PhDs in Ireland today mirrors the situation of other North European countries in the recent past so it would be reasonable to look to similar instruments to rectify the situation.

Implications

Ireland has already taken the first steps to increase industrial PhD-intensity through IRCSET's Enterprise Partnership Scheme grants. It would be useful to look at ways to cluster these into graduate schools and to back this approach up by experimenting with a 'Docstart' scheme aimed at companies without the resources or scale to co-fund doctoral training. Further measures to encourage short-term mobility between industry and the HE sector would be useful.

3.2.2 Public-Private Partnerships

The other way to raise absorptive capacity in Irish industry is through public-private partnerships. There is already a long history of such measures in Ireland, as in other countries. However, past Irish measures have tended to involve the HEIs doing the research for industry (as in the RTDI for Collaboration programme) or direct subsidies to industrial R&D. It is only relatively recently that – outside the EU Framework Programme – collaborative R&D has been funded, involving more active cooperation on R&D projects.

The Strategy for Science, Technology and Innovation highlights the importance of this and

> "places a heavy emphasis on growing business expenditure on R&D. As well as building strong HE based research teams, the movement of researchers from the HE sector to industry and the growth of collaboration between companies and research institutions through the development of industry led networks and competence centres are priorities."

In our interviews, many stakeholders saw the creation of CSETs as a positive step in establishing working links between Irish industry and universities. However, it was highlighted that this is a relatively expensive mechanism for industry to be involved with, dealing with rather advanced

[37] Erik Arnold and Sarah Teather, *People as Vectors of Technology in Technology, Knowledge and Skills Transfer Schemes*, report to the UK Department of Trade and Industry, Brighton: Technopolis, 2001

research, and was out of reach for many businesses in Ireland. Competence Centres were also seen as a positive step.

The report Promoting Enterprise-Higher Education Partnerships highlights the need to increase effective HE-Industry links. Some of the stakeholders consulted in our study felt that the Institutes of Technology were particularly good at forging links between academia and industry through schemes like the innovation partnerships for postgraduates and involvement in NIBRT. They also benefit from often being located very close to industry.

The ASC report on promoting relationships between enterprise and academia highlights that the existing initiatives being run by through the IDA and SFI to promote the links between industry and academia are "creditworthy and important and should be encouraged". The report does point out though that there is an absence in Ireland of the intermediary structures between HEIs and enterprise that have been successful in other countries. These intermediaries are generally more active in the applied research space. Measures were felt to not be fully succeeding due, in part, to the poor absorptive capacity of Irish SMEs. This will only solved alongside a major programme to build applied research capacity.

Irish Initiatives

There are a number of initiatives already in existence in Ireland, or which are being introduced, that are designed to increase collaboration between university and industry and thus foster R&D activities.

A crucial prerequisite for cooperation is strength. After many years of comparatively low priority, it was necessary to build strength in the university sector. The Programme for Research in Third-Level Institutions (PRTLI) was therefore launched in 1998 following the success of a pilot programme in science and technology. The PRTLI provides integrated financial support for institutional strategies, programmes and infrastructure and ensures that institutions have the capacity and incentives to formulate and implement research strategies, which will give them critical mass and world level capacity in key areas of research. To date, €605m has been allocated to third level institutions under this competitive programme for research. Substantial funding has been also been provided from private philanthropic sources, which have supported the strategic focus and competitive basis of the programme.

The Centres for Science, Engineering and Technology (CSETs) are funded by SFI. They are research partnerships between industry and higher education. CSETs are the largest of the SFI awards. They fund a number of investigators who are funded individually, but also come together in inter-institutional arrangements and must have some linkages with industry. Grants normally range from €1m to €5m per year for 5 years and can extend for up to 10 years based on performance. CSETs must be both scientifically and strategically significant with 20 percent of funding (in cash and kind) coming from industry. Irish third-level educational institutions may submit proposals. There are currently 7 CSETs with 2 more under review. It is considered that they are successful in terms of industry support, but it is too early to measure their outcomes. It is SFI's aim to fund these mechanisms for 10 years after which the linkages established should be self perpetuating. The scale

of the grants being given under CSETs for example are large enough to allow for more medium term planning (5 years) giving researchers the opportunity for longer contracts.

Competence centres are a new idea from Enterprise Ireland and IDA and are collaborative entities lead by industry resourced by highly qualified researchers associated with research institutions. Both Enterprise Ireland and IDA have recently visited Austria, Finland, and Sweden to look at the competence centre models there to see how they should go about implementing a similar structure in Ireland.

This is a joint programme in Ireland between IDA and EI, and looks to establish five competence centres in Ireland in the first round of funding. A group of companies will decide on a market/industry/applied research lead agenda and then involve a number of academic partners. EI or IDA will take the lead on individual centres and fund them for €2million each year for 5 years. 100 percent of the funding will be provided up front and it is expected in Y2, Y3, Y4 etc the consortia will make match contributions of 20 percent, 30 percent etc so the centre has an increasing budget. The rationale for this is the hope that after the 5 year funding from EI/IDA the centre will be funded wholly by the consortia.

The centres will be totally industry led with an appointed CEO who reports to a management board predominantly formed of industry members. Of the original applications, there is a good mix of sectors represented – waste, digital, finance, ICT, manufacturing, bio-energy, construction etc (HP, Abbot, Boston, Bausch and Lomb, Intel etc). The competence centre owns the IP and internally this is distributed according to individual centre arrangements. Depending on who leads the centre (IDA or EI), if is felt that IDA is keener on establishing capital/tangible assets such as buildings and facilities. It is not yet clear whether these centres will be located within university facilities or elsewhere.

The idea for these centres came initially from the ASC report recently published: Promoting Enterprise–Higher Education Relationships and catalysed by the Strategy for Science and Technology. The timeframe is not so clear although it is hoped that the first centre should be established by the middle of next year due to the time it takes to evaluate proposals and establish internal partnership arrangements within the consortia.

Exhibit 25 The Tyndall Institute: A Prototype Competence Centre?

The Tyndall National Institute at UCC is being developed as a multi-disciplinary centre across several fields of ICT hardware and networking, with a strong science base and a specific industrial development mission. This was originally called the NMRC and was funded in 1982 as part of the UCC. It wanted to be part of the University but maintain some independence, and looked at how to hire researchers. Employees were given a new staff profile, tenure B where they would have a permanent contract on the condition that the money was available for research from the funding agencies or the industry. Researchers therefore have the full complement of employee rights and benefits. This model, offering a model for better conditions for Post-docs, was felt to have worked very well and could be expanded and replicated elsewhere.

International Initiatives

The Swedish Foundation for Strategic Research (SSF), in order to strengthen Sweden's position in manufacturing and to increase productivity, set up the ProViking programme in 2003. Its objective is to support research in the area of product realization (product development, manufacturing, product support and maintenance in a life-cycle perspective). The main focus is on industry with manufacturing and/or development, operating in Sweden. The programme aimed to provide industry with researchers and PhD students in order to contribute to a faster product development pace - that is, direct value added. It is potentially interesting within the Irish context as it is industry led – i.e. industry identifies what problems it is interested in, which secures industrial relevance and improves the chances of strengthening the company's absorptive capacity. The design of the programme could be transferred to other sectors given that many face similar problems.

The SSF also funds a National Graduate Research School with a total of SEK 30 million during the five- year period 2003 - 2008. Seven different universities participate in this school. The courses in combination with the Proviking programme's research provide the PhD students with internationally competitive technical competence in their areas giving them a holistic view of the production development process and enabling them to convert their research results into industrial applications. The one compulsory module of the Graduate Research School's three modules focuses on how companies function and what their needs are. The industrial PhD model and the Graduate Research School can also provide conditions for SMEs to house doctoral students. SSF pays for a part of the costs of a doctoral student, making it possible for smaller companies to participate.

Participating companies must finance at least 50 percent of the project costs, and each project must include at least two industrial companies. In total more than 50 industrial companies have participated in 18 Proviking projects, out of which 12 are SMEs. Some 30 percent of the PhDs in the Proviking Programme are industrial PhDs, and the rest "normal" PhDs. In total, Proviking has provided for 95 PhDs; 80 are still in the system while five have dropped out. Proviking pays 20 percent of the PhDs´ salaries for five years.

The Swedish Competence Centres Programme is a long-term effort to strengthen the crucial link in the Swedish National Innovation System between university research and industrial R&D. The aim is

to achieve a stronger industrial impact and concentration of resources by creating multidisciplinary university-based research environments in which industrial companies participate actively. The programme comprises at present 28 Competence Centres at 8 universities. So far, more than 300 future-oriented companies have participated as partners in the centres and currently 230 companies are taking part[38].

The German Research Foundation and the Korea Science and Engineering Foundation created the Korea International Research Training Group. This mechanism brings together universities in Germany and Korea with the aim of bringing together basic research and practical applications at an internationally high level. Doctoral students have the opportunity to work in an international research environment with supervisors from both countries as well as gain international experience.

Conclusions

Ireland is well advanced in building public-private research partnerships. This principle is accepted and the instruments used are gradually increasing the extent to which industry has to be an active partner. In combination with policies to place PhD-level manpower into Irish firms, this should gradually raise the perceived need for research-capable industrial manpower.

Implications

This appears to be an area where no additional action is required, beyond ensuring that existing measures are exploited as widely as possible and that efforts focus on programmes that require active industrial participation in R&D.

3.3 Mobility throughout the research career

International Mobility of Irish Researchers

International mobility brings undisputed benefits such as skills acquisition and knowledge transfer, including the potential to attract good researchers from overseas into Ireland in order to deliver the numbers of PhDs at which the SSTI is aiming.

It is thought (there are no reliable statistics) that fewer postdocs are now leaving Ireland. In the past, low levels of pay, which were said at one point to be below that of welfare payments, had encouraged mobility and emigration. In our consultation with the Irish research community, quite a number of people remarked that researcher mobility at all levels among Irish universities is low and this was confirmed by analysis of the careers of respondents to the survey. Movement of researchers between academic institutions should be encouraged and facilitated. This is likely to have a detrimental effect on research quality by reducing exposure to a diversity of approaches and methods. It is certainly the case that many more people are now remaining in Ireland to do PhDs and take up post-doctoral positions than in the past. Fewer are now leaving Ireland for international

[38] VINNOVA, The Swedish Competence Centres Programme - Third International Evaluation, 2004.

postdoc experience. While the expansion of the research system has brought many advantages, increasing opportunities for researchers within Ireland has effectively resulted in decreased mobility. The new generation of researchers is likely to be globally less well networked than its predecessors. Faced with the same situation in the early 2000s, as a result of the expansion of the Norwegian research system, the Research Council of Norway set about encouraging PhDs to do at least one year of training abroad.

We do not have data on the numbers of Irish PhD students studying overseas, but stakeholders believed the numbers were quite large, especially in the UK. On the one hand, stakeholders were concerned that it might be difficult to attract them back to Ireland afterwards. On the other hand, there was a consensus that it was imperative for Irish researchers to be allowed to travel and work elsewhere. It was considered almost impossible to secure employment in academia without having spent time abroad. As one stakeholder put it -

> "There is a need for researchers to be allowed to leave to enhance their careers but also policies in place to guarantee a position back in Ireland when they want to return. This is why there are Post-docs that are going nowhere with their careers and end up driving taxis. They need the international reputation to take the next step up the career ladder."

Some felt that there was the need for policy makers to recognise that international mobility is positive, and that doggedly to try to hold onto Irish researchers is damaging for them as individuals and the research community as a whole.

Mobility of Researchers into Ireland

There are concerns that the planned doubling of PhD numbers will not be able to be met purely via Irish supply. As the SSTI states, removing obstacles to the mobility of researchers has been identified as a priority for Ireland and there are many international students in the Irish higher education system. Over 26 percent of students enrolled on a PhD are from outside Ireland[39]. The challenge is to encourage these individuals to remain in Ireland as well as to attract further high calibre researchers from overseas.

Stakeholders generally saw little problem in attracting overseas researchers due to new laboratories, equipment and the fact that there is now the housing infrastructure to accommodate them. Many applications to IRCSET come from Asia, and Ireland is generally perceived as an attractive place to study. It was felt that there was previously a problem attracting non-EU researchers with families but this was no longer an issue now that provisions have been made to include researchers' families in any research contract. Whether good quality overseas researchers remain within Ireland is not known however and retaining them within Ireland was seen as more problematic due to the hosting institutions' inability to secure both onward funding and an extension/renewal to the visa requirements. The long-term career prospects for those entering

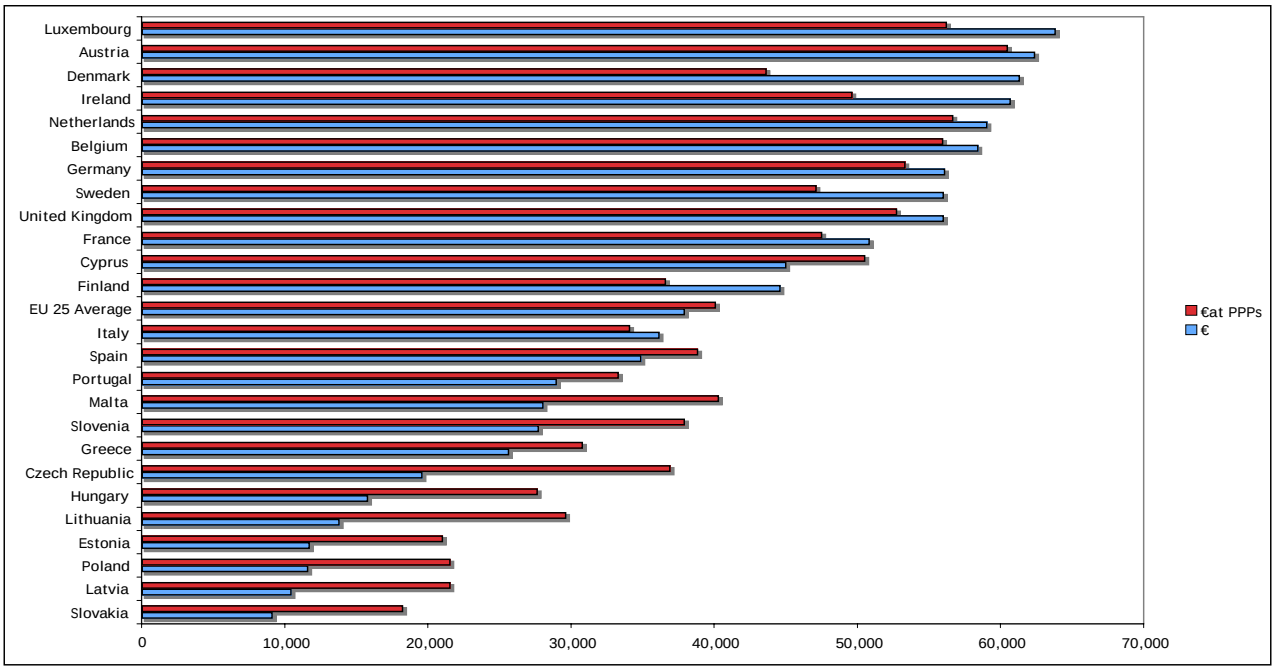
[39] HEA Statistics Office, 2007

Ireland at the post-doc level were also questioned. While, therefore, Ireland may do well in importing and training foreign researchers, it was harder to attract more senior people and the uncertainties experienced by Irish researchers applied no less to foreigners.

Salaries

Ireland ought to be a rather attractive place to do research. Not only has there been a large investment in infrastructure via the PRTLI but salaries are also good. Exhibit 26 shows the gross yearly salary average of researchers in EU countries. In money terms, Irish salaries are the third highest in Europe, at an average of €60,727, compared with an EU average of €37,948. In terms of purchasing power parities Irish researchers do less well at €49,654, eighth in Europe but still 24 percent better than the EU 25 average of €40,126 (and 7 percent better than the EU-15 average of €46,498).

Exhibit 26 Total Yearly Salary Average for Researchers, 2006 (€)[40]



Mobility among Irish academic institutions

Many of the stakeholders consulted wanted increased flexibility to facilitate academic institutional mobility. Researchers should be encouraged to take up their first post-doctoral position in an institution different to that of their PhD studies. All too often researchers remain at the same HEI.

Cooperation and Movement between Industry and Academia

There is currently little reported movement between the academic and the industrial spheres at any stage of a research career. Doing industrial work means researchers become less attractive to

[40] Study on the remuneration of researchers in the public and private commercial sectors, DG Research 2007

academia, because they tend neither to publish much in academic journals nor to teach. Nor does time spent in industry count towards the years of service that drive academics up the salary scales. There are no incentives for senior researchers to spend time in industry. There are some industrial placements on offer to PhDs but these are usually no longer than three months. Longer placements of up to six months would be of greater benefit to both parties.

In addition to the systemic issue of a lack of absorptive capacity and a weak research base in industry, a number of stakeholders drew attention to the issue of Intellectual Property (IP) and how this affects the relationship between industry and academia. IP contract negotiations between industry and academia are often prohibitively long. As universities have begun to focus more on commercialisation of IP, they have become far more protective of it. Both the delays and university defensiveness stifle cooperation and researcher recruitment by industry. Some argued that a similar logic also impeded mobility among academic institutions.

Irish/EU Initiatives

Several programmes promote the international mobility of researchers. Many of them are European initiatives, such as the European Network of Mobility Centres, or originate in EU Directives. Ireland has its own national mobility centre and portal operated by the Irish Universities Association. Marie Curie Fellowships provide European placements for pre and post-doctoral researchers, usually up to the age of 35, and for experienced researchers.

Exhibit 27 presents the European Commission's recommendations for the mobility of researchers between academia and industry. The recommendations are in line with many of Ireland's recent initiatives and some of the international practice, which is highlighted in this report.

Conclusions

Ireland has increasingly become an attractive place to do research and the expansion of the HE and research system has reduced the drive for people to leave the country in order to gain research training and experience. While in the past there was concern about brain drain, there now need to be measures to ensure the international circulation of Irish researchers.

There are increasingly important barriers to researchers being able to return to academia following employment within industry, which is detrimental to both sectors. In particular, the academic world does not recognise the value of experience in industry.

Implications

In addition to continuing to exploit existing international mobility schemes, Irish research funders could usefully consider a providing 'year abroad' options to PhD students, thereby ensuring international exposure while still encouraging them to return to Ireland to graduate (and by implication to work).

The HE institutions and industry (e.g. IBEC) together should consider and implement ways to recognise relevant experience outside their respective sectors for the purposes of recruitment, promotion and pay.

Exhibit 27 Twelve Practical Recommendations for the Mobility of Researchers between Academia and Industry[41]

No.	Recommendation
1 & 2	Training Content and Environment In order to better answer to future employers' needs, graduates and early stage researchers should be trained adequately, providing them the appropriate skills for their future profession of researcher in both sectors, in particular the private business sector. Develop graduate and doctoral programmes in partnerships with the business community, including with SMEs, as programmes jointly developed will better suit future employers' needs. Industry involvement in defining and reviewing academic training programmes will also help adapting them to constantly changing market needs.
3	Training Supervision Provide supervision quality insurance, in particular for early stage researchers. Researchers should be followed by two supervisors with adequate training, one from each sector.
4	Access to Inter-sectoral Mobility Increase inter-sector mobility possibilities for both early stage and established researchers, in particular through consultancy and internships. Advertise vacancy positions and provide access to researchers' industry relevant expertise online.
5	Appraisal of Mobility Incentivise inter-sectoral mobility through adequate evaluation criteria, and a fair and transparent career evaluation process, including trained evaluators and researchers from both sectors in the evaluation committees.
6	"Permanent" Mobility to the Enterprise Sector Recruit more staff on permanent positions with experience from the enterprise sector.
7	Administrative barriers and autonomy needed to overcome them Remove administrative barriers and provide the necessary autonomy to public sector institutions enabling them to undertake the above-mentioned recommendations, especially with regard to recruitment.

[41] DG Research, European Commission (2006) "Mobility of Researchers between Academia and Industry – 12 Practical Recommendations". Cat. No. EUR 22572

8	Framework conditions for academia-industry partnerships Set the framework conditions for academia-industry partnerships by favouring co-location, collaboration through jointly funded research grants and fellowships, and the establishment of codes and interface offices between academia and industry.
9	Appraising institutions Include academia / industry collaboration as a criterion when appraising institutions, including when academia involves industry representatives in its organisation.
10	SME-Academia networks Develop informal networks between SMEs and academia.
11	Funding for training academic staff Provide funding for training to further professionalise academic staff at all levels to become "on a par to industry" (administration, TTO officers 28, supervisors, evaluators, career appraisals, etc.)
12	Legal Instruments and Awareness of EU Instruments Actively support the implementation of EU existing and future initiatives, schemes and instruments that remove obstacles to inter-sectoral mobility by raising awareness on their importance, e.g. social security rules, complementary pension schemes etc... If necessary, change national legislation so as to overcome obstacles.

3.4 Making use of all the talent

3.4.1 Gender issues

The proportion of women in academic research declines the higher up the career ladder one progresses, in a phenomenon often referred to as the 'Irish Gender Scissors'[42] although this phenomenon is reportedly not so apparent within the humanities and social sciences as in science, engineering and technology.

Exhibit 28 shows the proportion of women at different researcher levels although the available data are rather out of date (1998-1999). This illustrates starkly how the numbers of women fall away the higher up the career ladder they get. While Ireland performs better than the UK and Sweden at the PhD level, at the level of Assistant Professor for example only 16 percent are females in Ireland as compared to 40 percent in the UK and 52 percent in Sweden.

Exhibit 28 Proportion of Female Researchers at Different Levels – 'Gender Scissors'[43]

Country	Students	PhD	Assistant Prof	Associate Prof	Full Prof
Belgium	54%	27%	21%	10%	7%
Germany	44%	33%	13%	10%	6%
Spain	53%	44%	33%	35%	15%
Ireland	55%	41%	16%	8%	5%
Netherlands	49%	30%	22%	9%	6%
Finland	53%	43%	47%	45%	18%
Denmark	50%	31%	34%	20%	8%
Greece	47%	46%	32%	21%	10%
Italy	55%	45%	41%	26%	12%
Austria	47%	34%	31%	11%	6%
Sweden	59%	34%	52%	25%	11%
United Kingdom	52%	37%	40%	24%	12%
EU Average (12)	52%	45%	38%	28%	12%

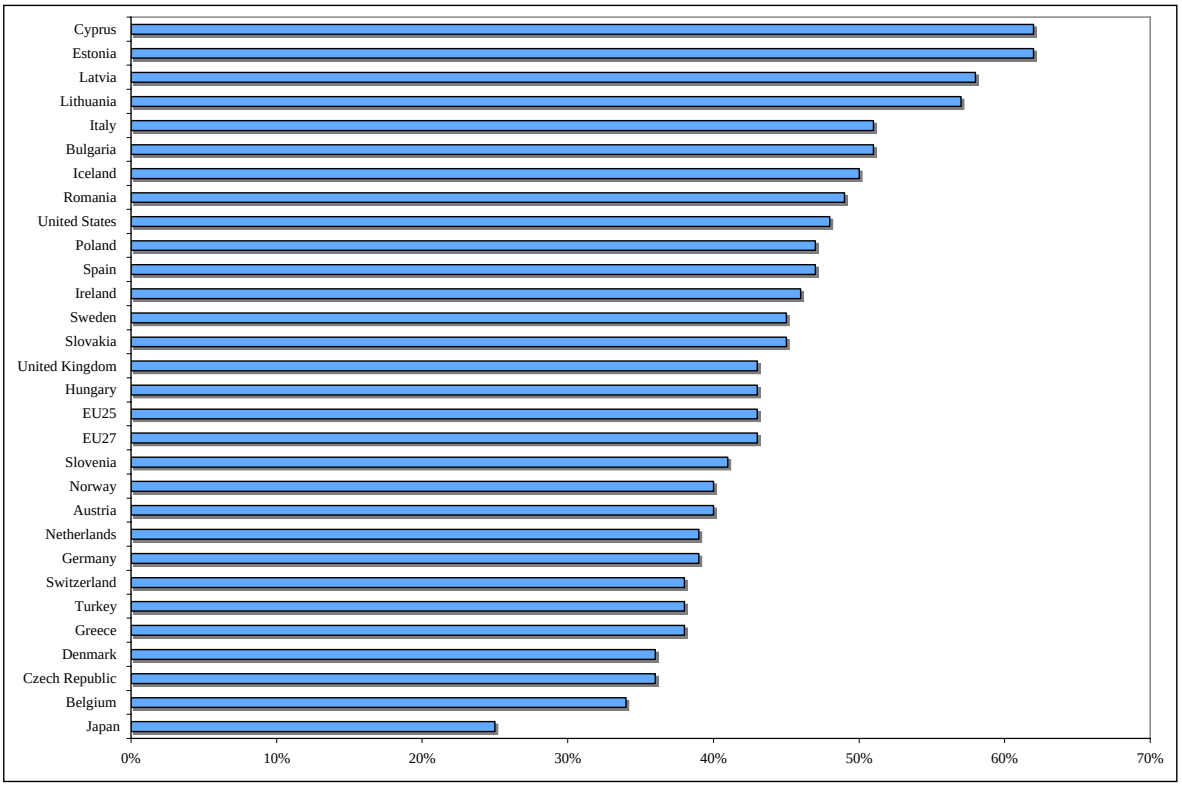
Interviewees felt that lack of job security was particularly serious for women and that the lack of maternity provision for women in post-doctoral employment will clearly act as a barrier to them remaining in a research career. Family life and childcare are essentially incompatible with the long hours demanded of a post-doc. However, it is not clear why there is such a stark difference between Ireland and other EU countries. Exhibit 29 shows a more recent picture of the percentage

[42] Building Research Careers – the Postdoctoral Experience. Irish Universities Association. 4th/5th May 2005.

[43] Scissors Diagrams for 12 EU Member States (1998-9) - % female. *Third European report on Science and Technology Indicators*, Cordis 2003.

of females as a proportion of PhD graduates. At least at this stage of a research career, Ireland is a little ahead of the EU average.

Exhibit 29 Women as a Proportion of all PhD Graduates, 2004



Source: Eurostat

There are also still enormous gender divisions by domain. Exhibit 30 illustrates how the Humanities and Social Science domain at the PhD level is dominated by women, whereas there is still significant under representation in Science, Engineering and Technology.

Exhibit 30 Gender Breakdown at PhD Level of Enrolment in Ireland[44]- 2006

Domain	Male	Female	Total	Female % of total
HSS	589	815	1404	58%
SET	1425	853	2278	37%
Total enrolments 2006	2014	1668	3682	45%

There were slightly more female than male respondents to the questionnaire: 573 (54 percent) of the 1056 total. Women are therefore slightly over-represented in the response, since women account for only about 45 percent of PhD graduations.

[44] HEA Statistics Office, 2007

Women accounted for 60 percent of the 171 responses from people whose highest qualification was a Masters but 53 percent of the 885 people with PhDs. Surprisingly, the proportion of women is stable across the three cohorts of PhD graduates (32).

Exhibit 31 Gender Ratio in PhD Cohorts

	before 1997		1997-2000		since 2001	
	Nb	percent cit.	Nb	percent cit.	Nb	percent cit.
Female	59	50%	108	53%	166	52%
Male	60	50%	96	47%	154	48%
Total	119	100%	204	100%	320	100%

56 percent of the 472 Irish respondents to the question about nationality are female, compared with 46 percent of the 219 foreigners, suggesting that women are less internationally mobile than men. A further surprise was that gender seems to have limited influence on subject choice, both at Masters (Exhibit 32) or PhD level (Exhibit 33).

Exhibit 32 Influence of Gender on Masters Degree Field

	Total of respondents	Women
	% cit.	% cit.
Science	46%	45%
Social Sciences, business and Law	18%	22%
Health and Welfare	14%	19%
Other (please specify)	8%	8%
Engineering, Manufacturing and Construction	11%	4%
Education	2%	2%
Humanities and Arts	2%	<1%

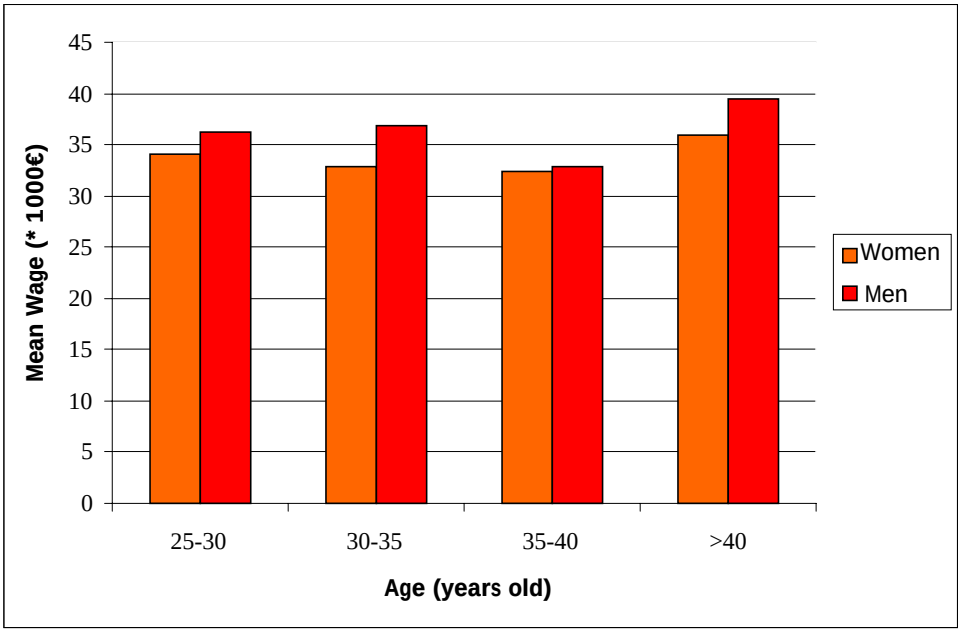
Exhibit 33 Influence of Gender on PhD Degree Field

	Total of respondents		Women	
	No	% cit.	No	% cit.
Science	481	67%	258	68%
Humanities and Arts	36	5%	25	7%
Social Sciences, business and Law	44	6%	25	7%
Other (please specify)	60	8%	28	7%
Health and Welfare	28	4%	20	5%
Education	12	2%	11	3%
Engineering, Manufacturing and Construction	42	6%	7	2%

Agriculture	10	1%	2	<1%
Services	2	<1%	1	<1%
Total	715	100%	377	100%

The distribution of women by age is similar to that for all respondents. The mean, median, minimum and maximum ages are also similar. This implies that there has been no significant evolution of cultural habits about gender selection in research careers in Ireland during the last 30 years.

Exhibit 34 Mean Wages of Women and Men by Age



Less than one in ten women said that they had experienced gender discrimination in research work, though this is higher for those with a PhD than those having a Masters as their highest degree. Older women more frequently say they experienced difficulties with advancement because of their gender. This was an issue for 6 percent of respondents granted a PhD since 2001, 12 percent of those graduated between 1997 and 2000, and for 19 percent of those graduated before 1997, so the incidence of overt discrimination appears to be falling with time. Salary levels tell a similar story (Exhibit 34). Women are disadvantaged, but not by a large amount.

Women value job security more highly than men in making career decisions (

Exhibit 35). It appears that they do not use the availability of childcare as a criterion in choosing a job but that, where it is available, they value it much more highly than men (Exhibit 36).

Exhibit 35 Job Security in Job Choice as Motivation and Satisfaction for Women (men in brackets)

		Cohort	% Very Important	% Not Important at all
Choice	1st position	before 2001	15 (~5)	23 (24)
		after 2001	15 (12)	17 (17)
	current	before 2001	33 (37)	12 (16)
		after 2001	32 (19)	11 (14)
Satisfaction	1st position	before 2001	8 (3)	25 (32)
		after 2001	5 (5)	26 (28)
	current	before 2001	36 (42)	12 (17)
		after 2001	39 (32)	8 (11)

Exhibit 36 Good Child Care Facilities and Social Provision as Motivation and Satisfaction for Women (men in brackets)

		Cohort	percent Very Important	percent Not Important at all
Choice	1st position	before 2001	2 (2)	68 (64)
		after 2001	4 (5)	57 (65)
	current	before 2001	3 (5)	48 (47)
		after 2001	0 (6)	47 (62)
Satisfaction	1st position	before 2001	45 (37)	21 (50)
		after 2001	35 (35)	40 (33)
	current	before 2001	59 (13)	0 (35)
		after 2001	40 (7)	0 (44)

Irish Initiatives

Little was known by stakeholders about policies to assist women returnees to the researcher labour market, which would suggest that little support is available. One stakeholder mentioned that SFI has some funding for women returnees, which, while undoubtedly useful, could not address practical issues such as a lack of childcare provision on campuses. No specific initiatives were mentioned which aim to alleviate the problem of decreasing numbers of women up the career ladder. There is an initiative called the SFI/Dell scholarship – Young Women in Engineering which aims to attract and encourage more high achieving young women into third-level education in designated four-year engineering undergraduate degree programmes. The Scholarship is supported by DELL which supplies all the scholars with notebook computers.

International examples

Korea: National Institute for Supporting Women in Science and Technology

NIS-WIST was established in February 2005 under the Article 14 of the Korean National Law on Recruiting and Supporting Women in Science and Technology to aid women scientists, engineers,

and other associated groups. It offers a range of programmes designed to support women in SET including:

- A mentoring plan highlighting the role women can take in SET;
- A career centre matching candidates to suitable positions;
- Education and training for career development; and
- Employment guidance and counselling.

The State and local governments plan to establish the Working Centre for Women in Science and Technology. The Working Centre will aim to

- Develop policies on fostering and supporting women;
- Educating, training, studies and consultations;
- Provision of employment information;
- Other support.

The WISE Centres, which are supported by the Ministry of Education and Human Resource Development, link female students with scientific and technical female professionals using an online/offline mentoring programme.

UK: Strategy for Women in Science, Engineering and Technology

This strategy, launched by the Government in April 2003, decided on the establishment of a dedicated resource centre to co-ordinate the activities of existing organisations involved in women in SET and to support innovative schemes, such as mentoring, networking, speaker's bursaries and mobility needs. As part of the strategy, a Research Centre for Women in SET was set up which is funded by the DTI and ESF. The aim is to help 1000 women by the end of 2007 (women returnees, mature women, and those working part-time) in order that they are aware of how to access research grants and funding. The web site offers advice on where funding can be obtained and also answers questions on issues such as maternity rights while working on post-doctoral contracts, and updating skills and experience. It also offers advice for teachers who wish to encourage girls to take up SET subjects.

Conclusions

While the stakeholder interviews revealed few concerns about gender, the data tell another story of increasingly limited opportunities for women as they progress up the research career ladder. What we do not know is what happens to women who drop out of an academic career and whether they fare any better within industrial careers. However creating parity within the academic sphere is vital if the skills of good female researchers are not to be lost. In addition women are still under-represented in certain research sectors such as engineering.

Internationally, once overt discrimination against women has been forbidden, there is limited experience with effective ways to alleviate the kind of more subtle mechanisms that slow women's rate of progress and that are so graphically illustrated in the 'Irish Gender Scissors'. Some countries such as Austria have instituted special research grants for women and promoted networks of women

in industrial R&D. Austria has also inserted targets for female recruitment into the performance contracts between the education ministry and the universities.

Ireland appears to have limited targeted strategies or policies for female researchers. Some other countries seem to be more pro-active in this regard and fare better in the proportions of women reaching higher academic positions.

Implications

The under-use of women's talent in the Irish research system is severe by international comparison. Measures to encourage the presence of a critical mass of women researchers at all of research are needed and especially the higher levels. The research funders and universities should collectively decide upon a transitional period during which special women's grants and accompanying measures should be put in place.

3.4.2 Encouraging researchers from abroad

Ireland appears to have been rather successful in attracting foreign researchers. In terms of the overall researcher population, Ireland already compares well with other countries. In 2006, 15.5 percent of Ireland's science and technology workers aged between 25 and 64 were born outside Ireland, compared with an EU-27 average of 9.7 percent.45

One fifth of the respondents in the researcher consultation were not Irish citizens. One quarter of these come from UK, 12 percent from Germany and 7 percent from France. In total, 71 percent come from Europe, 14 percent from the Commonwealth (but not UK), and 4 percent from South America. 46 percent of the non-Irish citizens are female, 54 percent are male.

Irish and non-Irish PhD students have very similar motivations for conducting doctoral research, especially in their interest for the activity itself and the topic on which they are working. For them as for the total population of the respondents, job opportunities in industrial research and the location of partner's job are not considered as important.

Doing research in Ireland is motivated primarily by the quality of research groups. Financial reasons and opportunities for advancement are not important motives – presumably because they have limited expectations of staying in Ireland. 63 percent of foreign researchers would recommend a career in research to others, as compared to 51 percent of Irish respondents. However, this must be read against a background of expectations that are different to those of Irish respondents and should probably be understood as an endorsement of the idea of doing research abroad. More generally, foreigners have much the same concerns as Irish researchers (Exhibit 37): they want a proper research career structure, to create positions in academia and to ensure proper remuneration.

[45] EUROSTAT HRST Database, cited from Tomas Meri, *Statistics in Focus: Science and Technology*, No 75/2007, Luxembourg: EUROSTAT, 2007

In open comments from the questionnaire, several non-Irish researchers mentioned the need to make it easier and quicker for them and their spouses to obtain visas. This could only be a suggestion of a total implementation of the EC directive about a European scientific visa (2005/71/EC). Another option that would tackle the supposed shortage of researchers would be to give a green card and the tight of permanent residence to researchers who complete their PhD research in Ireland.

Ireland has also recently introduced a fast-track system for citizenship for highly skilled individuals, reducing the time taken to be eligible from five years to three years. However, as most post-doc contracts are for two years only, this will mean third-country national researchers under such contracts, will be ineligible for fast-track residency.

Exhibit 37 Non-Irish Researchers' Concerns about the Irish Research System

	No	% obs.
Lack of defined research career structure	89	41%
Lack of opportunity to develop key transferable skills (communication, project management etc.)	33	15%
Lack of positions in academia	84	38%
Lack of positions in industry	48	22%
Lack of positions in public sector	31	14%
Lack of proper remuneration	65	30%
Lack of recognition of experience developed outside academia?	37	17%
Lack of status	51	23%
Not easy to transfer between industry and academia	44	20%
Not easy to transfer between universities	21	10%
Other (please specify)	26	12%

There are some regulatory barriers at present to skilled third country nationals remaining in Ireland, but new legislation is being introduced to overcome these. An EU Directive[46] was bought in under Ireland's presidency in 2005 that includes a specific procedure for admitting third-country nationals for the purposes of scientific research. The Directive calls for the implementation of Hosting Agreements by designated accredited research organisations. This sets out conditions of employment such as social security, and tax benefits. However, the Directive also states that the residence permit shall only last as long as the duration of the contract – i.e. there is no scope for remaining in Ireland to secure further funding once the contract ends. The researcher will no longer

[46] Council Directive 2005/71/EC. 12th October.

be eligible under the hosting agreement to remain within Ireland. Ireland is beginning to come into line with the Directive, and will have to comply fully by October 2007.

From the stakeholder interviews it was highlighted that much had already been achieved to remove the regulatory barriers for incoming researchers. However, it was considered that more could be done in relation to actively attracting researchers to join companies and research institutions within Ireland. This could be achieved through a national level programme of research fellowships for international researchers. This would not only give those researchers exposure to Ireland and the research environment, but would also benefit the overall research system by the transfer of knowledge internationally from systems that are perhaps stronger than the current Irish system. In relation to attracting back to Ireland students who have done their PhDs overseas, good tracking systems need to be set up and potential returnees need to be constantly reminded that Ireland is an attractive place to work.

Conclusions

Ireland has succeeded in attracting a good number of foreign researchers, in part owing to its strong infrastructure. Irish pay levels should make it attractive for many of those who initially come for a short period to stay longer term. Following the full implementation of the EU scientific visa this year, few obstacles will remain to further recruitment form abroad. The key gap appears to be in measures that permit or encourage short-stay research workers and PhD students to remain in Ireland at the end of their contract or research training.

Implications

Ensuring that spouses of foreign contract research workers also have work permits is one way to ensure that Ireland is an attractive destination. A mechanism that would (whether automatically or selectively) provide a green card to foreign students on completion of their PhD would further strengthen the Irish research workforce.

3.4.3 Domain issues

The Irish research funding system allocates many more resources to Science, Engineering and Technology (SET) than to Humanities and Social Sciences (HSS). For example, there is more funding available to researchers from IRCSET than from IRCHSS despite the fact that the majority of students coming through third level education have qualifications in HSS. IRCHSS offers the only source of funding for post-graduates and Post-docs in HSS whereas for SET there is a broader range of funding opportunities. The SFI Frontier Research Programme has no equivalent in HSS for example.

One issue that can affect the funding structure of HSS is the very nature of the work researchers perform. There are far fewer research outputs and performance indicators in HSS (mainly books) as opposed to SET (patents, citations) making it very difficult to audit and identify value for money.

It has been difficult to forge links between industry and HSS. There are no current programmes within IRCHSS for researcher placements in industry or the encouragement of industry/academic mobility. There was felt to be little portability of HSS research into industry, which also limits career opportunities. Despite this, the growing importance of services in the economy means that there should be a growing role for people with advanced degrees in humanities and social sciences in the economy – and therefore also in academia.

Conclusion

Some of the potential economic and social value of humanities and social sciences research and researcher education appears to go unrealised.

Implications

This potential social value needs more closely to be investigated, to enable consideration of increased PhD and research funding.

3.4.4 Increase understanding of the value of research

Earlier in the report, we described the disappointment that many researchers in the public sector feel at what they actually do, compared with their idealised vision of their role. The consultation also made clear the widespread lack of awareness about industrial research and the opportunities it provides. Ireland is suffering from the almost OECD-wide 'flight from science' among younger people, reducing the inflow of potential researchers. Some respondents feel that research career attractiveness to be linked with the popular image of science. They suggest improving the way science is taught in schools by promoting research-led teaching and outreach so that young people can see at first-hand the interesting research that is being done in Ireland. This could take place in semi-formal school liaisons or in science centres. "Science has to be seen doing positive things, not just damaging the environment!"

These information deficits imply a need to map, measure and publicise the realities of research and research careers at all school and university levels and to 'market' PhD education around the message that undertaking a PhD will provide a career advantage.

While a growing amount been written about the issue of research careers in Ireland and elsewhere, there is still a lack of data for Ireland or comparative data about some of the concerns raised in this report. For example, little is known at the moment about the current locations of Irish researchers, their mobility levels and their career motivations. The survey carried out as part of this study provides some data, as will the longitudinal study being carried out by the Geary Institute on behalf of the Irish Universities Association. The OECD is attempting to harmonise indicators on the careers and mobility of doctorate holders and is undertaking an international survey in which Ireland will participate, although results will appear much too late to be of use to the ASC Task Force on Research careers. These surveys will reduce the extent to which it is currently necessary to rely on qualitative indications in designing policy for research careers.

Conclusions

Better information is needed so that the public, future potential researchers and policymakers alike are equipped to understand make good decisions.

Implications

Ireland needs to participate in international statistical studies of research careers, such as those of the OECD and on a national basis to collect more quantitative and qualitative information about the Irish PhD and researcher cadre, including its destinations. Work by the HEA, IUA and the Forfás Expert Group on Future Skills Needs provides good foundations. Information collected should also be used in wider efforts to inform the public about research and research careers.

4 Recommendations

Much of this report has been concerned to identify the problems associated with Irish research careers. In this Chapter, we summarise the solutions identified, showing that they are complex and interconnected but also suggesting that they are by and large tractable. The solutions involve

- Improving the organisation of academic careers, through;
- Generating a clearer career path for researchers;
- Raising the skills, status and career planning among researchers;
- Improving the absorptive capacity of enterprise and therefore its PhD-intensity;
- Increasing opportunities for mobility;
- Ensuring all available talent is welcomed into the profession.

Many of the solutions cannot be put in place by single actors working alone. Rather, several adjustments need to be made to the research training, funding and performing systems, both within companies and universities. Cooperation will be necessary to overcome problems that are often systemic.

4.1 Needed Solutions

Improving the organisation of academic careers

Ireland needs a more clearly articulated and modern research career structure, adapted to the needs of researchers in all parts of academia and consistent with preparing many of them to work elsewhere. The HERG has made a good start on this and it would be rational to build upon the emerging HERG model, which gives researchers parallel status with lecturers and is consistent with successful practice elsewhere. To manage and operate a clearer research career model in turn requires the more explicit involvement of university HR functions, building the common knowledge, courses and planning tools that cannot be developed if Principal Investigators continue to have sole responsibility for research career development.

Universities should provide researchers with the same pay, status and conditions as permanent faculty members. The most suitable form of pension provision for contract researchers should be investigated. Their status should include the right to apply for funding and to act as Principal Investigator, within the same set of constraints as apply to permanent faculty.

Researchers need industrial exposure and skills. The rapid proliferation of graduate school schemes – we identified four –is a welcome development that may better align PhD skills with needs. It may be worth coordinating some common taught course elements relating to industry and commercialisation, in order to avoid fragmentation, generate scale economies and assure quality.

Researchers need to plan their careers. Ignorance about research careers should be tackled in part through improved science communications and improved careers information at all levels, including university careers' services. Supporting postdoctoral researchers' career planning requires a combination of actions inside and outside the universities. First, the university HR functions need to

take responsibility for the task, which means that (preferably common) processes should be designed across the university sector and responsibility allocated to HR. It is not realistic to expect systematic and continuous career development support from principal investigators unless there is a managed system of appraisal and development to which they have to contribute. Second, the kind of external, open career development information and support provided by UK Grad is needed. This might be provided by establishing an Irish variant of the programme – or might better be handled by the HEA buying into the UK Grad programme.

Enterprise and absorptive capacity

Inadequate industrial demand for PhDs can, in part, be tackled by measures that place PhDs in industry, where they can demonstrate their value and stimulate demand for more, similar people to be recruited. Ireland has already taken the first steps to increase industrial PhD-intensity through IRCSET's Enterprise Partnership Scheme grants. It would be useful to look at ways to cluster these into graduate schools and to back this approach up by experimenting with a 'Docstart' scheme aimed at companies without the resources or scale to co-fund doctoral training. Further measures to encourage short-term mobility between industry and the HE sector would be useful.

Ireland is well advanced in building public-private research partnerships. This principle is accepted and the instruments used are gradually increasing the extent to which industry has to be an active partner. In combination with policies to place PhD-level manpower into Irish firms, this should gradually raise the perceived need for research-capable industrial manpower. This appears to be an area where no additional action is required, beyond ensuring that existing measures are exploited as widely as possible and that efforts focus on programmes that require active industrial participation in R&D.

Mobility throughout the research career

In addition to continuing to exploit existing international mobility schemes, Irish research funders could usefully consider a providing 'year abroad' options to PhD students, thereby ensuring international exposure while still encouraging them to return to Ireland to graduate (and by implication to work). The HE institutions and industry (e.g. IBEC) together should consider and implement ways to recognise relevant experience outside their respective sectors for the purposes of recruitment, promotion and pay.

Using all the talents

The under-use of women's talent in the Irish research system is severe by international comparison. Measures to encourage the presence of a critical mass of women researchers at all – and especially the higher – levels of research are needed. The research funders and universities should collectively decide upon a transitional period during which special women's grants and accompanying measures should be put in place.

Ireland has succeeded in attracting a good number of foreign researchers, in part owing to its recent research infrastructure investments. Irish pay levels should make it attractive for many of those who initially come for a short period to stay longer term. Following the full implementation of the EU scientific visa this year, few obstacles will remain to further recruitment form abroad. The

key gap appears to be in measures that permit or encourage short-stay research workers and PhD students to remain in Ireland at the end of their contract or research training. Ensuring that spouses of foreign contract research workers also have work permits is one way to ensure that Ireland is an attractive destination. Following the full implementation of the EU Scientific visa in 2007, few obstacles remain to further recruitment from abroad. The key gaps appear to be in measures that permit or encourage short-stay research workers and PhD students to remain in Ireland at the end of their contract or research training.

Some of the potential economic and social value of humanities and social sciences research and researcher education appears to go unrealised. This potential social value needs more closely to be investigated, to enable consideration of increased PhD and research funding.

Better understanding

Better strategic intelligence is needed, in order to design and implement policies relevant to research careers. Ireland therefore needs both to participate in international statistical studies of research careers, such as those of the OECD and on a national basis to collect more quantitative and qualitative information about the PhD and researcher cadre, including its destinations. Work by the HEA, IUA and the Expert Group on the Future Skills Needs provides good foundations. Information collected should also be used in wider efforts to inform the public about research and research careers.

4.2 Systemic Implementation Issues

Important constraints in the way the international research and innovation system works and the division of labour and governance among Irish authorities need to be considered in any attempt to implement the broad solutions suggested by this study.

Giving contract researchers the right to initiate research is a necessary part of the modernisation agenda for research careers. Since contract researchers are not, as a body, organised (as, for example in a trade union), there is in effect no one who speaks or exercises power on their behalf, except in the cases where researchers have formed associations within their own universities. HEFCE (England's higher education agency) has assumed responsibility for research careers so that the researchers at least have a proxy champion. Clearly identifying and empowering a champion in the Irish system would be useful – both to make sure there is someone in the policy debate to speak for researchers and because this would be a logical place to locate funding for extra-institutional support activities similar to UK Grad and to bolster the mobility activities of the IUA.

The way the global research community functions is a binding constraint. While many contract researchers might like to wish it away, the fact is that postdoc contract research is a required step in research careers in leading scientific nations. It is seen as a way to build networks and experience (avoiding intellectual 'in-breeding'), in part as further post-doctoral training, and as a test of quality. A more humane implementation of these principles in Ireland (and elsewhere) would be welcome, but Ireland cannot secede from the way the game is played internationally. More established Irish researchers tend to oppose the idea of these early research career jobs being

permanent. Both the Irish and the international and the Irish systems therefore imply that contract work will remain the norm for a part of the academic research career.

The Irish university system is committed to research-based teaching. In many cases, as the 2002 'baseline' study[47] of Irish research capabilities in biotech and ICT pointed out, this can mean small (by international standards) departments in small universities maintaining a diverse, fragmented and often under-critical research portfolio in order to underpin the breadth needed in undergraduate teaching. The needed strategic response, in order to build and maintain the research strength called for in national planning since 2000 is selectively to increase research capacity, thereby creating some sub-groups that increasingly focus on research rather than teaching. In an increasingly research-intensive innovation system, the universities must necessarily deal with at least this aspect of the de-integration of teaching and research. In practice, growing numbers of research groups that de facto operate as intra-university research institutes have appeared and established career structures based on research – often contract research, reflecting the large proportion of their income that comes from externally-financed research contracts. Understanding that contract research is, more broadly, an increasingly normal modus vivendi in universities internationally and not necessarily a stepping-stone to a tenured teaching position is an important realisation. The tendency of some academics to confuse people engaged in this kind of career with early career stage post-docs is a category mistake. There are therefore good reasons – over and above the ones exposed in our fieldwork – why Irish universities need to integrate a research career structure alongside the 'normal' lecturer track.

Establishing a more structured, higher status and better-supported research career is not something that is in the gift of any single Irish actor. Agreement will be needed among the universities, the research funders and the responsible departments of state.

Cooperation is needed because changes in research careers require changes in funding principles and levels. Since the Universities do not have a distinct set of internal funds for the purpose, research funders need to provide grants that take account of the costs of better conditions and careers. Once salary scales are established, the Research Councils and other funders may need to reconsider the role of price competition ('value for money') in research funding and how partially to decouple the cost of contract research staff from other assessment criteria in considering proposals.

The implications of modernising research careers within the universities are far reaching:

- Universities will need to take clear and active responsibility for managing the human resources represented by contract researchers;
- If contract researchers acquire the right to act as Principal Investigators, universities will need to manage access to internal resources, such as space and equipment;

[47] James Stroyan et al, Baseline Assessment of the Public Research System in Ireland in the Areas of Biotechnology and Information and Communication Technologies, Dublin: Forfás, 2002

- Measures will have to be built into research careers that create competition, otherwise the system will build lock-ins that limit entry and reduce quality.

If it is accepted that the Irish universities unilaterally cannot change the basis of research careers and salaries, potentially a Pandora's Box of other issues could be opened. It is not the business of this review to explore these issues, but it is perhaps worthwhile to be mindful of at least some of the things that lie inside the box. They are relevant to research careers but also to broader issues of research and higher education policy:

- In the absence of a UK-style Full Economic Costing principle, research council (and SFI) grants pay too-low overheads, so that every grant won effectively imposes an economic penalty on the winning university. Increasing research capacity by empowering contract researchers may add to other pressures to move to full economic costing, in order to avoid perverse behaviour by the universities;
- Lack of clarity about how university block grants should be allocated between teaching and research coupled with universities' weaknesses in strategy and related budgeting[48] undermine their ability to develop research strategies. This in turn constrains their ability to have strategies about research careers and specialisations;
- The great (and extremely welcome) expansion of funding for research in Ireland since 2000, and the accompanying PRTLI measure intended to strengthen the research infrastructure in higher education, have been delivered through programmes external to the universities and leads to questions about (a) whether the universities have sufficient internal core funded resources to enable them to develop and deploy their own strategies and (b) whether the uneven development of the internal and external funding streams has generated an imbalance. In some countries, universities have the resources (from the block grant or, where that is more closely specified, from the research component of the block grant) to make their own 'bets' on promising people. While the Irish universities clearly are not penniless, it is not clear that they have sufficient internal funding clout to do this properly.

Finally, as we have shown, there is growing use abroad of measures that tend to support – but also to rely on – the development of good research careers. Ireland has already made significant progress in adopting similar measures. While a better, more quantitative understanding of the problem is needed, in its absence, and despite some scepticism in the research community about the national target of doubling PhD graduations by 2013, there is no reason to abandon this goal, whose fulfilment is expected to raise the research level of both industry and academia in Ireland and have significant feedbacks to academic and industrial competitiveness. In a context where even the countries with the highest shares of R&D in GDP in the world (Sweden and Finland) are trying to increase PhD-intensity, it would be a brave decision maker who decided that Ireland was wrong to try to grow from a much lower level.

[48] OECD Directorate for Education, Education Committee, Review of National Policies for Education: Review of Higher Education in Ireland, EDU/EC (2004) 14, Paris: OECD, 2004

Appendix A: Discussion guide for researcher "case study" interviews

A1: Some generic questions

- What is the Educational background of the interviewee?
- To what extent is the Master degree suitable preparation for a PhD and, later on, a researcher position?
- What was the level of knowledge about PhDs and researchers positions at Master level?
- What was the general reputation of / feeling towards PhDs and researcher positions at that time? Has this evolved since then?

PhD/not PhD?

- Why has the interviewee done / not done a PhD?
- If they have done a PhD:
  - What were the main motivations?
  - What was their level of satisfaction?
  - What were the career plans of the interviewee when entering a PhD? (Research/not research? Academia/industry? Ireland/elsewhere?)
- If they have not done a PhD:
  - Why not?
  - What were the main barriers to entering a PhD programme?

During the PhD:

- What type of research was undertaken?
- What relationships did it have with industry, if any?
- What was the duration?
- What was the approximate salary and was this sufficient?

Professional positions since graduation

- Provide a detailed account of all positions
- What is / was the added value of the educational background in the various positions?
- Motivations / satisfaction?
- Why not choose the "other route"?
- Main barriers to research?

A.2 Interviewee's diagnostic regarding "the road to research"

According to the interviewee what are the main strengths and weaknesses of the Irish educational system with regards to the training of researchers (i.e. PhD programmes):

- Information on PhDs

- Opportunities after the PhD
- Remuneration
- Supervision and support to PhDs
- PhD training and courses?

What is the institutional framework for PhDs? Is there any doctoral school?

A.3 Interviewee's diagnostic regarding researcher careers

According to the interviewee what are the main strengths and weaknesses of the Irish research system with regards to researcher careers:

- Remuneration
- Job security
- Aspects of personal development
- Mobility (geographically, academia-industry)
- Recognition and status

What is the main motivation for researchers to choose this career?

A.4 Interviewee's suggestion for improvement

What should be done to establish a better career structure for researchers?

How should the remuneration structure be improved?

Knowing that Ireland has to increase both the number and quality of researchers:

- What should be done to improve the attractiveness and retention of researchers in Ireland?
- What should be done to improve the quality of researchers in Ireland?

Specific questions relating to gender / ethnicity

- Has any discrimination been experienced?
- More generally does the interviewee think that their gender / ethnicity affected their career in any way?

Appendix B: The initial survey advertisement

Researcher Careers Survey

The Advisory Science Council needs your help.

We are looking for all postgraduates and PhD holders who graduated from an Irish university anytime from January 1997 and/or are currently working as a researcher in Ireland.

You are invited to contribute to the Advisory Science Council on-line survey on Researcher Careers in Ireland. We want to encourage more people to enter and remain in a research career. Your views and experiences are vital in helping to improve the situation for researchers in Ireland, for example by helping to develop a better career structure for them, and identifying barriers to research careers.

Please go to the following website for further information and a link to the survey.

http://www.Forfàs.ie/ASCsurvey.html

Appendix C: Survey Website Homepage

Advisory Council for Science
Technology and Innovation
An Comhairle Eolaíochta

Researcher Careers Survey

The Advisory Science Council (ASC) is undertaking a study on the attractiveness of researcher careers in Ireland. The ASC is inviting PhD holders that have graduated since January 1997, in Science, Engineering or Technology (SET) or the Humanities and Social Sciences (HSS) to participate in an online survey. In addition the ASC requests interested parties (PhD holders, stakeholder groups, agencies etc.) to make a submission on the issue. The feedback received from the survey and submissions will inform policy decisions for researcher careers in Ireland.

The Government Inter-Departmental Committee has requested the ASC to examine, and come forward with proposals on a career structure for researchers, as set out in the Strategy for Science, Technology and Innovation 2006-2013 (SSTI). The SSTI has set targets to double the number of postgraduate researchers by 2013 and significantly increase the number of researchers employed in industry. A structured career path is necessary to attract and retain these professionals in the system and achieve this goal.

The study will concentrate on issues that affect the development of careers for researchers within the enterprise, academic and public research sectors. The ASC is looking specifically at issues pertaining to supply and demand, career structures, recruitment, retention, funding, gender, ethnicity and nationality, mobility between the public and private sectors and mobility of researchers to and from Ireland.

PhD holders (since 1997) in SET and HSS as well as all researcher currently in an Irish university or Irish companies can access the online survey via the following link

http://www.surveymonkey.com/s.asp?u=304433524843

All survey returns will be treated as confidential. The closing date for responses is x April 2007.

The closing date for receipt of submissions by interested parties is also x April 2007 and should be sent by email to jos.evertsen@Forfàs.ie.

All submissions may be made public as part of the consultation process.

Advisory Science Council Secretariat
c/o Forfàs, Wilton Park House, Wilton Place, Dublin 2.
Telephone: 01 6073054

Appendix D: Structure of survey respondent sample

Respondents holding or currently taking a Master degree

Respondents holding a Master degree as their highest degree or currently taking a Master degree represented only 16 percent of total respondents (171 observations among 1056). Among them, 87 percent were Irish (149 respondents). More than two-thirds of those respondents passed or are taking their Master degree in the main 7 universities of Ireland (see table below). The Trinity college of Dublin is the most represented followed by the University College Cork and the University College Dublin.

Exhibit 38 HEI of origin for students having or currently taking a Master degree

	No	percent cit.
Trinity College Dublin	31	18 percent
University College Cork	24	14 percent
University College Dublin	21	12 percent
National University of Ireland Galway	18	11 percent
Dublin City University	12	7 percent
University of Limerick	6	4 percent
National University of Ireland Maynooth	5	3 percent
Other	54	32 percent
Total	171	100 percent

The majority of respondents graduated very recently (37 percent of them graduated in the last two years 2005-2006). Only 12 of them graduated before 1997.

Concerning fields of study, 46 percent of respondents studied in Science, 18 percent in Social sciences and Law, 14 percent in Health and Welfare, 11 percent in Engineering manufacturing and construction.

Respondents that have or are currently taking a PhD degree

PhDs represented the bulk of respondents with 885 answers (84 percent of respondents). Among PhDs, 78 percent are Irish (688 respondents). Non Irish PhDs are mainly from the UK (45 respondents), Germany (24), France (16) and India (12).

Regarding the date of graduation, of the 644 respondents (we assume the 243 respondents left have not graduated yet), 19 percent graduated before 1997, 32 percent between 1997 and 2000, 31 percent between 2001 and 2004, and 18 percent of the rest graduated the last two years (2005-2006).

Appendix E: Individuals Consulted

A large number of people kindly participated in the research community consultation and our interviews. The latter are listed at the Appendix E. Throughout the study, Prof Dolores Cahill and the members of the Research Careers Task Force as well as Dr Jos Evertsen, Forfás, were constant sources of support and collegial criticism.

We are grateful to all, both named and un-named. They deserve significant credit for whatever strengths the study may have. For any weaknesses, of course, the authors have sole responsibility.

Exhibit 39 Individuals consulted as part of the scoping phase

Name	Organisation/role	Type of interview
Dolores Cahill	University College Dublin (also a member of the task-force)	Face to face
John Dolan	Dept of Education and Science (also a member of the task-force)	Face to face
Sheena Duffy and Justin Synott	IRCHSS	Face to face
Gemma Irvine	HEA	Face to face
Gerry Browne	Dept of Justice	Face to face
Conor o'Carroll	Irish Universities Association	Face to face
Vicky Garnett	IRCSET	Face to face
Laudeline Auriol	OECD	Face to face
Tony McElligott	Trinity Post-Doc Society	Telephone
Vivienne Patterson	HEA Statistics Department	Telephone
Aidan Hodson and Bill Brandon	Dept of Trade and Employment	Telephone
Ray Farley	IBEC	Telephone
Tom McCarthy	Chief Executive of the Irish Management Institute (also a member of the task-force)	Telephone
Richard Thorn	Director of Institute of Technology Sligo	Telephone
Ruth Barrington	Health Research Board	Telephone
Paddy Cunningham	Chief Scientific Advisor	Telephone
Anita McGuire	University College Cork (also a member of the task-force)	Telephone
Gary Crawley	SFI	Telephone
Leo Bishop	IDA	Telephone
Martin Lyes	Enterprise Ireland	Telephone
Karen Casey and Triona McCormack.	UCD	Telephone

Exhibit 40 Companies consulted as part of the scoping phase

Name	Company	Number of employees	Number of researchers	Number of researchers with PhDs
Dr David Corr	NTERA	36	18	11
Brendan O'Callaghan	Schering-Plough	410[49]	350	49[50]
Dr Munoo Prasad	Bord Na Mona	2000	10	7
Tom O'Ceallaigh	Merck, Sharp and Dohme	350	20	17
Dr Brian Lee	Ericsson	1500 in Ireland	15	8
Humphrey Moynihan	Lilly	540[51]	25-30	10
Frank O'Rourke	GSK	700	0	3
Jim Roycroft	Wyeth Biopharma	1200	80	40[52]
Dr Chris Brown	Glaxo Smith-Kline. Cork	600	105	68

Exhibit 41 Organisations consulted as part of the case-study phase

Country	Organisation	Policies/mechanisms	Type of data gathering
Sweden	Vinnova	Forska & Växt (Research and Grow)	Desk research Face to face interviews
Sweden	Research Council Sweden	Berzelius Centre	Desk research Face to face interviews
Sweden	Swedish Foundation for Strategic Research	Proviking programme	Desk research Face to face interviews
Sweden	Knowledge Foundation (KK Foundation)	Industrial Research Schools SME Doctorands	Desk research Face to face interviews
UK	UK Grad Programme	Courses for postgraduates	Desk research

[49] This figure applies only to the Avondale branch of Schering Plough. There are 1,500 employees across all Schering Plough offices in Ireland.
[50] With PhDs or Masters
[51] Permanent employees plus several hundred contractors (mainly engineers)
[52] On site at Wyeth Biopharma

		Regional Hubs	Telephone interviews
UK	RC UK	Academic Fellowships Collaborative Training Accounts (Industrial Case)	Desk research Face to face interviews
Finland	Ministry of Education Viikki Graduate School in Biosciences	Graduate Schools	Desk research Telephone interviews
Korea	General information gathering	General information gathering	Desk research

Appendix F: Stakeholder Interview Guides

Exhibit 42 Checklist for Stakeholder Interviews

The current situation	What does the current career structure of an Irish researcher look like? How does this differ from other countries and what are the negative aspects of this career structure? How is funding currently structured in Ireland for researchers? What partnerships currently exist between industry and academia to aid the movement of researchers between the two spheres? How does this differ from the past and are you aware of any future initiatives which will might have a bearing on some of the issues for this study?
Problems and issues	What are the issues within your organisation/sector in relation to researchers in Ireland? Attracting them Keeping them Allowing them to move to other countries institutions (mobility) Being able to integrate researchers into Ireland (e.g. recognition of qualifications etc..) Which of these issues is the most serious and why? What are the implications – e.g. insufficient labour supply etc… What needs are not being met in relation to researchers in Ireland? E.g the needs of Irish economy, the need for more researchers or the needs of researchers themselves? What are supply and demand issues? E.g. are there enough researchers entering academia or industry? Do they have the right skills for employers? Is there an issue about attracting Irish researchers back to Ireland or is it about attracting talent from elsewhere in Europe? What are the current barriers to attracting Researchers to Academia and Industry in Ireland more broadly? What is the nature of these barriers? Are there any particular pressure points where individuals would be more likely to leave a career in research? Why is this? Are you aware of any particular issues relating to gender, ethnicity or nationality? Are you aware of how Ireland performs in relation to other countries in terms of recruitment and retention of researchers?
Solutions	What might be some solutions to the issues raised? What would need to be in place within Ireland to make these solutions viable (e.g. funding systems, institutions)?

	How do you make research careers more attractive in Ireland? What is desirable in terms of researcher mobility in Ireland and why? Are you aware of any good practice or solutions elsewhere in Europe or internationally? What would be your recommendations at this stage for addressing some of the issues and problems you have identified (what would be ramifications for funding, culture, education systems?)

Exhibit 43 Interview Checklist for Company Stakeholders

Background	Name, Company, Sector, Number of employees How many of your employees work on R&D related activity? How many of these employees have PhDs? What is the average salary of a newly recruited researcher? Do you have any non-Irish staff working on research activities? Where are these employees from?
Recruitment	How do normally recruit employees to work on R&D related activity? E.g advertisements (where?), headhunting… Why do you use those methods? Do you have any problems recruiting people to do research within the company? E.g not enough applicants, not the right applicants (not the right experience, not the right discipline…) Why do you think that is the case? Have these problems always existed? What are the current and future implications for the company of these difficulties? E.g can't do as much R&D as we'd like, the R&D is not as innovative/good quality, we have to recruit from overseas…
Background of researchers	Where do your researchers generally come from? i.e previous employment/studies Are they: Straight out of university studies? (Masters?) (PhD?) Straight out of employment? (University?) (other company?) What kind of background/experience would you prefer, and why?
Skills	Do the researchers you employ have the necessary skills to do the job? If not, in what skills areas are they lacking? Why do you think this is? What could be done to improve the skills which researchers come to you with? (probe – e.g. better links between universities and industry, more industrially relevant PhDs, more general research skills should be taught.)

Retaining researchers	Have you experienced any difficulties keeping researchers in the job? Why do you think this is?
Mobility and links between business and academia	Do you have any partnerships with Universities to help researchers move and gain experience in the two spheres? Would you consider employing a PhD student on a placement while they were still studying for their Doctorate? Can you see any benefits to the company/student of doing this?
General solutions	Do you have any ideas for improving the career structure for researchers in Ireland? How do you make research careers more attractive in Ireland? Any ideas for improving the pool of researchers available to employers in Ireland? (Number and quality)