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Project Formation and the Motivations and Challenges of the Principal Investigator Role in Publicly Funded Research

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ABSTRACT

The *principal investigators* (PI) of publicly funded research projects are the key actors charged with direct responsibility for directing the research, reporting to the funding agency, and completing the project. Since the beginning of the 1990s the requirements for academic research and the management of academic research have undergone important changes, with the principal investigator now operating in a more complex environment and moved onto centre stage of industrial policy. Despite this shift, we continue to have a poor understanding of the PI role at a micro level. Set in an Irish context, this research employs thirty in-depth interviews with PIs from a range of cross disciplines, involving both national and European research projects and funding agencies, all of which were collaborative in nature. Together with offering recommendations for policy makers in the area, the findings of this research provide unique insights into how PIs can be categorized with respect to the distinguishable push and pull factors which underpin their decision to take on the role; how they strategically position their projects in their respective fields; and the nature of challenges they encounter when holding the position.

INTRODUCTION

There has been a dearth of attention afforded to the actual approaches adopted by research managers and their relevance in different settings. This lack of an in-depth understanding constitutes a problem as it inhibits both the acting managers from improving in their role, as well as the funding agencies from effectively evaluating their performance (Adler, Elmquist and Norrgren, 2009). This paper undertakes a micro-level investigation of the role of *principal investigators* (PIs). We specifically look at their rationales for taking up the position, the strategic perspective they adopt in forming or selecting their project, and the key challenges associated with their position.

Fundamental changes are underway in the governance of public sector research. These changes have seen research increasingly organised as part of major strategic research programs with an increasingly diverse base of participants and funding structures (Adler et al., 2009). In many cases the allocation of public funding has changed from recurrent funding to project based funding, and the academic sector has witnessed a growing reliance on R&D outsourced by industry. Much of this development has been accelerated by the strong adherence by policy makers to 'Mode 2' knowledge production (Gibbons, Limoges, and Nowotny, 1997), 'Academic Capitalism' (Slaughter and Leslie, 1997), 'Post-Academic Science' (Ziman, 2000) and the multi-stakeholder models for research and economic development such as the 'Triple Helix of Government, University and Industry' (Etzkowitz and Leydesdorff, 1997). There is now an increasing emphasis on problem-focused, interdisciplinary and collaborative research, and the emergence of joint research projects bringing together the public/university and private/industry spheres, supported by public authorities is ever more common (Adler et. al, 2009). Scientific research is no longer solely classified as an independent scholarly profession as there now exists greater responsibilities towards, and integration with, society (Ziman, 1998; Frazzetto, 2004). This institutional evolution and the increasing amount of complex alliances being created between academia and industry have resulted in the boundaries between

science, politics and economics becoming increasingly blurred (Shotter, Rabinow and Billings, 2003).

For most academics, taking on the role of lead researcher or PI represents an important landmark in their research career, as well as a significant challenge. As PI, the lead researcher will be expected to moderate their role identity from that of scientific researcher to incorporate the other duties involved in being PI (Jain, George, Maltarich, 2009). Traditionally an agent of research management and science policy, the duties of the PI have typically been broadly confined to forging goals, defining research programs and planning and implementing the research strategy. More recently, however, in line with the changing research environment and need to coordinate with multiple organizations, including industry, the PI has become increasingly important and a key agent of economic development and policy as they preside over the investment of significant public monies. PI responsibilities now include, but are not restricted to: project manager; stakeholder relationship manager; research strategist; technology transfer agent (see for example Thursby and Thursby 2004 for the importance of the scientist or inventor to technology transfer success); resource manager; people manager; trainer; and potentially entrepreneur.

In light of the changes to the governance and structure of publicly funded research, it is surprising that little attention has been afforded to understanding the role of the university scientists or PIs who coordinate and direct extensive research projects and programs (Jain, George, Maltarich, 2009), particularly given the increased complexity and importance associated with their position as a consequence of these changes. This study seeks to enhance our appreciation of their importance to the development of science and public policy. Set in an Irish context and based on in-depth interviews with 30 PIs from a range of cross disciplines, and involving both national and European research projects and funding agencies, all of which were collaborative in nature, this study demonstrates how PIs can be categorized and distinguished with respect to the rationales underpinning their decision to take on the role, how they strategically position their projects in their respective fields, and how they are challenged in the role. More specifically our findings reveal how PIs can be 'pushed' or 'pulled' into taking on the role of project lead; how they can be strategically focused or more agile when deciding on what projects calls to pursue; and how they face a number of disguisable challenges, particularly in the areas of: accounting for the inadequate training and support provided by their institution; coping with extensive administration duties; managing industry and cross disciplined/cultured partners; monitoring their environment and managing the project's focus and relevance.

Given the magnitude and complexity of the recent changes in the public research environment, this study merely scratches the surface with respect to developing a definitive understanding of the contemporary PI. The findings do however serve to generate a deeper appreciation of the importance and make-up of their position, which is crucial given the movement of the PI towards centre stage of industrial policy. Most crucially though, the study should stimulate further investigation into the enigmatic role of the PI that could join the present research agenda and feed into much needed policy recommendations that will support PIs to deliver their research projects successfully. The remainder of this paper is structured as follows. The literature review that follows looks at the nature and meaning of publicly funded research and principal investigators. It also presents some of the literature on the motivations and challenges typically associated with the PI role. Following on from this the study's methodology is detailed before the research findings are presented. We then discuss the significance of these findings. The paper draws to a close with a presentation of the key conclusions, policy implications, and avenues for future research to emerge from the study.

LITERATURE REVIEW

The Principal Investigator

The position of PI is now generally acknowledged as a formal and progressive position on the researcher's career ladder. Significantly, and underlying the importance of the role, it is interesting to note that many institutions have clear restrictions (e.g. tenure status, level of expertise or authority demonstrated) on who can operate as a principal investigator within their respective institutions. Generally, for smaller projects involving less that five project participants the PI is typically the person who initiated the study, however, for larger projects the team can often strategically select the PI based on their respective credentials to lead a project in the given subject area. The funding agencies and public research institutions typically set the definitions and parameters of the role. As is exemplified in the collection of PI definitions presented in this research (see Appendix 1), there are a range of commonalities across various institutions with regard to the

expectations associated with the role. The definitions collected here were purposely selected to include the role parameters documented not only by funding agencies relevant to the present study context, but also from world leading research institutions including the Ivy League universities.

What becomes apparent is that PIs are generally charged with the task of completing the research within the funding limits awarded and in accordance with the policies, terms and conditions of the funding agency. Despite the importance and formal status of the role, much of the task is taken up by administrative duties. For example, PIs are expected to oversee the day to day management of the project, supervise and sometimes mentor staff conduct, sign off on the project's budgets and financial management, ensure all deliverable and deadlines are met, and submit technical documentation and progress reports. PIs also take on a more general management role whereby they are expected to design and schedule the research project, coordinate and direct a research team, liaise with stakeholders and act as a primary contact point with the funding agency, and flag and respond to institutional or project issues. Significantly, however, the responsibilities associated with position of PI are somewhat heightened with the added expectations that they will develop and maintain their own status and expertise in the field, demonstrate intellectual leadership, set the scientific direction, deliver technical success, and oversee the project's impact activities following the projects' completion.

Public funded research projects

Publicly funded research projects can be envisioned as mini-joint ventures where collaborating scientists exchange resources and skills to generate and share expected research output (Landry and Amara, 1998). As alluded to already, the structuring of publicly funded research in such a collaborative manner is aligned with the increasing attention being afforded in the literature to such terms as 'Mode 2' (Gibbons, Limoges, and Nowotny, 1997), 'Academic Capitalism' (Slaughter and Leslie, 1997), 'Post-Academic Science' (Ziman, 2000) and the 'Triple Helix of Government, University and Industry' (Etzkowitz and Leydesdorff, 1997). Frazzetto (2004) also makes the point that, because of the expansion of knowledge and practitioners which has led to a process of specialization and tunnel vision across a wide differentiation of subjects in science, collaboration has become an essential component of research activity and has created an interconnected community in which the individual is replaced by the collective.

Aside from the cross discipline partnerships, the partners in a research partnership can come from both the public sector and the private sector. Given these parameters, research partnerships can be public, they can be private, or they can be public-private (Hagedoorn, Link and Vonortas, 2000). We know, for example, that industry personnel often engage in and benefit from their involvement in such public research projects (Darby, Zucker and Wang, 2003). The participation, networking and interactions that emerge from such collaborations are in many ways reliant on and benefit from government funding and support (Lundvall, 1992). From a literature and technology policy perspective, public-private partnerships have attracted the greatest attention because they represent a relationship that directly embodies government intervention into the innovation process and hence are scrutinised more carefully. More generally, however, and in citing extensive literature evidence, it is posited that there are three categories of team and team member characteristics that can predict success in professional collaboration: (i) project-relevant skill and knowledge - with a particular focus on the diversity and complementarity of the skills, perspectives, and knowledge of team members, paired with a common core of understanding about the problem domain, (ii) collaboration skill stemming from experience with collaborative relationships, and (iii) attitudes and motivation - including trust, which stems in part from an expectation of longevity of collaboration, practitioners' intrinsic interest in the research in which they are participating; team members' openness to change, to different people, and to new ideas; team members' sense that they have equal stakes in outcomes; and members' understanding of possible cultural differences among them (Amabile et al., 2001).

Aside from the use of patents, publications, patents, licensing revenue and spinoffs etc. it can be difficult to accurately measure or quantify the true economic and social benefits to be accrued from publicly funded research investments. Not withstanding this, the literature does point to a number of benefits that illustrate the importance of publicly funded research. For example, we learn how publicly funded research is related to among other things - new start-ups (Zucker Darby and Armstrong, 2002; Stuart and Ding, 2006); industrial patents (McMillan and Hamilton, 2003); knowledge spillovers and industry clusters (Feldman and Florida, 1994; Mansfield and Lee, 1996; Coronado and Acosta, 2005); private sector innovations (Mansfield, 1998, Beise and Stahl, 1999); creation of new scientific methodologies and equipment (Rosenberg, 1994); and broader economic and social benefits (Martin et al. 1996; Salter and Martin, 2001). Another benefit of publicly funded research is the creation of platforms for research collaboration and the teamwork advantages that this offers. Research collaborations provide social networks and a learning experience for scientists to acquire and/or access

among other things: skills, expertise, techniques, integration across disciplines, equipment, tacit knowledge, increased specialization and valuable information on research opportunities or enhanced reputation and prestige which can encourage and support future research activities (Bozeman and Corley, 2004; He, Geng, and Campbell-Hunt, 2009). Moreover, publicly funded research can facilitate a form of knowledge recombination which suggests that knowledge creation and problem solving abilities are often enhanced by combining different but complimentary areas of expertise, know-how or resources from a wide variety of sources (Bammer, 2008; He et al., 2009). Significantly, a recent report by the OECD (2006) which explored how publicly funded research could encourage industry participation in R&D and collaborative projects, alluded to the fact that research partnerships can emerge and existing ones be strengthened further as a result of government funding and support.

Not withstanding the increasing utilisation and effectiveness of science collaborations, and as such publicly funded research, research in this area has been dominated by a macro perspective, addressing the trends on a high aggregation level without taking into account the position of individual scientists (Rijnsover, Hesseland and Vandeberg, 2008). As such there is a need for an increased attention towards the study of research collaborations at an individual level rather than an institutional or systems level. Universities and other such research institutions are professional organisations, for which success depends to a large extent on the work of its individual researchers. These institutions can be regarded as coalitions whose members and stakeholders seek to maximise their personal goals. Consequently, to improve the effectiveness and performance of their work, it is important that we first gain an improved understanding of the role of the PI in the collaborative projects of which they both lead and are a part. This study contributes to this process by examining the strategic thinking and motivations of the PI when taking on the role, and the nature of the challenges they encounter when delivering on the responsibilities associated with position.

Motivations

In terms of the rewards and motivations in research, much of the literature has discussed how scientists' motives have changed for the better or worse in line with the shift in focus from basic to applied research. Science work has long been advocated as one of the most self-dedicating forms of work, a vocation with personal rewards emanating from the autonomy, personal development and challenges it presents, as well as the intrinsic value of producing and expanding knowledge frontiers (Weber 1918). Similarly,

Merton (1968) suggests that traditional academic scientists prioritise discoveries in their work and are immersed in a normative system called the 'ethos of science', one aspect of which is 'disinterestedness' (the others being 'universalism', 'communism' and 'skepticism') which posits that scientists have no emotional or financial attachments to their work. The primary attractions to work as a traditional scientist have been suggested to be the very meaningful nature of the work itself together with its 'quality of professional life' and the diverse and intrinsic characteristics of work that can improve job satisfaction and job performance (Miller, 1986; Jones, 1996; Keller, 1997).

In contrast to this view, it is suggested that motives are being compromised as research scientist's increasingly pursue and become active in publicly funded research collaborations with industry agents in research projects that are more applied and commercial in their nature (Owen-Smith, 2005). With applied research becoming more imperative and scientists' attitude towards commercial involvement evolving from opposition to acquiescence to acceptance (Etzkowitz, 2002), there is a concern that research and science agendas are being influenced by motives of profit and technology development as opposed to solely the advancement of knowledge. The distinction between science and technology is important in this respect. In science, the assumption is that findings must be made known completely and speedily. For technology, however, results may not be entirely disclosed. Science aims to increase the stock of knowledge by promoting originality, while technology seeks the rents that can be secured from this knowledge (Rausser, 1999). While scientists' motives and their relationships to collaborative, innovative and commercialisation activity may differ across broadly defined fields of life sciences, engineering and physical sciences (Melin, 2000; Sauermann, Cohen and Stephan, 2010), there is a broad view that the key payoff from applied research is the financial income associated with the commercialisation and technology transfer agenda (e.g. Jensen and Thursby, 2001; Thursby, and Thursby, 2007). The 'distraction' by money it is feared could jeopardize the amount of publicly available knowledge emerging from research activities and obscure the boundaries between universities and private firms (Argyres and Liebeskind, 1998; Louis, Anderson, Jones, Blumenthal, Campbell, 2001).

Despite such views, motives other than those financial continue to be acknowledged as important factors for scientists (Haeussler and Colyvas, 2009; Murray, 2006). Sauermann, Cohen and Stephan (2010), for example, argue that their finding that financial motives and incentives have no association with the choice between basic and applied research, and have not shifted academics' attention towards applied work and commercialization

activity, supports prior work that did not find negative relationships between patents and publications (Fabrizio and Minin, 2008; Mowery et al., 2001). The same authors support the view that motives can vary across different fields with, for example, a desire to contribute to society being a key motive predicting patenting in the life sciences; pecuniary motives being a strong predictor of patenting in the physical sciences; and patenting being strongly related to the motives of challenge and advancement in the field of engineering (Sauermann, Cohen and Stephan, 2010). Jain, George, Maltarich (2009) also allude to the fact that a scientist's or PI's decision to pursue applied research, technology transfer or entrepreneurial activities can be divided into two perspectives: supply-side and demand-side (Thornton, 1999). The authors point out that the former is exemplified by the manner in which some academics are attitudinally more predisposed to commercialize their findings, or possess prior knowledge that makes them more capable of recognizing entrepreneurial opportunity (Etzkowitz, 1983; 2007; Shane, 2000). The latter can be characterised by changes in academic's institutional framework, research funding pressures, or the influence of their peers and or university/department (Pelz and Andrews, 1976; Etzkowitz, 2002; Kenney and Goe, 2004). Other factors influencing the PI's decision can include the potential for publications, identification of new ideas and problems, and a desire for recognition among peers (Mansfield, 1995; Agrawal and Henderson, 2002; Owen-Smith, 2003; Thursby et al., 2007). Finally, the potential for reward under political impact criterion can be a driver for PIs to deliver on technology transfer targets (Bozeman, 2000). For example, the role of the PI is recognised by policy makers if the research project has a major impact on national or regional socio-economic priority areas. Secondly, appraisals of the research initiative by industry partners, often the technology recipients in a technology transfer process can see the industrial partner pursuing the policy maker, often a key funder of public research, to commend the academic partner for their work and commitment to technology transfer. Thirdly, as is evident by the aggressive pursuit of publicising research projects, partnerships, breakthroughs and technology transfer achievements by research institutions, research projects can be rewarded for the appearance of active and aggressive research and technology transfer success.

Challenges

Adler et al. (2009) make an interesting contribution to the literature on research management when identifying six important managerial challenges that are encountered when managing research activities which include (i) a lack of focus on research management and unsatisfying prerequisites; (ii) weak identity and low status of the role of the research managers; (iii) few

incentives for research management; (iv) lack of leadership development opportunities for researchers; (v) multiple (and sometimes contradictory) expectations and logics from different stakeholders, and (vi) sustained funding. Many of these challenges are specifically related to role of PI in publicly funded research projects, however, given the degree of complexity and heightened expectations associated with some of the projects they are involved in, their challenges can be substantiated even further.

Through training and experience a scientist is most often domain or discipline grounded. However principal investigators are often required to shape a temporary project or organizational structure and manage multidisciplinary and multicultural personnel across a range of locations. Aside from the delicate and troublesome tensions which can arise in such relationships, PIs often have to accept that project partners only commit a portion of their time to the research program, but also ensure that interruptions to the critical dependencies and flow of the project are kept to a minimum. Ironically, the PIs themselves can struggle with the amount of time and/or resources they can afford to dedicate to the leadership of a project. Projects tend not to be managed in isolation but rather as part of a collection of projects and often within programmes. Moreover, PIs have to plan for funding beyond the defined lifetime of the existing structure. In this context PIs co-ordinate the management of a series of interconnected projects and other non-project work, and their work can be organised as a chain, portfolio, or network of activities (Maylor, Brady, Cooke-Davies and Hodgson, 2006). Furthermore, as research tends to take place in multi-project organisations resource conflicts are a common issue. In such organisations, principal investigators make use of several pools of limited resources (human and physical). The simultaneous management of the project throughput times, resource allocations and costs of projects creates complexities in balancing the often conflicting interests of multiple participants (Platje and Seidel, 2003).

In reference to one of Adler et al.'s (2009) more salient challenges, it should be acknowledged that publicly funded project stakeholders can include, but are not restricted to, research team members, public research centre partners, industry partners, the employing academic institution, the academic department, the funding agency, potential technology transfer recipients and officers, national and local government, as well as the general public. For strategists and leaders a key challenge is to maintain positive and meaningful relationships with relevant stakeholders, but also to harness their ideas and perspectives for the overall betterment of the business. The stakeholder challenge is as Bill George [2003] former CEO and chair of Medtronic describes: "The key to dealing with stakeholder groups is a balanced approach. It rarely serves a leader well to focus on one group to the exclusion

of others. All stakeholders have legitimate needs that must be met by the company to the best of its ability. Yes, they are competing interests among stakeholders. The leader's job is to define them and ensure that all stakeholders are well served". The importance of this task is increased by the funding structure of public research and the need to maintain policy maker support. Research management, including research collaboration, also entails various costs or time based challenges, including the costs of finding, assessing, and coordinating research partners well as developing agreements. It should also be noted that no one can exhaust all the contingencies of a public research project, as no one is absolutely sure what research findings will be produced in the future or be fully aware of the costs of implementing a specific part of the project. This inability to design complete project plans, for example, creates room for opportunistic behaviours such as a scientist strategically misrepresenting information to secure more resources or credit for their contribution to the final research output (He, 2008).

Policy direction relating to public research has also imposed new demands on PIs. The transfer of scientific and technological know-how into valuable economic activity has become an important priority on many policy agendas, with links between industry and science being a crucial element of this policy direction (Debackere and Veugelers, 2005). The Triple Helix model is based on the assumption that industry, university and government are increasingly interdependent. The rise of this configuration is mainly due to the enhanced role of knowledge in our economy and society, while the role of universities in this configuration is often referred to as its 'third mission' (Hessels and Van Lente, 2008). There is now an expectation attached to most publicly funded research that the PI's efforts would make an economic and social contribution. This is normally realized through the technology transfer of the research outputs with many arguing that the support and involvement of the inventor or research leader in the process is a critical determinant of success (Siegel, Waldman and Link 2003; Thursby and Thursby 2004).

Crucially however, with a number of authors commenting on how the process of technology transfer is a complex topic and one that is not fully comprehended (Boozeman, 2000), it should be noted that it can require a completely new set of competencies that are often outside the scientific training of scientists including IPR management, business acumen, financial management, legal know-how and commercial awareness. PIs also often have to play a type of market shaping role as they must form expectations about future markets at the outset of their project. Moreover, as argued by Jain et al. (2009), it can require the PI to take on the complex challenge of 'delegating' and 'buffering' where they modify their identity and adopt a hybrid role in which they simultaneously employ a scientific and entrepreneurial persona.

This role can also bring with it difficulties in terms of dealing with the contrasting expectations of scientific and industry partners. More specifically, science is expensive and seldom contributes to near-term profitability in a direct sense. Moreover, it has a long-term generic perspective on what is important, and scientists are motivated by achievement of scientific fame. Technology on the other hand has a shorter-term view, requires significant scale and breadth, and is often focused on solving a particular problem. Furthermore, technologists are motivated by the satisfaction of solving a problem and being rewarded by commercial and financial success (Betz, 1996). Finally, while funding structures are essentially part of the framework for the innovation system they have a major influence on how public research is managed. There is significant variance, however, in terms of funding agency expectations across a number of areas including expectations relating to technology transfer, industry involvement in public research, technical project management requirements, and nature of research. As such the funding structure, as well as the institution and culture for that matter, within which the principal investigator is operating will have very direct implications for the management approach taken.

Summary of research focus

Our review of the literature drew attention to the significant shifts that have taken place in the public research environment. The management and leadership of publicly funded research project has become a far more complex and challenging task. While these research collaborations have received increased attention in the literature at a macro level, little attention has been afforded to the individual PI. This is surprising given that research on successful research environments have pointed to the importance of management and leadership for good research output (Peltz and Andrews, 1976). Our contention is that there are significant discrepancies between the heightened expectations now associated with the role, and the assumed capability and preparation of the PI to deliver on these. Given this view, we had three specific objectives. Firstly, we wished to examine why scientists take on the role of project lead in these publicly funded research projects, as opposed to how they are motivated by science itself. Secondly, we wished to uncover how they strategically select and position these research projects with respect to their broader scientific and career ambitions. And finally, we wished to uncover and improve our understanding of the challenges for the PI in leading publicly funded research projects.

METHODOLOGY

This research utilized thirty interviews with PIs across a range of disciplines in the life and physical sciences. Our final sample also included a selection of cross gendered, aged, and level interviewees to ensure we gathered as complete a view as possible on the role of the PI. Because of the variety, and in some instances complexity, of the research projects in question, in-depth semi structured interviews were employed with careful attention being afforded to the key research objectives of the study. This approach is supported by Bell (1987, p.138) when encouraging "some loose structure to ensure all topics which are considered crucial to the study are covered". In line with this approach our in-depth interactions with PIs allowed us to drill down and understand their core motives, beliefs and behaviors with respect to their position as project lead. Project documentation including press releases, interim reports, final reports and workshop brochures were also utilized as part of the data collection. Analysis of the secondary and primary data was undertaken in a processual manner and in close conjunction with the aforementioned research objectives. In line with this approach data pertaining to the PI's motives, project formation strategies and challenges were first extrapolated and subsequently juxtaposed and written up to present a more complete picture of the PI role.

FINDINGS

The following section presents the key findings to emerge following our analysis of the data. Firstly, irrespective of the financial incentives (e.g. directorships in spin-out companies) associated with research agendas and collaborations that are increasingly focused on realizing some form of technology transfer, our findings reveal that there are a number of distinctive factors that can be categorised as either 'push' or 'pull' forces with regard to how researchers become, or choose to become, elevated into the role of PI for the publicly funded research projects of which they are a part. Secondly, we demonstrate how there is a distinct dichotomy in the strategic perspectives and approaches adopted by PIs when it comes to selecting and positioning their projects in their respective fields. Finally, our findings present the most common and prevalent challenges to emerge following our examination of the PI role.

PI Motives

Push factors

One of the *push factors* uncovered relates to the dependency of the project on the PI to step forward. This can based on the particular skill set of the person

or even, for international projects, the ability to speak English fluently – "a lot of stuff you get from European partners you have to re-write in English anyway". More likely, however, it is based on the intellect or reputation of the person as pointed out by one PI - "ususally the role of the PI is the CV to get the funding, not necessarily to be the person to run the project". Another aspect of the 'dependancy' issue is the reality that there may be no other alternative in place. For example, a number of PIs referred to "a lack of enthusiasm from others", and the fact that even though they "would rather not lead, ultimately if it is something you want to see through someone has to grab it and do it". Similar another PI explained, "after applying for the Enterprise Ireland consortium funding we had spent money trying to get everyone together to write the proposal. With no one stepping forward your school was left with a liability for a project that had not been submitted, so someone had to step up". It was also found that the selection of a particular PI sought to address disagreements that were emerging in the consortium – "there were territorial tensions and neither of our other two partners wanted the other to take the lead so we were approached and I was made the coordinator quite literally because we were seen to be the honest broker".

Aside from the dependency issue, another definitive push factor came from cultural or institutional pressures associated with the role. Numerous PIs, for example, referred to the "huge pressure to go out there and get your own money". This point is elaborated upon by one PI who explained "we are sort of a business within the university. I don't care if I am a coordinator, a partner or if some philanthropist walks in the door and gives me a million a euro, but if I don't get money in we won't have post grads next year". Moreover the threat to their own positions and careers were laid bear - "I really do feel that if I don't take personal control of a proposal there might not be money to keep my job going". It was apparent that this threat was ever present for PI irrespective of their current duties - "if I don't have projects coming in I don't have any activity, so I don't have a job. Even if you are covered now for the next few years you still have to be working on getting in new projects".

Pull factors

PIs often prefer to step into the role of project lead as it gives them more control over a number of components of the project. It was found that some PIs felt that having control over the quality of the proposal being submitted would ensure it had a better chance of being funded – "I often feel if I take over the proposal myself I can control it and it will get funded". Exemplifying this point further another PI recalled, "In call 5 of FP7 we submitted in the order of 40 project proposals. We got 8 funded out of this 40 and the vast amount of success within these 8 were from the ones we pushed and led, rather the ones that we just piggy backed on". It was also suggested by a

number of PIs that "control over the budget" was important. Expanding on this point one particular PI voiced a word of caution when commenting "you have better control over the money. If you are not a PI you could potentially get written out of a project". A final element of ' project control' which emerged was that of ownership of the actual scientifc direction and territory. For example, one PI made clear that "the concept actually came from me so I wanted to keep control of it". Another pointed out that "I did not want this call to be met by someone in Dublin in a different area, so I was in some ways minding my own corner". Substantiating this further was a PI who explained "it is important that we push forward our agenda. In every round there will be proposals that are driven by our vision and others which help adapt and modify that vision".

A second distinguishable *pull factor* to emerge was that of potential career advancement, specifically in relation to status and reputation. It was pointed out that these collaborative projects can help "maintain ones world status" and " are the only sound academic way to develop an international profile, it is where the game is at". In explaining how such outcomes come about another PI commented - "if you see a good project or you see a good partner that could be a good match it is very interesting. Working with a world leader in the area represented a huge opportunity". Another remarked, ""for me the role of PI continues to be about publications to enhance my reputation and further my own career". Recognition internally, however, is also regarded as an important factor for researchers to take on the lead role. One PI recalled how a particular project resulted in her getting a "recommendation for promotion", while another commented that "you are looked upon very favorably within the organisation if you take on a role to co-ordinate or a lead role in a project or programme". Building on this point it was pointed out by another PI that "you are the one who stands up there and presents so it is your name that is attached to it. While you acknowledge your partners, you get the most recognition and credit".

A third *pull factor* identified was the drive and passion of the PI. For example, their persistence was demonstrated by one PI who commented "we put in a bid and it failed, we regrouped and modified our bid before re-submitting and that failed again. I still did not lose faith and wanted to go again. Next time we got it, you have to keep going". Another PI, in referring to his peers, explained "the guys who lead these projects work morning evening and night, and it certainly is not for money. They are on fire with this, it is their passion and they live, eat, and drink it". More specifically, however, it was revealed how PIs held a deep zeal for their own particular discipline. For example, one PI from the marine sciences argued, "I believe in the economic benefits that are to be realized by our natural resources. In the course of that

belief I get to do interesting science and get publications". Another from the ICT sector commented "I am sincerely interested in advanced new innovations for Irish companies, how you can take innovations out of an organisation like this and use them to create start ups, that is a genuine passion of mine".

Strategic positioning

Strategic focus

On the one hand we found that there were PIs who had a very clear and purposeful strategic focus in terms of the projects they were presently engaging in, or proposing to actively pursue. These PI's were in most instances of more senior status in terms of their age, reputation in the field, and position (e.g. professor). They took a more strategic perspective and acknowledged "the need to be a thought leader in terms of thinking about what technical direction you would like to be going". For example, one PI commented that he was "very strategic in the projects I decide to take on. Everything has to be interwoven, I will not even apply for something that is not interconnected". The same PI commented that the present project he was leading "was part of a long-term strategy which has seen us gain our present FP7 position. We are involved in a much larger and more extensive project as a consequence of our purposeful project in FP6". Another PI commented that the nature of their work was such that they could not afford the luxury of chasing opportunities just to bring in funding – "these programs are deadly serious, with very focused outcomes in mind. If we want to be successful in heading where we are trying to get to we cannot waste our time solely on trying to get the money". Another PI who is heavily immersed in the ICT sector expanded upon this point when explaining:

> "we often turn things down. We want to try and build an expertise in a particular area and then really make a difference in that area. We could not do that if you are hopping from A to B to C, the money is not the most fundamental thing, it is about who you are working with and the problem you are working on. We have particular goals that we are trying to solve and they are bigger than any one project that we are involved in. I use projects as stepping stones to solving a particular set of problems"

Thus, it became apparent that there was a clearer core strategic focus underpinning the publicly funded research activities of certain PIs. Due to the pressures and commitments associated with their role they, as one PI put it, "need to know their limit and be able to decline opportunities and say no. They know exactly what they want and limit what they do". The ability to make such trade offs and to realise their ambitions, however, demands that these PIs, despite the strategic level at which they operate, never "become too

detached from the science field and its problem". This point is further substantiated by another PI who likened his role to "a good Chief Technical Officer who is continuosly tracking how technologies are evolving and building roadmaps for how the products can evolve".

Strategic agility

In contrast to this 'big picture' and purposeful approach there were other PIs who demonstrated a greater degree of flexibility to remain competitive in their field. Exemplifying how this agile approach is put into practice one PI explained "we failed by the skin of our teeth for a call related to terrorism and the potential contamination of water supplies throughout Europe. Though we came second, what it showed me was that we were never involved in the security space yet we could put together a very credible proposal based on the expertise we had in food and water and adding something on the potential contamination of water supplies". Another PI commented on his own institutions efforts to also diversify into the security arena when commenting "security is not an academic competence of our organisation and yet we have taken a number of security projects recently which look at broad security issues".

Despite having a clearly defined core focus, it was found that these PIs still felt it important that they remain sufficently fluid as to avail of potential funding opportunities. For example, one PI pointed out "it would be nice to be able to say the research focus is on a, b or c and they are the only things that we will look at. However you have to be flexible, we have survived and prospered simply because we have taken this type of strategic view. We will always be looking to see what calls are coming up and if we can contribute. When you do that what ends up happening is you move your areas somewhat". Another PI commented "we have a very clear core research focus on network management but we also pursue a huge amount of opportunistic funding activity around that core that means at times we go into e-learning, sensor networks and other things. We prefer not to define rigidly what our core is because then you effectively run into a brick wall when the money runs out".

With regards to possible explanations as to why this agile position is adopted, one PI alludes to the pressure associated with operating within a research funding environment - "we would have a research agenda we would be trying to drive forward. However, because we don't have any baseline funding there is the need to jump towards certain funding. We will always have a set of strategic projects that are promoting ourselves but we will also opportunistically go into certain projects". In a similar vein another PI spoke of the necessity of such an approach despite efforts to add more structure to

their efforts - "we could not be waiting around the whole time for something that is totally aligned with our expertise and then risk not getting it, then we would have been in trouble. But we are now trying to set up a new structure that brings more attention to what we are doing and what we want to be doing". Similar sentiments in relation to research funding environments, and the difficulty of planning for anything withing them, were put forward by other PIs. For example, one PI suggested that "part of the problem with trying to strategically plan out our projects for the next three years is that you get dragged a lot. When something gets funded it is hard to say 'I want to work in this area' because you might not get funding again". Another PI referred to the dangers of over committing and over extending yourself in terms of resources and capabilities when adopting a flexible approach – "when funding opportunites are announced then your eye gets drawn to it. There are two worries always though, one is that we will not have enough money to keep the team in place and the second is that we have too much funding in other words we will not be able to deliver the people on the projects".

PI Challenges

There are many challenges associated with the PI role and many are more prevalent than others depending on the discipline of research and the actual project context (i.e. ability of PI, skills of partners, resources available, environmental shifts etc.). There were numerous challenges, however, which were particularly apparent across the thirty projects we studied.

Administration duties

According to one PI "The role of coordinator according to EU documentation under Framework 6 was really a glorified secretary. The main role was to get the management structure and the proposal to run smoothly with the coordinator merely delivering the decisions and tasks to the other partners and submitting reports etc". This view was echoed across numerous PIs when referring to the endless report writing, coordination of partners, chairing of meetings, form filling, preparation of cost statements and project finances, and the monitoring of deliverables. Most frustrating for the PIs, however, was their removal from their more accustomed technical and scientific work to manage the actual project. Moreover, PI were frustrated with being branded as the person that will fix everything - "people think that we will sort everything. A coordinator of a project is one person, but that person's organisation is also a partner in the project and they are doing day to work the same as any other partner". Similarly another PI commented, "I am the person everyone complains to when things go wrong which can be frustrating".

Maintaining project focus and alignment

PIs were responsible for integrating everyone's contribution and indeed getting partners to contribute in the first instance. This required reiterating the research objectives and focus in all communication and meetings and ensuring that research partners did not go off on tangents or disappear into silos and work in isolation, regardless of the other commitments they had. As one PI explained "they often want to just do their part and not be bothered with anything else. I have to ensure that it is not just their little test tube that matters, there is a far bigger picture to always think of in these projects". A word of warning was voiced by another PI when commenting "partners can sometimes look to bring in other partners who they feel are essential. That can be dangerous because it can balloon very quickly and create a huge problem as you lose focus and control".

Managing cross discipline and cultures

It was pointed out that when working with partners from different disciplines they often have different mindsets and this can create tensions. One PI made the point - "I heard once at a conference that a micro-biologist would sooner use someone else's tooth brush rather than someone else's method". As such it is crucial that the PI explains each contribution to each partner and gets them to value each other's role. Furthermore, it was suggested that PI's needed to give partners in international collaborations sufficient room to maneuver and to work with them in order to overcome the inevitable cross cultural dynamics at play. For example one PI commented - "a southern European sociologist will behave differently to a northern European one, especially if you give them a hard deadline. The German guy will deliver it on time and the Spanish or Italian guy won't, you have to understand these differences and work with them". Similarly it was pointed out that in some international institutions "a deadline is just an approximate target". In such instances it is important that the PI communicate the fact that a delay on their part would stifle progress for the rest of the group and halt the project.

Recruitment and career paths for researchers

For many PIs the recruitment process is extremely cumbersome and time consuming. On the one hand there is huge pressure "to try and create employment for my team for a number of years, and not have them constantly looking over their shoulder". On the other hand, it is pointed out that the "nature of the research officer role is such that they often move on during the project". This turnover of staff and "revolving door situation" has been compounded in recent years in Ireland with the introduction of contracts for indefinte duration which entitle researchers to permanent positions if they have a contract for four years or more. As such PIs speak of the frustration of

"having experienced staff here and my role is to get them out and not to keep them in". Expanding on this another PI explained that "you might even have to turn down the most suitable candidate in an interview. That obviously means there will be a loss of talent, know-how, momentum and sustainability". Consequently, with the recurrent need to replace staff one PI commented that "I often feel more like a trainer than a scientist".

Project Adaptation

A significant challenge for PIs was the need to keep their projects relevant. As one PI commented - "During the project we always change what the deliverables are. When you are imagining what will happen over the next four years it is very difficult and it never goes where you think it will. So while we know what the general problem is and we often then reconstruct how we are going to attack it". This point was substantiated by another PI who pointed out that "for longer projects it is quite possible that the cutting edge brilliant stuff that you highlighted in the initial proposal becomes matter of fact mid-way through so it becomes much more important to have mid-term reviews which could possibly lead to a change in direction". As such there was a continuous need to continuosly monitor the relevant literature and their repective markets and/or scientific landscapes for notable changes that could affect the project's direction or outcomes – e.g. regulatory developments, state of the art, new disruptive technologies, pricing strategies, customer perceptions etc.

In exemplyfying how challenging environmental changes can be it was found how one project had to shift its focus mid-way from the procurement to the financial mindustry. In another instance it was found how one project which was examinnig video distribution over mobile phones suffered from the explosion of video on the web – "during the project it became quite clear that this really was not going to take off on mobile. We thought of a number of ways of re-adapting but when we got to the end of that project the stakeholders were somewhat underwhelmed – the market had passed it out". Similarly another PI explained how they were successful with their deliverable but the market moved – "the project was succesful but there was no market now. But that piece of technology that we developed is still unused really at the moment and still waiting on the wings".

Industry Partners

PI's have to struggle with the reality that in the majority of cases the balance of power is with the industry partner in these collaborative projects. There appeared to be numerous instances in which the concerns of the industry partner had to be addressed for the sake of the project's continuity. For example, in referring to how their goals can change during the project, one PI

noted how he had to "rewite the proposal three months into the project as the funders were very keen that we did what the stakeholders wanted". Another PI referred to the problems that arose when it emerged that the project materials being produced were no longer relevant for one of the companys, and that there was no exploitation potential whatsoever for them as it stood. It was also pointed out how industry partners are getting "increasingly selective about who they partner with…all of the big players know that everyone wants their name on the proposal".

Another significant challenge for PIs was their ability to keep these industry partners engaged and interested. More specifically, it was explained by one PI that "when there is nothing tangible happening for them in the next few months they often get dragged away to other projects or activities that can deliver more immediately". This point was reiterated by another PI who remarked - "it is very hard for them to get motivated when they don't see an immediate product coming off the line in the next six months. Academics are less restricted by commercial pressures, papers and publications are outcomes that give a degree of satisfaction". A final challenge pertaining to the inclusion of industry partners related to the PI's ability to accept and manage the reality that they "often take a lot of the results and do their own thing with it as they have a lot of similar things going on in parallel that may well be commercialised but unincumbered by the IP rules of the consortium agreements".

Lack of/Inadequate training for PIs

The challenges associated with the PI role are compounded by the fact that in almost all of our cases studied, the PI referred to lack of or inadequate training received. The training was said to be either absent in any formal capacity or limited to mundane tasks such as proposal writing and people management. The key criticism, however, was that the courses attended were overly generic and not specifically tailored or applicable to the role of the PI. This point was explained by one PI when commenting, "because public funding for projects covers such a diverse area they probably try and find common ground with generic project management courses but my whole experience with them is that they are delivered over too long a time frame and the learning achieved is quite shallow".

Institutional Supprt

It was found that the majority of our PIs were somewhat underwhemed by the quality of support received from their academic instituitions in the performance of their role. One PI, for example, suggested that there was a concern sometimes as to whether "the University really wants the PI to succeed". Another PI commented, "you nearly have to remind the people in

research accounts that we are all the one team and not in opposition". This view was further substantiated by another PI when remarking "it seems like you are encouraged to get in funding and then they do everything to stop you progressing with it. If you are talking to someone down in headquarters they will often have no concept of what you are doing or why you are doing it, you are just another number". With regard to specifics, it was argued that much of the supports on offer in the universities were reactive and merely "compliant based as opposed to actually asking you more about what you want to do and guiding you as required". Expanding on this point another PI explained "in some departments there is this 'civil service' attitude where they stay quiet and whisper quietly 'we are here, come to us and we will explain how to do things', but as a PI you would really like someone to actually come to you and say 'I am here how can I help you'. It can just be a bit passive really".

Technology Transfer Supports

It was found that while the need for technology transfer support was becoming increasingly recognised, there continued to deficiencies and a lack of clarity in this support which hampered the ability of the PI to perform their role in this area effectively. For example, one PI commented - "our TTO is strong at legals and agreements but not so much on pushing patents out so we have to try and work around that". It was also argued that their respective transfer offices could only do so much and were overly stretched in many instances – "the reality is they could be dealing with bio technology projects the very next day after dealing with us. We might say 'we don't want to patent something' and they would be looking at you and saying 'but you always patent', so there can be mismatches". Another PI commented "our main interaction with the transfer office is in relation to protecting IP, to be honest though there is not much in the technology transfer office or in fact across the whole university structure which can deal with the commercialization of the IP effectively".

It was also found that PIs struggled to a certain extent with the dilemma surrround the protection of IP – "knowing how to divide international recognition and IP, and to sustain both is crucial. If you go too far down the IP route you don't get the acknowledgement and it doesn't feed through to grants and things like that. And if you go too far into publishing etc. you can lose IP, so that is a big challenge". Significantly, however, it was suggested that the pressure and indecisiveness of institutions was not helping PIs manage this dilemma – "if the IP leaks without a license the universities are saying 'well why did you not protect it?'. If you say it is really really valuable then they might not want to sell it. I always think of the universities as wanting to be the gatekeeper, they are almost afraid of letting anything out as

it may be even better in the future". Table 1 which follows present a summary of the findings.

Table 1 – Summary of findings

PI Motivations and Rationales	Strategic Perspectives Adopted During Project Formation	Challenges Associated with the PI Role
Push Factors 1. Project Dependency - Skills - Reputation - Last option 2. Professional Pressures **Pull Factors** 1. Control - Quality of proposal - Budget - Science 2. Elevate status 3. Passion and drive	**Strategic Focus** - High level view - Purposeful - Interwoven with larger research agendas - Trade-offs and little diversification **Strategic Agility** - Flexible core focus - Diversify to avail of funding opportunities - Funding pressures - Careful not to over extend	- Administrative duties - Project alignment - Managing cross cultures and disciplines - Researcher recruitment and career paths - Project relevance - Industry partners - Inadequate training - 'Compliance' based and reactive support - Tech transfer gaps

DISCUSSION

This research examined the role of the PI in publicly funded research projects with respect to three key areas. We firstly looked at the rationale and motivations underpinning an academic or scientist's decision to take on the role of research leader for the project of which they are a part – as opposed to their decision to pursue a research career in itself, which has received far more attention in the literature. Significantly we uncovered this could be categorised into distinguishable 'push' and 'pull' factors. Push factors were reduced to two key components – project dependency issues and institutional pressures. Project dependency requires that a PI be to some extent forced into the role as a consequence of a particular skill set or reputation they have which could enhance the project's chances of being funded or completed successfully. Project dependency is also evident where the PI acknowledges that there are few other alternatives available with respect to taking the lead, and/or to ease tensions or power battles that exist between other members of the consortium. Finally, a PI can be 'forced' into the role as a consequence of the pressures associated with their profession. Career advancement and

continuation within their institution are dependent on their ability to bring in funding and to develop and complete specific research agendas. Pull factors were found to contain three components. PIs were encouraged to take on a lead role in certain instances as it gave them greater control over the quality of the proposal being submitted. PIs were more confident that a proposal would get funded if it was under their stewardship, and obviously for reputational reasons were keen to keep a healthy 'success rate'. PIs were also motivated to step into the role as it gave them greater control over the budget and direction of the project. With regard to the latter, PIs not only wanted to shape the project's outcomes, but also demonstrated that they were very territorial when it came to owning or being accountable for funding calls in their area. Another pull factor pertained to the PI's desire to maintain or elevate their status in the field, both internally with a view to career advancement, and also among their broader research community. The final pull factor uncovered was that of the – sometimes entrepreneurial (Baum and Locke, 2004) - passion and persistence of the PI to make a difference and to develop their respective disciplines, whilst simultaneously satisfying their own intrinsic curiosity.

In supporting existing literature in the field our findings acknowledged how the formation of publicly funded projects often stemmed from informal consultations at research meetings, workshops and conferences, and through formal coordinated actions etc., where acquaintances, reputation, expertise, and/or experience of potential partners were exploited. Somewhat more intriguing, however, was the distinct dichotomy that existed between the strategic perspectives and thought processes of different PIs when it came to positioning their projects in their respective fields. More specifically, it was found that certain PIs were very focused and took a high level view of where they saw their own outputs contributing. Moreover, these PIs are very purposeful in terms of the projects that they would engage in, and were committed to developing a distinguishable presence in their field. Everything, it was argued, had to have a clear intent and be interwoven with, and incrementally working towards, larger scale strategic agendas. As such these PIs could not afford the luxury of chasing funding calls, were accustomed to making tradeoffs, and carefully chose areas of activity that involved little if any diversification. Contrasting this were those PIs who were no less strategic but who demonstrated more flexibility and were happy to diversify into areas that were closely related to their core expertise. These PIs constantly surveyed the environment and were careful not to adopt an overly rigid research stance or focus which could inhibit their ability to adapt their position and avail of fleeting funding opportunities. Again the pressure to bring in funding to satisfy their institutional and professional requirements was paramount in adopting such a nimble approach. Significantly, however, given how difficult

it was to plan in such an uncertain funding environment, it was also found that PIs need to be careful not to over extend themselves as they may not have the capabilities or resources to deliver on these committments.

With respect to the challenges associated with the role of PI we uncovered a number of findings that compliment and extend existing literature in the area. It was found that administrative duties are a dominant component of the PI role. This can be particularly frustrating when the PI finds himself, not only removed from the science, but also characterised as a type of 'Mr. Fix-it' by other partners. PIs are also charged with the responsibility of keeping all the partners focused and aligned, and with ensuring that they each come to acknowledge, value, and cope with the mindsets and logics of other partners from different disciplines and cultures. It was found that PIs struggled with the dual pressure of wishing to stimulate and motivate research staff with more certain and progressive career paths whilst simultaneously dealing with institutional restrictions on their ability to do just that. Moreover it emerged that PIs frequently struggled with the sometimes conflicting requirements of meeting specific project deliverables, and keeping the project relevant, cutting edge and in line with the expectations of different stakeholders. Another key challenge for PIs lay in the task of accepting and managing the fact that the balance of power in the majority of these collaborations lay with the industry partner. As such the PI had to ensure that the project's direction and potential value met their evolving needs, and kept them sufficiently interested that they would remain engaged until its completion. With regard to the latter, for example Rowinsky (2005) points out how academic institutions are becoming smaller cogs in larger, industry-sponsored, multi-institutional studies that are in part designed to fulfill overly ambitious corporate timelines and short-term interests of the investment community. Our PIs also revealed that the training they received was overly generic in its project management focus and was not applicable to their own role. The supports provided from their respective institutions were also deemed to be too impersonal, compliance based, and far too reactive for what they required. Finally, it was found that our PIs struggled with the dilemma of whether they should hold onto valuable intellectual property that emerged out of these projects, or should pursue international recognition and concrete exposure through its release and through publications etc. Interestingly, it was suggested that universities could be indecisive in relation to this issue and as such were providing little guidance to PIs.

CONCLUDING COMMENTS AND FUTURE RESEARCH

The principal investigator role is a central one in delivering basic and applied research and requires individuals that have more than technical expertise. Our study highlights that the role of principal investigator extends beyond scientific leadership to the core functions of management – planning, leading, organising and controlling. Yet many public funding agencies in their evaluation of research projects focus on the scientific leadership and the leadership capacity of the PI is a secondary or minor concern. For policy markers and public funding agencies our study of PI has some implications in the way they support and fund PIs. First, PIs need professional development and support in core functions of management to increase their leadership effectiveness in delivering on publicly funded research. Second, knowledge and skills gaps regarding technology transfer need to be addressed as the potential benefits of publicly funded research project may be lost. Third, the career path of PIs has high degrees of uncertainly regarding the sustainability of their career paths. In order to attract the best PIs and develop scientific leadership the career structures have to be attractive. Fourthly, in terms of research management new structures, approaches and mechanisms need to be found to reduce the administrative burden on PIs. In the case of publicly funded research accountability with respect to projects is necessary but this needs to be balanced with the needs of PIs and their research groups during and post project delivery.

Our study also brings to the up new areas of research anchored around the PI as a unit of analysis. First, appropriate and broad measurements of PI outputs need to be developed as they are under developed. Second, similarly our understanding of the human resource development of principal investigators needs to be enhanced. Third, further research needs to be conducted to explore the strategic posture of PIs and to identify sets of push and pull factors across PIs in different disciplines. Finally, an assessment as to how prevalent are PI challenges in different disciplines and across different public funding schemes in variety of research systems is necessary.

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Appendix 1

Funding Body Descriptions of the Principal Investigator	
Funding Body	**Description**
Science Foundation Ireland (SFI)[i]	The lead applicant responsible for the scientific and technical direction of the research programme and the submission of reports to SFI. They are the primary contact point and have primary fiduciary responsibility and accountability for carrying out the research within the funding limits awarded and in accordance with the terms and conditions Science Foundation Ireland (SFI)
Irish Research Council for the Humanities and Social Sciences (IRCHSS)[ii]	Principal Investigators shall be full-time members of the academic staff, either permanent or on temporary contracts of sufficient duration to cover the period of the project, of a (legitimate) third-level institution. They must be in a position to devote adequate time to the management and realisation of the project. The actual scope of involvement by the Principal Investigators in each project will be considered by the Assessment Board (AB) in their evaluation of the expertise of the proposed research team.
National Development Plan (NDP)[iii]	The Principal Investigator will co-ordinate the research and drive the overall objectives. They must ensure that all reports are submitted on time and that they are of a satisfactory standard that clearly details progress on the project.
Food Institutional Research Measure[iv]	The Principal Investigator is the person who is responsible for the research activities in your area
Economic and Social Research Council (ESRC)[v]	The Principal Investigator (PI) is the individual who takes responsibility for the intellectual leadership of the research project and for the overall management of the research. He/She will be the Council's main contact for the proposal. The nature of the role includes making a significant contribution to the design, project management, scientific leadership, impact activities, and overall supervision of staff conduct/responsibilities.
European Research Council (ERC)[vi]	The Principal Investigator is the individual that may assemble a team to carry out the project under his/her scientific guidance
European Medicines	The Principal Investigator is the person with the responsibility for the

Agency (EMA)[vii]	coordination of investigators at different centres participating in a multicentre trial, or the leading investigator of a monocentre trial, or the coordinating (principal) investigator signing the clinical study report
National Science Foundation (NSF)[viii]	The Principal Investigator is the individual designated by the grantee, and approved by NSF, who will be responsible for the scientific or technical direction of the project. The term "Principal Investigator" generally is used in research projects, while the term "Project Director" generally is used in science and engineering education and other projects
National Aeronautics & Space Administration (NASA)[ix]	A Principal Investigator is the individual(s) a research organization designates as having an appropriate level of authority and responsibility for the proper conduct of the research, including the appropriate use of funds and administrative requirements such as the submission of scientific progress reports to the agency
National Institute of Health (NIH)[x]	The principal investigator is the individual(s) judged by the applicant organisation to have the appropriate level of authority and responsibility to direct the project or program supported by the grant
Ivy League Descriptions of the Principal Investigator	
Funding Body	**Description**
University of Pennsylvania[xi]	A principal investigator is an individual designated by the University and approved by the sponsor to direct a project funded by an external sponsor. S/he is responsible and accountable to the University and sponsor for the proper programmatic, scientific, or technical conduct of the project and its financial management
Dartmouth University[xii]	The Principal Investigator has primary responsibility for achieving the technical success of the project, while also complying with the financial and administrative policies and regulations associated with the award. Although Principal Investigator's may have administrative staff to assist them with the management of project funds, the ultimate responsibility for the management of the sponsored research award rests with the Principal Investigator
Columbia University[xiii]	The full administrative, fiscal and scientific responsibility for the management of a sponsored project resides with the Principal Investigator named in the award
Brown University[xiv]	The Principal Investigator is the individual responsible for all scientific or technical aspects of the project and for the overall day-to-day management of the project or program. This person may be any member of the Brown faculty, or, with special permission and the signature of the senior officer for their division, a graduate student, medical student, or an exempt staff member
Cornell University[xv]	The Principal Investigator is the individual responsible for the conduct of the project. This responsibility includes the intellectual conduct of the project, fiscal accountability, administrative aspects, and the project's adherence to relevant policies and regulations. A project may have multiple individuals as PIs who share the authority and responsibility for leading and directing the project, intellectually and logistically
Princeton	A Principal Investigator (PI) is an individual judged by the University to

University[xvi]	have the appropriate level of authority, expertise, and responsibility to direct a research project or program supported by a grant. There also may be multiple individuals serving as co-PIs who share the authority and responsibility for leading and directing the project, intellectually and logistically. Each PI/co-PI is responsible and accountable to the University for the proper conduct of the project or program. PIs are responsible for mentoring students involved in the project. They are also responsible for fulfilling the programmatic, management, and other requirements of the sponsoring organization
Harvard University[xvii]	A principal investigator is the project director of a research grant or contract responsible for seeing that the work is carried out according to the terms, conditions, and policies of both the sponsor and the university. The principal investigator is solely responsible for the intellectual integrity of the work. Normally, a principal investigator must hold a full-time academic ladder appointment
Yale University[xviii]	The Principal Investigator is designated by the University and approved by the sponsor to direct a project funded by an external sponsor. S/he is directly responsible and accountable to the University and sponsor for the proper programmatic, scientific or technical conduct of the project, and its financial and day-to-day management. The principal investigator is a critical member of the sponsored project team responsible for ensuring compliance with the financial and administrative aspects of the award. The principal investigator works closely with appropriate administrators within the University to create and maintain necessary documentation, including both technical and administrative reports; prepare budget justifications; appropriately acknowledge external support of research findings in publications, announcements, news programs, and other media; and ensure compliance with other Federal and organizational requirements. It is expected that the principal investigator will maintain contact with the appropriate sponsor representative with respect to the scientific aspects of the project and the business and administrative aspects of the award

[i] http://www.sfi.ie/funding/grant-policies/sfi-investigator-titles/
[ii] http://www.irchss.ie/schemes/scheme06/FAQ.htm
[iii] *www.epa.ie/.../research/researchtcandguides/cgpp4%20guide%20for%20grantees.pdf*
[iv] *www.nuigalway.ie/research/vp_research/.../FIRM%20Presentation.ppt*
[v] Provided by ESRC RTD Enquiries Service
[vi] Provided by EUROPE DIRECT Contact Centre/ Research Enquiry Service
[vii] *www.ema.europa.eu/docs/en_GB/document.../10/WC500097905.pdf*
[viii] http://www.nsf.gov/pubs/2002/nsf02151/gpm2.jsp#210
[ix] *www.hq.nasa.gov/office/procurement/nraguidebook/proposer2010.doc*
[x] *enhancing-peer-review.nih.gov/.../Tab_6b-Applicant_Survey_Version_B.pdf*
[xi] *www.upenn.edu/researchservices/faq.html*
[xii] http://www.dartmouth.edu/~osp/resources/manual/post-award/pirole.html
[xiii] *www.columbia.edu/cu/compliance/pdfs/PI_Quick_Guide.pdf*
[xiv] *research.brown.edu/pdf/PSAF_Guide.pdf*
[xv] *www.research.cornell.edu/VPR/Policies/PI-policy.html*
[xvi] *www.princeton.edu/.../PI%20Request%20for%20Website%20-%20Final.pdf*
[xvii] http://www.gsd.harvard.edu/academic/faculty_resources/faculty_handbook/chapter_three.htm

[xviii] *www.yale.edu/ppdev/policy/1310/1310.pdf*