Value for Money Review of Science Foundation Ireland

Prepared for

Department of Enterprise Trade and Employment

By

Indecon International Economic Consultants

Indecon

www.indecon.ie

June 2008

Contents

Page

Executive Summary **i**

1 Introduction, Scope and Methodology **1**
1.1 Introduction 1
1.2 Background and Terms of Reference 1
1.3 Methodological Approach to Review 3
1.4 Overview of SFI Programmes 8
1.5 Report Structure 12
1.6 Acknowledgements and Disclaimer 13

2 Policy & Programme Context **14**
2.1 Introduction 14
2.2 Policy and External Context 14
2.3 Overview of Related R&D Programmes 21
2.4 Coordination Arrangements 25
2.5 Summary and Implications 26

3 Review of Funding Activities and Human Capital Development **28**
3.1 Introduction 28
3.2 Review of SFI Research Funding 28
3.3 Contribution to Human Capital Development 49
3.4 Summary of Key Findings 56

4 Evaluation of Programme Outputs **59**
4.1 Introduction 59
4.2 Review of Research Outputs 59
4.3 Review of Collaboration Activity 63
4.4 Review of Commercialisation Activities 66
4.5 Summary of Key Findings 69

Contents

Page

5 Evaluation of Programme Effectiveness and Impact 72

5.1 Introduction 72
5.2 Assessment of Research Outputs and Quality 72
5.3 Assessment of Wider Economic Impacts 92
5.4 Programme Management and Monitoring 98
5.5 International Comparative Position of SFI 114
5.6 Summary of Key Findings 115

6 Conclusions and Recommendations 119

6.1 Introduction 119
6.2 Programme Validity and Policy Consistency 119
6.3 Programme Effectiveness and Impact 120
6.4 Programme Management and Monitoring 125
6.5 Overall Conclusions 127
6.6 Recommendations 128

Annex 1 Glossary of Terms 139

Annex 2 Case Studies on CSETs 143

Annex 3 Additional Supporting SFI Data 182

Annex 4 Additional Bibliometric Outputs 186

Annex 5 Additional Survey Research Outputs 198

Annex 6 Copies of Survey Questionnaires 232

Executive Summary

Introduction and Background

This report is submitted to the Office of Science, Technology and Innovation (OSTI) within the Department of Enterprise, Trade and Employment by Indecon International Economic Consultants. The report concerns a Value for Money review of Science Foundation Ireland (SFI).

This review takes place within the context of the Government's Value for Money and Policy Review Initiative (previously referred to as the Expenditure Review Initiative) and builds and expands upon the findings of the initial Brook evaluation of Science Foundation Ireland's activities over the period 2000-2005[1]. The review examines SFI's major funding programmes and makes targeted comments and recommendations, where appropriate, on the overall effectiveness of the agency supports in building a world-class research system in Ireland, with a focus on whether the programmes, as operated, constitute value for money and efficient use of public funds. Given the scale of public investment involved, this review is particularly appropriate.

Policy and Programme Context

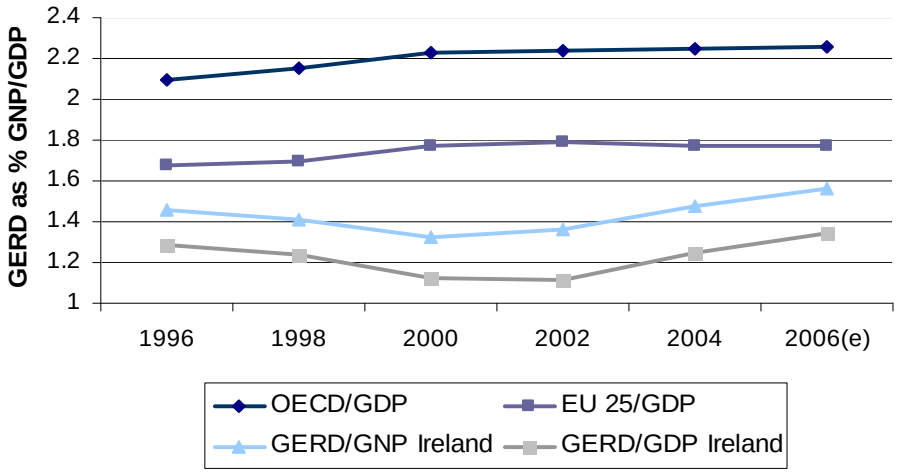
The review commenced by considering aspects of the wider context in which the SFI programmes operate, with a focus on issues regarding the policy consistency and validity of SFI activities and their coherence and linkages with other publicly-funded R&D interventions. The following points from this assessment are highlighted:

- The analysis suggests that the types of advanced research programmes operated by SFI are consistent with the Government's overall innovation policy objectives, as enunciated in the *Strategy for Science, Technology and Innovation* (SSTI). Through the National Development Plan (NDP), the Government has committed substantial resources to the implementation of the SSTI over the period 2006-2013. The Government's policy approach and commitment of resources is also consistent with EU level policy under the Lisbon agenda process.
- Historically, Ireland exhibited clear under-performance in relation to R&D funding and activity relative to its European and international counterparts. Since the late-1990s, however, a radical transformation has taken place in the research funding landscape and there have been substantial increases in R&D expenditures – not only in the public sector but also, encouragingly, in the business sector. SFI, along with the Higher Education Authority (HEA) (via the Programme for Research in Third-Level Institutions (PRTLI)), has played an important role in this turn-around.

[1] Forfás, *Science Foundation Ireland – The First Years 2001-2005: Report of an International Evaluation Panel*, 2005. See http://www.forfas.ie/publications/show/pub216.html.

- Notwithstanding these positive achievements, Ireland remains in catch-up mode relative to its EU counterparts. State expenditures on R&D, equivalent to 1.6% of GNP in 2006, remain below the EU average of 1.8% (see figure below), highlighting the importance of further progress if Ireland is to maximise its international position in the research field.

Comparative Gross Expenditure on R&D (GERD) - GDP/GNP* - 1996-2006



Source: Forfás
Note: * GDP data in Ireland are inflated by the transfer pricing policies of large multinationals, therefore, the use of GNP as a base is the more relevant measure of economic activity for international benchmarking purposes.

- An issue that arises in the context of the wider research development framework in Ireland is whether there is effective coordination between funding agencies. The HEA and SFI - among a number of other agencies – are actively involved in funding research activity in the university sector. Notwithstanding the varying remit of these agencies, while the NDP and SSTI delineate a high-level division of labour between funding agencies, there are inevitable challenges in the ongoing co-ordination of planning and programme/funding activities. This may be most apparent at the level of beneficiary institutions which interact with these agencies on a day-to-day basis. Outside the formal arrangements under SSTI/NDP, the degree of 'on-the-ground' co-operation and information sharing is an important issue.

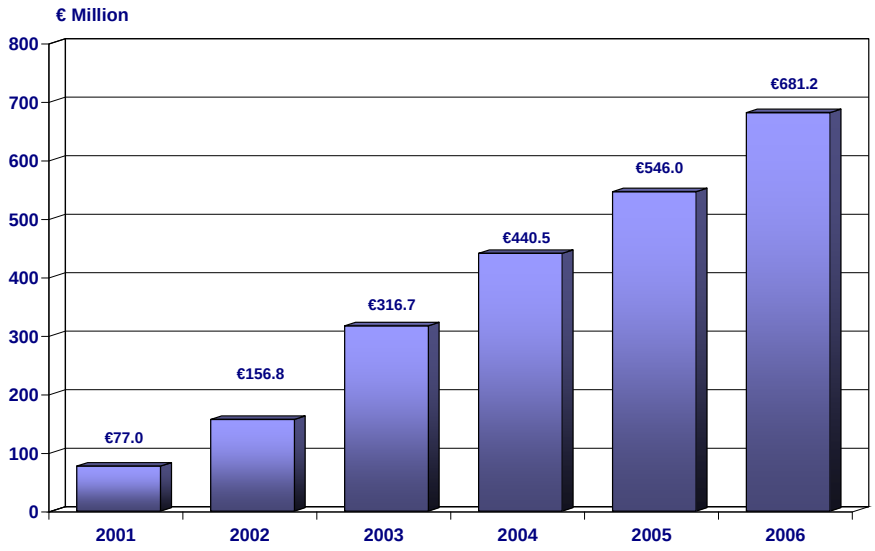
Review of Funding Activities and Human Capital Development Supported by SFI

A detailed analysis and review of both the extent and nature of funding committed by SFI across its research programmes, and the immediate implications of this funding in terms of SFI's contribution to the development of human capital in research, was undertaken. The main findings from this review are set out below.

Funding Activities

- SFI has rolled out a range of funding programmes with the objective of funding research excellence through a portfolio of supports, from programmes targeted at potential scientists/researchers through to Post-doctoral researchers and, in particular, experienced senior researchers and research groups.
- Over the period between 2001 and 2006 SFI committed a total of €681.2 million in funding across 17 different research programmes and supports (see chart below).

Overall SFI Research Programme Funding Committed – Annual Cumulative Total Since 2001 - € Million



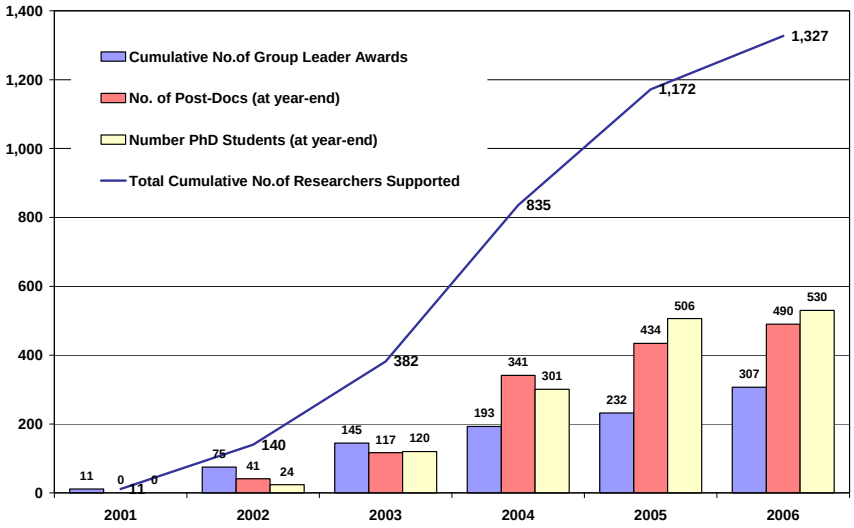
Source: Indecon analysis of SFI data

- The scale and rapid build-up of funding over what has been a short time period can be seen by reference to other research funding programmes, notably the PRTLI, which provided €605 million over Cycles 1-3 between 1999 and 2006, and the fact that SFI funding was equivalent to 18.6% of total Government Budget Appropriations or Outlays on R&D (GBAORD) over the period 2001-2006.
- 37% of SFI funding has been allocated through its Biotechnology (BIO) Directorate, while 48% and 15% respectively has been committed through the Information and Communications Technology (ICT) and Frontiers Engineering and Science (FES) Directorates.
- In terms of research programmes, the largest proportion of funding between 2001 and 2006 (€326.6 million or 47.9%) has been allocated through the Investigator/Principal Investigator programme, while a further €137.7 million or 20.2% of funding commitments have been directed towards the CSETs (Centres for Sciences, Engineering and Technology). The balance of funding commitments, €216.9 million or 32% is spread across a number of other programmes, which include the Research Frontiers programme (€71 million) and the Research Professor/Research Professor Recruitment award (€39.3 million).
- SFI has become the main source of funding for researchers funded by its programmes and, on average, SFI funding now accounts for of the order of 63% of current funding among these researchers. While EU Framework Programme (EU FP) funding, for example, has increased in absolute terms, the evident realignment of funding sources towards SFI over the period under review has reduced the importance of other Irish funding sources, which have declined in proportionate terms. We believe it is too early at this juncture to deliver a definitive conclusion on the progression of the funding mix accessed by SFI-supported researchers. However, it will be important, going forward, to maximise the overall value for money of public funds devoted to research activities in the State. This highlights the need to ensure that researchers maximise the leverage opportunities offered through the positive signalling and other benefits deriving from SFI support.

Human capital contribution

- A key issue concerns the extent to which research funding channelled through SFI is contributing towards the development of the human capital base in research in Ireland. By 2006, through the attraction of high calibre graduates and researchers, both from overseas and from the country's indigenous pool of researchers, SFI's activities had supported a total of 1,327 researchers, including a cumulative total of 307 group leader/senior researcher awards, 490 post-docs and 530 PhD students (see chart overleaf).

Contribution of SFI to Human Capital Base in Research – Breakdown of Cumulative Numbers of Researchers Supported – 2001-2006



Source: Indecon analysis of SFI data

- The extent of SFI's contribution is also evident by reference to national developments in this area. By 2006 SFI-funded research staff accounted for 28% of research staff in the higher education sector and 26% of overall public sector research staff, highlighting the contribution of SFI to human capital development in Ireland.
- Although the primary group of funded researchers have been Irish-based, SFI has been successful in attracting overseas researchers to Ireland and the number of awards made by the Foundation to researchers who came to Ireland from overseas equated to 28% of the overall number of group leader awards made between 2001 and 2006.
- While clearly very positive, the developments in relation to human capital development supported by SFI must also be viewed within the context of the 'ramp-up' phase of the Foundation's operations. Going forward, it will be important to maintain progress commensurate with the achievement of targets set out in the government's Strategy for Science, Technology and Innovation.

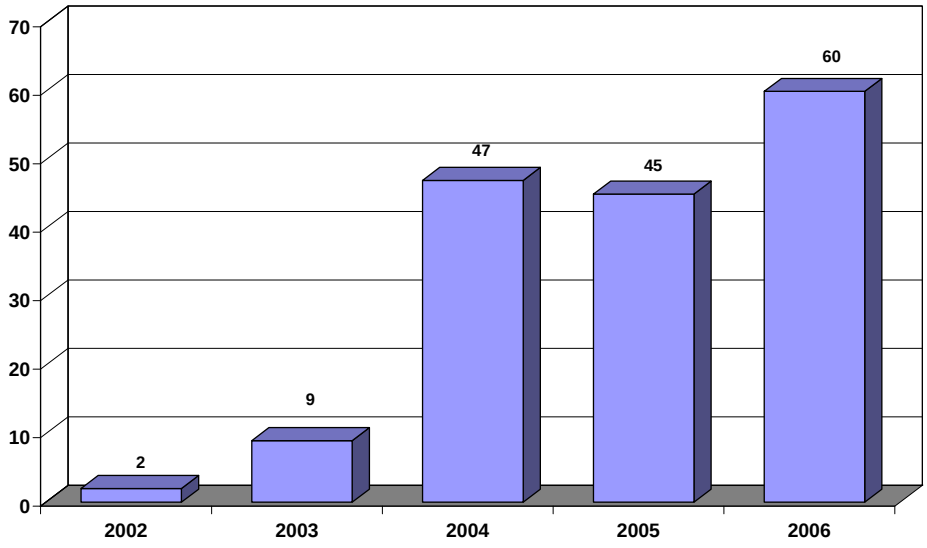
Evaluation of Research Outputs, Collaboration and Commercialisation Activities

We investigated in turn the extent and types of research output produced and the nature of collaborative activity engaged in by SFI-funded researchers, and the emerging evidence in relation to commercialisation activities. In interpreting the findings from the assessment, it is important to highlight the short time period since the establishment of SFI and the fact that research teams and associated research outputs did not begin to emerge until 2004/05. Consequently, the effective time window through which the assessment of outputs, impact and effectiveness of SFI funding could be examined is constrained. Notwithstanding this issue, the key findings in relation to emerging research outputs, collaboration and commercialisation activities are as follows:

- We examined the nature of **research outputs**, looking in particular at (i) the number of refereed journal articles published by funded researchers in internationally recognised journals and (ii) the number of conference based presentations delivered by these researchers. While of greater importance to the assessment of effectiveness is the quality of research produced, the findings reveal that journal publication rates have increased significantly both in absolute terms and relative to the number of researchers funded, although further evidence in this area will be required going forward.
- SFI-funded researchers and research groups have forged and are engaged in extensive **collaboration activity** involving linkages with academic institutions and industry, both in Ireland and overseas. By 2006, the cumulative number of collaborative linkages with academic institutions reached a total of 663. It is notable that these linkages have been weighted more in favour of international linkages.
- In relation to **collaboration with industry**, by 2006 a cumulative total of 264 interactions with firms located in Ireland and overseas were evident. Of this total, 146 interactions (55.3%) in total involved interactions in Ireland with indigenous Irish firms and foreign-owned firms with bases in Ireland, while 118 interactions (44.7%) were with firms located overseas. While information in relation to the scale of firms involved was not available to the review team, of importance is the extent of interaction between SFI researchers/research groups and indigenous Irish firms. The overall number of such interactions has increased. However, although we are supportive of international linkages with industry, our analysis raises concerns over the comparative extent to which SFI-funded research has to-date engaged successfully with Irish-based, indigenous firms and further progress in this area is required if SFI researcher is to generate significant economic spin-offs involving Irish-based, indigenous industry.

- We believe it is too early in the vast majority of cases to discern significant **commercialisation** and IP outputs. However, the available data in relation to one measure of commercialisation, namely patenting activity, indicates an acceleration in activity from 2004 onwards, with the annual number of patents filed rising to 60 during 2006 bringing the total since 2001 to 163. Gains in intellectual property advances arising from the allocation of research funding of this nature often occur with a considerable lag, however, and it will be important that significant outputs in terms of patents granted are forthcoming in future years.

Commercialisation of SFI Research – Patent Activity – No. of Patents Filed by SFI-funded Researchers/Research Groups



Source: Indecon analysis of SFI data

- Overall, significant **collaborative**, **research and commercial outputs** have emerged over the 2002-2006 period since the establishment of SFI. It is important not to fully attribute all these gains to the incidence of higher SFI funding, as there are a constellation of other exogenous factors, including other funding sources which may also have contributed to these impressive gains. However, in light of the significant funding allocations made by SFI which outweigh all other sources, we feel it reasonable to attribute most of these gains to the increased incidence of SFI funding.

Evaluation of Programme Effectiveness and Impact

The review examined the emerging impact and effectiveness of SFI's programmes. A core element of the evaluation focused on the assessment of the performance and quality of SFI-funded research outputs. In addition, we considered the evidence in relation to emerging wider economic impacts. The key findings from the assessment of impact and effectiveness are set out below.

Assessment of research outputs and quality

To support the assessment of the effectiveness of SFI's research funding programmes, an in-depth analysis of the outputs of SFI researchers and the quality of this research was completed. In what is known in the research field as a *bibliometric* assessment, this exercise entailed the collation and detailed analysis of researcher and related publication outputs.

It is important to highlight that the short time period since the establishment of SFI and the fact that research teams and associated research outputs did not begin to emerge until 2004/05 has meant that the effective time window through which the assessment of research performance could be examined is necessarily constrained and further evidence on progress in this important area will be required going forward. Based on the available evidence, however, the key findings from this assessment are as follows:

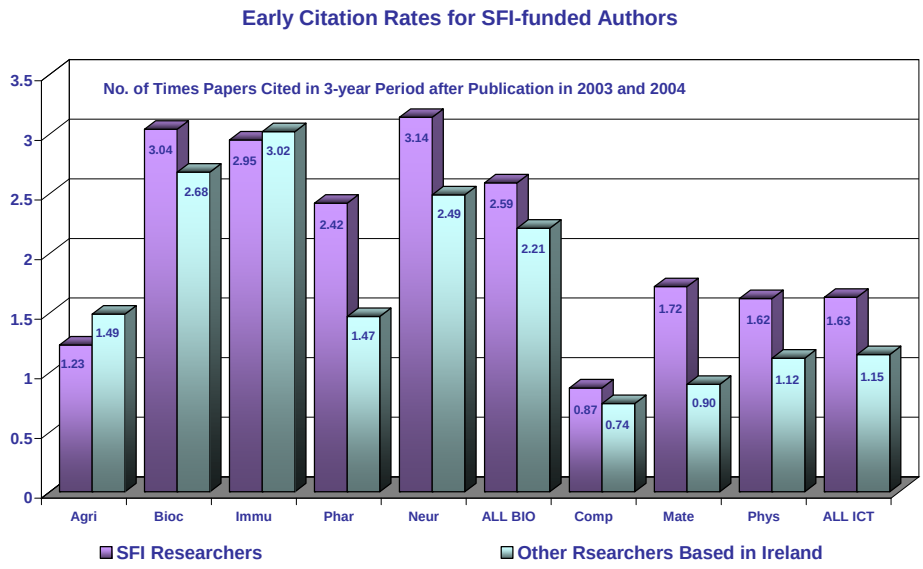
- SFI's research funding programmes and supports are successfully targeting and attracting the highest quality research talent, both in Ireland and internationally; and
- These researchers are producing research outputs in the highest ranking international publications in their fields.

In particular, it was noted that:

- SFI-funded research outputs are published extensively in the top quartile (25%) of international journals;
- SFI authors enjoy a significant advantage over non-SFI researchers based in Ireland in terms of the extent to which their research outputs are cited by other researchers (see figure overleaf).
- SFI funding has coincided with an increase in publication productivity levels of researchers.

The figure overleaf compares the response to publications released by SFI-funded researchers and other researchers in Ireland across specific ICT and BIO disciplines. On the basis of 'early' citation rates achieved within a 3-year period following publication, this highlights the positive differential evident in favour of SFI-funded researchers compared to the non-SFI colleagues in Ireland. In 7 of the 9 areas considered, SFI funded authors have higher levels of citation.

Comparative Response to SFI-funded Research Publications in ICT and Biotechnology Disciplines - Citation Rates Achieved in 3-year Period after Publication in 2003 and 2004



Source: Bibliometric Assessment of SFI Research Outputs

Wider Economic Impacts

In terms of broader economic impacts, reflecting the short time period since the establishment of SFI and the associated limited data/information set available to the review team, we believe it is premature at this juncture to reach a definitive judgment on the precise impact of SFI's programmes. However, there are some promising emerging indications of potential future impacts.

Collaboration between SFI researchers and industry has increased significantly and the CSETs, in particular, have engaged with a wide range of industrial and other partners. However, Indecon believes that further progress can be achieved in this area, particularly in relation to the development of further linkages with Multi-National Corporations (MNCs) located in Ireland and with indigenous Irish industry.

In relation to commercialisation activity, as noted previously, we believe it is too early in the vast majority of cases to discern significant commercialisation and IP outputs at this juncture. One measure of commercialisation outputs, namely patents, has shown an acceleration in activity levels particularly from 2004 onwards and significant numbers of patent filings are evident. However, further evidence on the outputs from these filings, in addition to other measures of output and impact in this area, are required to enable a more detailed assessment of progress.

IDA Ireland has stated as part of this review that SFI funding has acted as a strong reference sell for IDA visiting companies visiting Ireland and has also noted that significant R&D investment projects have come to Ireland and have developed strong linkages with SFI CSETs in particular. Leading companies surveyed by Indecon as part of this review believe that SFI is playing a role in the development of high-skilled human capital and the contribution of SFI in this area is evident in the numbers of PhD students and prospective graduates trained within SFI teams and particularly within the CSETs.

However, there remains a requirement for continued agency involvement – including via the Technology Transfer Officers supported by Enterprise Ireland, and IDA Ireland - to bridge the gap between SFI-funded research and commercial development of new technologies. With the first round of CSET and PI funding drawing to an end, a sharper focus on this issue will be needed in the next funding period.

Conclusions and Recommendations

Conclusions on Programme Validity and Policy Consistency

We reviewed developments in the innovation policy context at both national and EU level. Based on that analysis, we conclude that the SFI programmes are consistent with national and EU policy. At EU level, the Lisbon agenda for growth and employment generation emphasises the need for Europe to improve its innovation performance and to substantially increase economy-wide R&D investment.

At national level, the SFI programmes are relevant to the policy of creating a knowledge-based economy. They also follow from the objectives set out in the *Strategy for Science, Technology and Innovation*. For example, the SFI programmes should contribute directly to the objectives of building a sustainable world class research system and the more operational, output-focused objective of doubling the number of PhD's. Thus, in overall terms, SFI's programmes and activities remain valid and supportive of wider economic and innovation policy objectives.

Conclusions re Programme Effectiveness and Impact

We reviewed various aspects of the performance and effectiveness of SFI activity. We conclude overall that programme effectiveness, broadly assessed in terms of funding commitments (inputs), employment of researchers (activity) and research outputs, is positive on the basis of observable outcomes to date. This is supported by the following findings:

- A substantial volume of investment has been committed by SFI to research in the key areas of ICT and Biotechnology. This has take place over what has been a relatively short timeframe and on a scale comparable to that of the HEA's PRTLI programme.
- SFI has made an important contribution to the development of human capital in research in Ireland. A significant ramp-up in research activity and outputs has occurred with the assembly of strong and growing research teams, including the attraction of highly regarded researchers to Ireland from overseas; and
- The evidence from our assessment suggests that SFI funding has produced research outputs which can be measured among the highest in quality terms in both ICT and BIO disciplines internationally. Both the PI programme and CSET mechanism have funded research outputs which have been published in the highest ranked journals internationally.

In terms of the individual SFI programmes and in line with the Terms of Reference for this review, our analysis has focused on the Principal Investigator/Investigator programme and the Centres for Science, Engineering and Technology (CSETs) mechanism, which have been allocated the largest share of overall funding. While it is too early to draw definitive conclusions in relation to the longer-term impacts of SFI's programmes, the assessment lends support to the view that the Foundation's key programmes have and are continuing to play an important role in building a world-class research system in Ireland. Among the key findings that emerge from the assessment include the following:

- The Foundation has been in the process, principally via its Principal Investigators/Investigators programme, of building strong research teams, including through the attraction of significant numbers of leading researchers from overseas. Achieving and maintaining critical mass will be vital in this respect;
- In terms of researcher productivity, the evidence to date points to a steady increase in the volume of research outputs funded under the Principal Investigators/Investigators programme, although further evidence on research performance going forward, including bibliometric assessment of research quality, would be required before more definitive conclusions could be drawn;
- SFI funding provided through the CSETs mechanism has helped to create research centres of international research excellence, which in the absence of SFI funding would be unlikely to be present in Ireland;
- SFI-funded research centres have forged partnership and networking arrangements with a wide range of industrial and academic partners. However, of key importance are the outcomes that emerge from these collaborative linkages in terms of research and commercialisation activities, and wider economic impacts;

- In addition, SFI research centres, and particularly the CSETs, have acted as a reference sell for IDA visiting companies visiting Ireland;
- While a number of the researchers and research centres have been successful in securing funding from non-SFI sources, in general further progress is required to maximise the leverage from SFI and PRTLI funding, particularly in relation to non-State, EU and other international sources, and industry funding; and
- The CSETs are involved in a range of outreach activities, including educational programmes, development of links with students at first and second level and wider public awareness-raising actions. Of importance, however, is the extent to which the research groups achieve wider dissemination of research among the public generally and industry in particular.

Overall, the available evidence on the performance of the PI and CSET programmes would indicate that the programmes are performing effectively. It is also important to note that while the CSETs have been successful, the nature of the model is such that it has enabled the centres to attract a greater profile and visibility. The Principal Investigators/Investigators programme, however, has attracted the lion's share (almost 49%) of overall funding commitments over the period 2001-2006, while this core programme has also supported the largest contribution to human capital generation in terms of researcher numbers and to research outputs. An important feature is the synergistic co-existence of these two programmes/mechanisms and the future of the CSET model or similar mechanisms is dependent upon the seeding of emerging research teams and centres among the PI-level researcher population.

In addition, a number of positive features of SFI's operations were highlighted by the external academic advisors to the review team. These include the Foundation's strategic focus on funding of research excellence within a targeted set of sectors and disciplinary areas of research; the operation of a 'portfolio' approach to funding; and the Foundation's rigorous peer review procedures. These features were acknowledged by the international experts as particular strengths of the SFI approach which draw from international best practice and which we strongly believe should be maintained and further strengthened where possible going forward.

Notwithstanding the above features, there are areas where improvements could enhance value for money and the economic impact of future phases of SFI funding, in addition to aspects where programme management and ongoing monitoring could be improved, and these are addressed in our recommendations.

Implications of Discontinuation, Reduction or Expansion in Supports

An issue raised in the Terms of Reference for this review concerns the outcomes that might result from the discontinuation, reduction or expansion of the programmes. We have concentrated our analysis on the Principal Investigator (PI) and CSET programmes, which have accounted for the vast bulk of funding committed by SFI over the period 2001-2006.

As noted previously, the two programmes have generally performed well in terms of research quality (as measured by destination journal ranking) and both programmes are, in general, associated with an improvement in researcher productivity. The two programmes would also appear to sit well with the overall mission of SFI and with wider government objectives as set out in the SSTI.

It is also important to recognise the merit of SFI offering a portfolio of different programmes which can attract different types of researchers and research activities, particularly in the early years of SFI. However, the question of the balance of funding as between these programmes and with other SFI programmes is an issue that will come into sharper focus as funding commitments to existing projects draw to a close and decisions have to be taken on whether to agree to an additional funding round or to cease funding.

Any significant discontinuation or reduction in supports could adversely affect the build-up of research capacity in Ireland, which is important for international competitiveness. This is the case particularly in relation to the human capital base in research and our assessment has shown that achievement of SSTI targets would not be possible without increased outputs of PhD graduates and increased numbers of Principal Investigators/senior researchers to support the development of these graduates.

Of particular importance in relation to decisions on future funding concerns the need to maximise the overall value for money of the very substantial level of public funds devoted to research activities (under the current National Development Plan (2007-2013), a total of €1.4 billion in funding has been allocated to SFI programmes). Over the medium- to longer-term, as research projects achieve financial sustainability, a more balanced funding mix should prevail, which would be characterised by a reduced dependency on any one source of funding. This highlights the need to ensure that researchers maximise the leverage opportunities offered through the positive signalling and other benefits deriving from SFI support. In this regard, we believe that some weighting in funding decisions to proposals which also demonstrate access to or the potential to attract EU or other international and industry sources of funding would assist in maximising the leverage of other funding sources.

The funding provided by SFI has significant potential to support economic development in Ireland and our recommendations, set out below, are designed to maximise the impact of this important research programme.

Overall Conclusions

This review entailed a detailed independent and rigorous assessment of the funding activities and related outputs, emerging impacts and effectiveness, and overall value for money achieved by SFI since its establishment in 2000/2001. Overall, the findings from the review must be interpreted within the context that the assessment was constrained by the very short time period of data available since the establishment of SFI and the commencement of its main programmes. In this regard, while we believe it is premature to reach definitive conclusions at this juncture, the emerging picture is positive and indicates that if current progress is maintained and if a number of emerging issues are addressed, SFI programmes hold out the prospect of delivering value for money. This is evident in the scale of funding committed, both in absolute terms and relative to overall R&D funding in Ireland, the contribution of the Foundation to the development of human capital in research, and the performance and quality of research outputs which have emerged to-date. Significant outputs and emerging impacts are also visible in relation to the development of collaborative linkages, although we would contend that further progress is required in this area, particularly in relation to the further development of linkages with industry in Ireland, including with indigenous firms.

An important issue concerns the wider economic impacts of the investment in R&D activities supported by SFI programmes. Again, while we believe it is too early to deliver a definitive judgment on the extent of wider economic benefits, the limited available data on commercialisation activities suggests that some progress is evident (measured, for example, by reference to patent filings) but further evidence of impacts will be required in this area. In relation to inward investment linkages, we understand that SFI funding has acted as a strong reference sell for IDA visiting companies visiting Ireland, while significant R&D investment projects have come to Ireland which have developed strong linkages with SFI CSETs, in particular.

Notwithstanding these positive developments, if the impacts of SFI funding are to be maximised going forward, continued focus on funding of research excellence is required and ongoing close attention will need to be given to ensuring that the Foundation's programmes target funding at those activities which are aligned with, and build upon, existing strengths in niche areas of research where Ireland can compete effectively on a global scale. In addition, closer attention is required to ensure that value for money from public funds is maximised through incentivising the leverage of alternative non-State and international sources of funding. Given the scale of research funded and human capital built up to-date through SFI programmes, there will also be an increased challenge in terms of retaining high-skilled researchers. Finally, ongoing work is required in the area of programme management and monitoring to ensure that activities are managed efficiently and in line with best practice approaches internationally.

Recommendations

A series of recommendations flow from the assessment undertaken and conclusions derived through this review and these are summarised in the table below. These recommendations, which also draw from the inputs of the external international advisors to the team, maintain the focus of existing SFI operations but are designed to improve the ongoing implementation and management of the Foundation's programmes and to maximise the future impact and value for money from the substantial public resources invested in SFI-supported research in Ireland.

Summary of Recommendations

No.	Recommendation
1.	SFI should continue to implement its core mission of funding research excellence in areas where Ireland can compete effectively on a global scale
2.	An increased focus on effective industry collaboration (see further below) and measures to enhance the commercialisation of research should form part of future management of the next phases of SFI funding.
3.	Increased focus is required to align collaborations by SFI-funded researchers with the requirements of industry based in Ireland.
4.	Mechanisms to ensure that SFI funding maximises the leverage of EU and other international sources of funding for Irish research should be introduced.
5.	The development agencies, including IDA Ireland and Enterprise Ireland, should intensify efforts to engage new and existing client companies with SFI-funded research teams/centres.
6.	SFI should consider the merits of a centrally managed database of inputs and outputs relating to SFI funded projects, which would track a range of input, output and impact indicators.
7.	A system of ex-post review, which would combine elements of the existing ex-ante peer review and interim review process but place greater emphasis on the assessment of economic impact and value for money, should be put in place for completed SFI-funded research.
8.	Continued efforts are needed to ensure effective inter-agency interaction and co-ordination including, in particular, between SFI and HEA.
9.	SFI should carry out regular, systematic bibliometric analysis of SFI-funded research outputs and publish the highlights of this analysis
10.	Measures to enhance the likelihood of top-ranking researchers remaining in Ireland should be given a high priority.

Source: Indecon

Acknowledgements and Disclaimer

The completion of this review would not have been possible without the assistance and inputs provided by numerous organisations and individuals. We would like to acknowledge the support of all members of the Steering Group for their assistance and would particularly like to thank the Department of Enterprise, Trade and Employment, the Department of Finance, Forfás, IDA Ireland and Enterprise Ireland, the Higher Education Authority, the Irish Universities Association and the Office of the Chief Scientific Adviser to the Government. We would also like to acknowledge Science Foundations Ireland's cooperation and inputs throughout the course of the review.

Thanks are also due to leading companies throughout Ireland who provided valuable inputs to the review. We would like to thank the numerous researchers and research groups who inputted to this review both through their submissions and responses to our survey research and through their discussions with the review team during the site visits programme and subsequently. In addition, we would like to acknowledge the inputs of senior management within each of the higher education and research institutions, including the Provost and Dean of Research at Trinity College Dublin, and the Presidents and Vice-Presidents of Research at Dublin City University, University College Cork, the National University of Ireland, Galway, and the University of Limerick. Indecon also acknowledges the valuable advice and inputs provided by our high-level panel of international academic advisers to the review, including Professor Enric Banda, Professor Nigel Slater, David Clark and Dr Ian Rowlands. Finally, we would also like to acknowledge the external quality assessment of this review, undertaken by Dr Richard Boyle. The usual disclaimer applies and the views and analyses are the sole responsibility of Indecon.

1 Introduction, Scope and Methodology

1.1 Introduction

This report is submitted to the Office of Science, Technology and Innovation (OSTI) within the Department of Enterprise, Trade and Employment by Indecon International Economic Consultants. The reports concerns a Value for Money review of Science Foundation Ireland (SFI).

1.2 Background and Terms of Reference

This review takes place within the context of the Government's Value for Money and Policy Review Initiative (previously referred to as the Expenditure Review Initiative). Such reviews provide a systematic analysis of what is being achieved by targeted amounts of expenditure in select areas or programmes and aims to provide a basis for more informed decision making.

This value for money review builds and expands upon the findings of the initial Brook evaluation of Science Foundation Ireland's activities over the period 2000-2005. The review examines SFI's major funding programmes and makes targeted comments and recommendations, where appropriate, on the overall effectiveness of the agency supports in building a world-class research system in Ireland, with a focus on whether the programmes, as operated, constitute value for money and efficient use of public funds. Given the scale of public expenditure involved, this review is particularly appropriate.

Specifically, it focuses on the assessment of the following two SFI programmes:

(a) Principal Investigator Programmes including Research Professor Awards and E.T.S. Walton Visitor Awards; and

(b) Centres for Science, Engineering and Technology (CSET): Campus-Industry Partnership

The detailed Terms of Reference for the review are as follows:

- **Objectives:**
  - To examine the validity of the above programmes in meeting the long-term objective of SFI, to create a highly visible critical mass of world-class research excellence in niches areas of ICT and Biotechnology (BIO), considered important to Ireland's future industrial development.
  - To examine the validity of these programmes within the context of changing circumstances and their individual and overall consistency with the objectives of the Strategy for Science, Technology and Innovation (SSTI) 2006-2013, as well as other relevant Government policies and strategies, and EU strategies on Innovation, Science & Technology.
  - To determine the probable outcomes that could result from the discontinuation, reduction or expansion of any programme(s).
  - To review the individual objectives of each programme and assess the extent to which they are being met.
  - To examine the separate programmes in terms of comprehensive measurement of inputs and outputs.

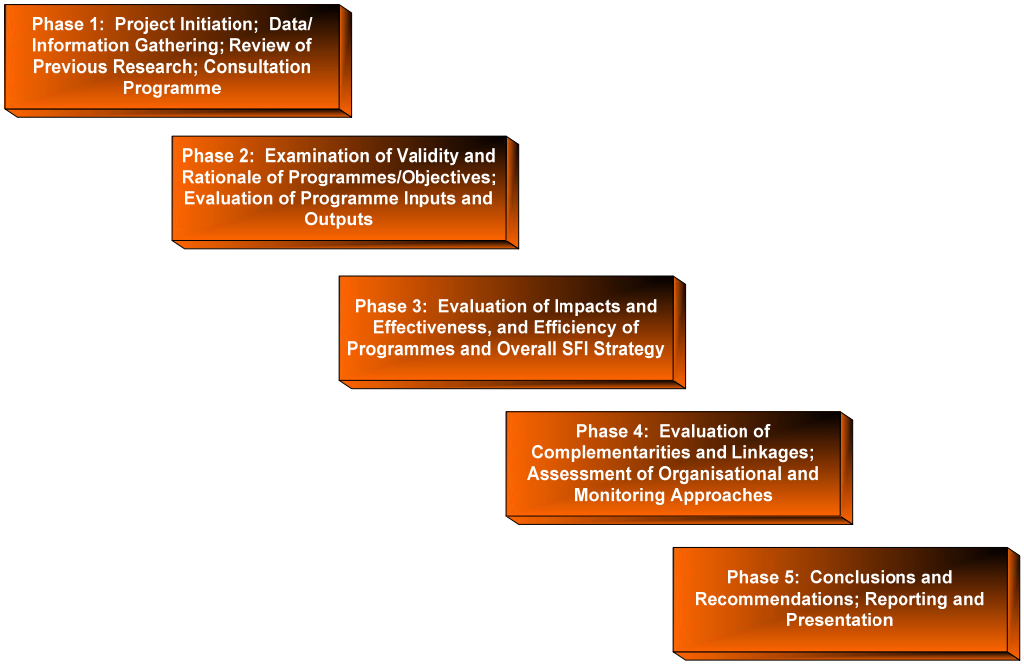
- **Impacts:**
  - To review the effectiveness of the operation of individual programmes, with reference to their outputs and their impacts where possible; the quality of projects supported and review whether the same objectives could be achieved by alternative means.
  - To review user satisfaction with the management and implementation of these programmes by Science Foundation Ireland.

- **Complementarity/linkages:**
  - To review the effectiveness and coherence of the schemes in terms of the overall objectives of Government investment in research and innovation (SSTI 2006-2013), and the effectiveness in practice of their linkages to other related expenditure programmes and supports, particularly those operated by the Higher Education Authority (HEA) and the other research supports to companies provided by the Enterprise Development Agencies.
  - To specify whether improvements can be made to the overall agency strategy for supporting outstanding researchers, including analysing relevance of existing and specifying future indicators.

1.3 Methodological Approach to Review

A detailed 5-phased methodology was applied to this value for money review, with the objective of ensuring a rigorous assessment of the funding committed to the support of research staff and research projects, and the outputs and impacts of these activities. A schematic summary of the methodology applied is presented in the figure below.

Figure 1.1: Schematic Summary of Methodological Approach to Review



Source: Indecon

1.3.1 Analysis of existing research

An extensive analysis and review of relevant existing policy and other documents was undertaken with the aim, inter alia, of situating the review in its wider policy context. This encompassed both EU policy (where various European Commission policy papers under the broad Lisbon agenda were considered, as well as the Government's National Reform Programme) and national policy, including the Strategy for Science, Technology and Innovation and the National Development Plan.

1.3.2 Data/information supporting assessment

A range of detailed data, other information and research were accessed to support the analysis in this review. In particular, detailed data is outlined by the review team from Science Foundation Ireland and by researchers/research groups funded by SFI. This included detailed data on funding, staffing, research outputs, collaboration activity and commercialisation activity. Additional data and research were also provided by other State agencies, including Forfás, IDA Ireland, Enterprise Ireland and the Higher Education Authority.

Analysis of SFI commitments and expenditure data

As one part of our review of the effectiveness of SFI programmes, we conducted an extensive financial analysis of both commitments and expenditure data, including at SFI directorate and programme level as well as area of research focus.

Analysis of Research Activities and Outputs

This analysis focused on the short-term, immediate research activities and outputs generated by SFI funding. This encompassed an analysis of the numbers and origin of research staff funded and of research outputs such as journal articles and conference presentations generated by these researchers.

Assessment of Research Outputs and Quality

To support the assessment of the effectiveness of SFI's research funding programmes, an in-depth analysis of the outputs of SFI researchers and the quality of this research was completed. In what is known in the research field as a *bibliometric* assessment, this exercise entailed the collation and detailed analysis of researcher and related publication outputs data with the objective of addressing the following evaluation issues:

- Has SFI funding impacted on the *quality* of research outputs? In particular:
  - How do SFI-funded research outputs compare with other Irish outputs in similar disciplines in terms of measurable quality?
  - How do SFI-funded research outputs compare with international outputs in similar disciplines in terms of measurable quality?
- Has SFI funding impacted on author *productivity*?

1.3.3 Consultation and Survey programme

Consultation programme

As part of our consultations, extensive new primary research was undertaken by the review team as part of the assessment. This entailed 3 components, namely:

- Survey of SFI-funded researchers
- Survey of unsuccessful applicants for SFI funding
- Survey of Industry

These survey elements sought the inputs and views of researchers and industry on a range of issues pertinent to the review. In formulating the questionnaires for each survey stream, the inputs of the international academic advisors to the review team were reflected. Copies of the questionnaires for each survey are provided in the annexes to this report.

A high response rate was achieved in respect of each of survey stream and a summary of this response is presented in the table below. In relation to the survey of companies, while this was a confidential survey (as in the case of all surveys conducted), the responses received include returns from some of the largest multi-nationals and other firms located in Ireland and employing over 500,000 persons worldwide.

Indecon Survey Research - Survey Responses

Survey Stream Respondent	Total No. Surveyed	Total Responses
SFI-funded researchers	200	88
Unsuccessful applicants for SFI funding	420	67
Industry Partners and Other Firms	105	27 (employing 507,000 employees worldwide)

Source: Indecon Surveys

In addition, particular in-depth discussions were held with and submissions received from senior management/officials within a number of State organisations, including:

- Science Foundation Ireland, including regular ongoing discussions with SFI's Director General and Chief Operations Officer, Directors and Programme Managers within the ICT, Biotechnology (BIO) and Frontiers Engineering and Science (FES) Directorates, and the agency's Director of Corporate Affairs;
- The Department of Enterprise, Trade and Employment/OSTI;
- IDA Ireland;
- Enterprise Ireland;
- Department of Finance;
- Forfás;
- Higher Education Authority; and
- Chief Scientific Adviser to the Government.

An extensive programme of *Site Visits* was completed, involving the following higher education and research institutions who have been recipients of SFI funding:

- Trinity College Dublin;
- Dublin City University;
- NUI Galway;
- University College Cork; and
- University of Limerick.

The core element of the site visit programme entailed visits to/discussions with six major research groups located within each of these institutions, namely:

- CRANN and CTVR at Trinity College Dublin
- BDI group at Dublin City University
- REMEDI and DERI groups at NUI Galway
- APC group and Tyndall Institute at UCC
- LERO group at University of Limerick.

This involved detailed discussions with centre directors, board members, industrial partner representatives and individual researchers.

During these campus visits, detailed discussions were also held with the presidents/provosts and deans/vice-presidents for research, within each of the above institutions.

As a representative body and member of the steering group for this review, detailed discussions were also held with the Irish Universities Association (IUA), which also facilitated group sessions involving the deans/vice-presidents for research and, separately, technology transfer officers, within each of the above institutions.

1.3.4 Inputs of International Academic Advisors

Extensive assistance and inputs were provided by the international academic advisors who assisted the Indecon team on this review, namely:

- **Professor Enric Banda**, Director of the Catalan Research and Innovation Foundation in Barcelona and was previously Secretary General of the European Science Foundation and Spanish Secretary of State for Universities and Research.
- **Professor Nigel Slater,** Professor of Chemical Engineering at Cambridge University and is one of the leading researchers in the biotechnology area and bio-product manufacture in industrial and academic laboratories.
- **Dr David Clark,** Senior Research Scientist at MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) and chairs the Computer Science and Telecommunications Board of the National Research Council.
- **Dr Ian Rowlands**, research bibliometrics expert and senior lecturer in the School of Library, Archive and Information Studies at University College London (UCL) and a founding member of the UCL Centre for Publishing and the CIBER research group.

In terms of specific inputs, valuable inputs were provided to the team by these experts in relation to:

- Design of survey research, including surveys of researchers and industry;
- Views on international comparative position of SFI viz. other research funding organisations (discussed in Section 5);
- Inputs on other aspects of review/terms of reference (noted throughout this report).

1.4 Overview of SFI Programmes

Science Foundation Ireland (SFI) was established in 2000 as a national body with the objective of ensuring that Irelands research capabilities in certain specialist science and engineering fields (specifically ICT, Biotechnology and related fields) were subject leaders and of the highest international standards. This has the objective of helping develop Ireland's competitive advantage in these sectors.

The Irish Council for Science, Technology, and Innovation (ICSTI) published a "Technology Foresight Report" which was the first step in the formation of SFI. This report requested government to establish a fund which would aid Ireland in becoming a centre for research excellence in niche areas of ICT, biotechnology and their underlying sciences. This was designed with the aim of building up inward investment in these areas.

As part of the National Development Plan 2000-2006, the Government established a Technology Foresight Fund of over €630m. It also approved the establishment of a "National Strategic Research Foundation" to undertake and support strategic research in key areas of scientific endeavour including the aforementioned sectors. The Government also set up an Advisory Group to progress the foundation. The Group outlined the following objectives for the foundation:

"to develop and maintain in Ireland an enhanced capability in research that:

1) *is of intrinsic excellence acknowledged internationally;*
2) *is of sufficient scale and critical mass to be effective; and*
3) *Strengthens the scientific foundations underpinning industry."*

Science Foundation Ireland became operational in 2001 and the agency was given official legislative status under the Industrial Development (Science Foundation Ireland) Act 2003. The Act outlines a number of objectives for SFI, including:

- To promote, develop, and assist the carrying out of oriented basic research in strategic areas of scientific endeavour that concerns the future development and competitiveness of industry and enterprise in the state;
- To endeavour to ensure a standard of excellence in the oriented basic research as measured by competitive peer review on an international basis;

- To develop and extend the capability for the carrying out of oriented basic research in institutions; and
- To promote the attraction of research teams and individuals with an interest in research that are of a world class standard with a view to carrying out oriented basic research in the State.

The strategic areas of scientific endeavour are defined "as information and communications technology, biotechnology, and such other areas that concern economic and social benefit, long term industrial competitiveness or environmentally sustainable development as may be prescribed from time to time" [2].

Overview of SFI Programmes

The following section gives a brief outline of the main programmes provided by SFI ranked in terms of funding allocations committed over the period 2001-2006:

Investigators/Principal Investigators Programme

This programme provides grant funding to researchers, normally ranging from €50,000 to €1,000,000 direct costs per year, for up to five years. The grants support fields of science and engineering that underpin biotechnology and information and communications technology. Included in this programme is the Principal Investigator Career Advancement Award (PICA).

Centres for Science, Engineering and Technology (CSETs)

The aim of the CSETs is to link scientists and engineers in partnerships across academia and industry to address crucial research questions, foster the development of new and existing Irish-based technology companies, attract industry that could make an important contribution to Ireland and its economy, and expand educational and career opportunities in Ireland in science and engineering. Grants can range from €1m to €5m per annum for 5 years.

[2] Industrial Development (Science Foundation Ireland) Act 2003, p.7

Research Frontiers

This programme aims to support the best research in a broad range of disciplines in Science, Mathematics and Engineering that impacts diverse fields and that contributes educational benefit that will advance national scientific progress. Grants from this programme normally range up to €150,000 over three years.

Research Professorship Recruitment Awards

This programme aims to attract to Ireland outstanding researchers, with particularly distinguished international reputations. Up to €500,000 per annum for a two year period is the scale of the grant allocation under this programme.

President of Ireland Young Researchers (PIYRA)

This programme provides awards to recognised outstanding engineers and scientists who, in their early careers (no more than 5 years since PhD), have already demonstrated or shown exceptional potential for leadership at the frontiers of knowledge. Awards are normally up to €1 million over five years.

Annual Overhead Investment Plan (AOIP)

The overhead investment provides funding contributions, made to research bodies, to the indirect costs associated with hosting SFI-funded research programmes.

Mathematics Initiative

This initiative is intended to encourage mathematical research that has a potential impact on enterprise, industry, science, engineering, and mathematical education. Awards of up to €1 Million in direct costs over 4 years can be made under this programme.

ETS Walton

The ETS Walton programme supports leading international scientists who wish to undertake research in Ireland for up to 12 months. Awards of up to €200,000 are normally allocated.

Undergraduate Research Experience and Knowledge Award (UREKA)

The UREKA programme supports active research participation by undergraduate students during summer months. It facilitates the participation in laboratories of clustered researchers from Irish 3rd level institutions. It also includes an international exchange programme.

Secondary Teachers Assistant Researchers Award (STAR)

This programme aims to engage teachers' interest in science as researchers, to develop connections between second and third level education institutions and to disseminate new skills and knowledge which can be passed on to pupils.

Women in Science and Engineering Research (WISER)

SFI aims to address the under representation of women in Science, Engineering, and Technology careers through a number of specific programmes. It also aims to ensure that highly accomplished women researchers will have an opportunity to use their skills in an environment which has been adapted to suitably meet the needs of all who work within it. The programmes concerned are (a) Principal Investigator Career Advancement Awards (PICA) ; (b) Institute Planning Grants; (c) Institute Development Awards; and (d) SFI/DELL Scholarships for Young Women in Engineering at undergraduate level.

China-Ireland Research Collaboration Fund

The China-Ireland Research Collaboration Fund provides for exchanges of leading researchers at third level institutions in Ireland and China working in the fields underpinning Bio and ICT.

Strategic Research Clusters

The Strategic Research Clusters aim to create clusters of internationally competitive researchers from academia and industry, particularly Irish-based industry. Grants normally range from €500,000 to €1.5m for a three year period. This programme was launched in 2006 and the first awards were made in late 2007. While the programme does not form part of this review, given its very recent commencement, the importance of the SRCs is acknowledged within the context of providing an additional linkage between the research community and Irish industry.

Stokes Professorship and Lectureship Programme

The objective of the Stokes Professorship and Lectureship Programme is to "support the strategic planning for increasing the number of research active faculty members in the short term". The programme is designed to facilitate more flexible and proactive strategic recruiting by Higher Education Institutions (HEIs) of key research personnel at junior and senior levels. It allows Schools to strategically plan staffing, to integrate quality research staff into the current base of staff and to add to the School's pool of expertise.

Other programmes

There are a number of other programmes provided by SFI. These include International Research and Industrial Partnership supplements, and the Engineering Professorship and Lectureship programme. Grant funding is also available for workshops and conferences that support international meetings held in Ireland for intensive inquiry and collaboration on topics of timely scientific importance relating to the areas of research that underpin BIO and ICT.

1.5 Report Structure

The remainder of this report is structured as follows: Section 2 sets the context for the review by considering the policy context in which the SFI programmes operate, including the coherence of its programmes with the objectives of the Government's Strategy for Science, Technology and Innovation (SSTI) and the complementarity and co-ordination of SFI with other research programmes. Section 3 commences the detailed analysis and assessment by examining the funding committed by SFI and its contribution to human capital development in the form of research personnel supported through the agency's programmes. Section 4 reviews the research outputs, collaboration and commercialisation activities emerging through SFI's programmes. In Section 5 examines the impact and effectiveness of SFI's programmes in terms of research performance and quality, and wider economic impacts, while also reviewing programme management and monitoring. Finally, in Section 6 we bring together the analyses and assessment undertaken in the preceding sections and develop our overall conclusions in addition to recommendations designed to maximise value for money going forward.

1.6 Acknowledgements and Disclaimer

The completion of this review would not have been possible without the assistance and inputs provided by numerous organisations and individuals. We would like to acknowledge the support of all members of the Steering Group for their assistance and would particularly like to thank the Department of Enterprise, Trade and Employment, the Department of Finance, Forfás, IDA Ireland and Enterprise Ireland, the Higher Education Authority, the Irish Universities Association and the Office of the Chief Science Adviser to the Government. We would also like to acknowledge Science Foundations Ireland's cooperation and inputs throughout the course of the review.

Thanks are also due to leading companies throughout Ireland who provided valuable inputs to the review. We would like to thank the numerous researchers and research groups who inputted to this review both through their submissions and responses to our survey research and through their discussions with the review team during the site visits programme and subsequently. In addition, we would like to acknowledge the inputs of senior management within each of the higher education and research institutions, including the Provost and Dean of Research at Trinity College Dublin, and the Presidents and Vice-Presidents of Research at Dublin City University, University College Cork, the National University of Ireland, Galway, and the University of Limerick. Indecon also acknowledges the valuable advice and inputs provided by our high-level panel of international academic advisers to the review, including Professor Enric Banda, Professor Nigel Slater, David Clark and Dr Ian Rowlands. Finally, we would also like to acknowledge the external quality assessment of this review, undertaken by Dr Richard Boyle. The usual disclaimer applies and the views and analyses are the sole responsibility of Indecon.

2 Policy & Programme Context

2.1 Introduction

This section concerns aspects of the wider context in which the SFI programmes operate with a focus on issues regarding the policy consistency and validity of SFI activities and their coherence and linkages with other publicly-funded R&D interventions. Section 2.2 considers aspects of Ireland's R&D performance before outlining the main themes which emerge from a review of key policy documents in the innovation area. Section 2.3 provides an overview of related, non-SFI funded, programmes in the R&D area, while Section 2.4 describes the coordination structures put in place. The final section 2.5 draws out some of the main implications that are also taken-up in later sections of this review.

2.2 Policy and External Context

This section first presents some overall summary indicators of trends in Ireland's R&D performance. We cover both developments at EU level under the Lisbon agenda, and national policy as articulated in the Strategy for Science, Technology and Innovation and the National Development Plan.

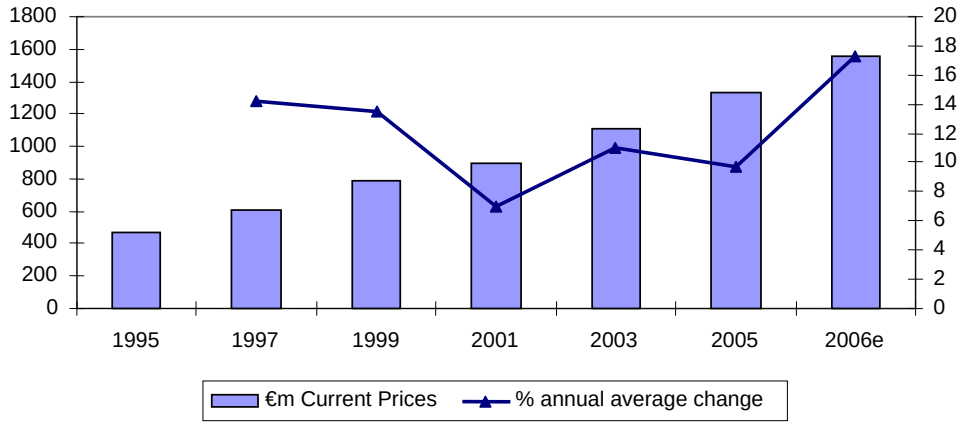
2.2.1 Irelands R&D Performance

The latest estimates of R&D activity in Ireland, which relate to 2006, were published by Forfás in March 2007.[3] These data show that overall Gross Expenditure on Research and Development (GERD) rose to just over €2.3 billion in 2006, equivalent to 1.6 per cent of GNP. This represented an increase of 0.08 per cent of GNP over the 2005 level.

[3] Forfás, *Research & Development Statistics in Ireland, 2006 - at a Glance*, March 2007 (see www.forfas.ie/publications/forfas070325_gerd_report/forfas070325_gerd_report.pdf.

Details of business sector related R&D spend, in current 2006 prices, are outlined in Figure 2.1 below, together with a trend line indicating annual average change in the level in percentage terms.

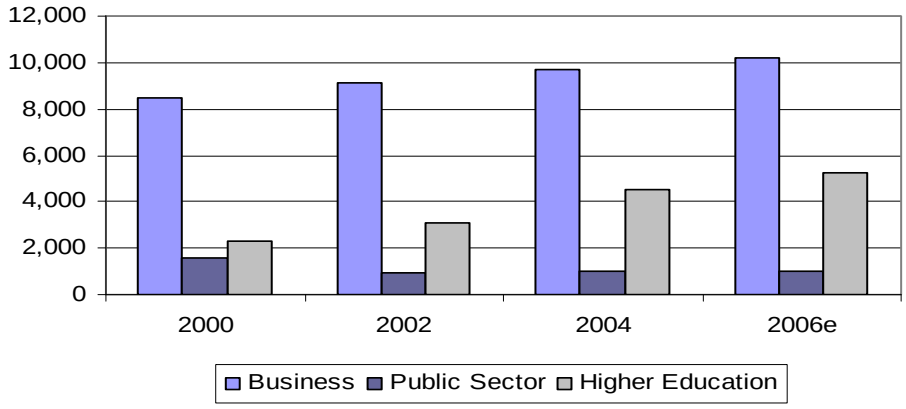
Figure 2.1: BERD (Business Sector Performed R&D) Expenditure in Current Prices, Ireland 1996-2006



Source: Forfás (2007) - 'Research & Development Statistics in Ireland, 2006 - at a Glance'

Figure 2.2 below shows the number of R&D-related personnel employed across the business, public and higher education sectors between 2000 and 2006. As the graph indicates, the numbers of researchers employed has followed a linear upward trend across the period under review and reached over 10,000 in 2006.

Figure 2.2: R&D Personnel by Sector of Employment in Ireland, 2000-2006



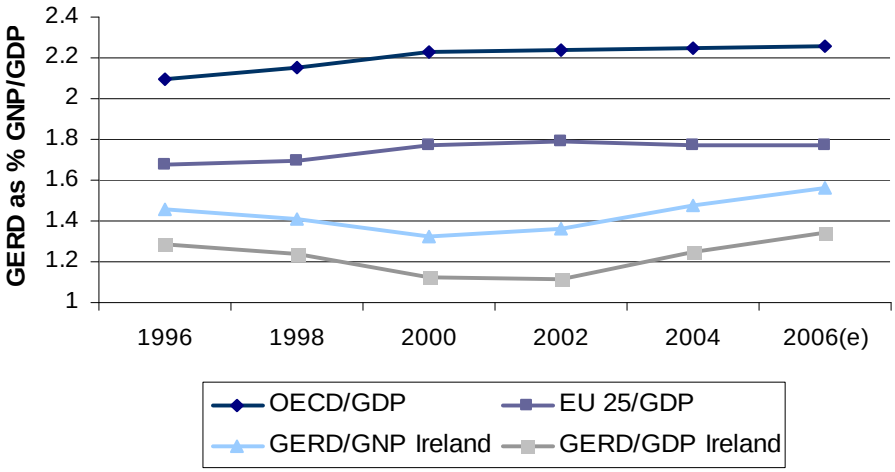
Source: Forfás (2007) - 'Research & Development Statistics in Ireland, 2006 - at a Glance'
Note: R&D Personnel includes both Research and Support Staff (FTE)

Comparative international context

Despite the increase in R&D spending, Ireland's R&D intensity – measured in terms of Gross Expenditure on R&D (GERD) relative to GDP or GNP - remains behind the average across the EU25 Member States (1.77%) and that of the OECD (2.26%) (See figure overleaf).[4] This gap is largely explained by lower R&D activity in the business and government sectors.

[4] The EU and OECD data relate to 2004/2005 and are calculated by reference to a GDP base.

Figure 2.3: Gross Expenditure on R&D (GERD) as a proportion of GDP/GNP*, 1996-2006



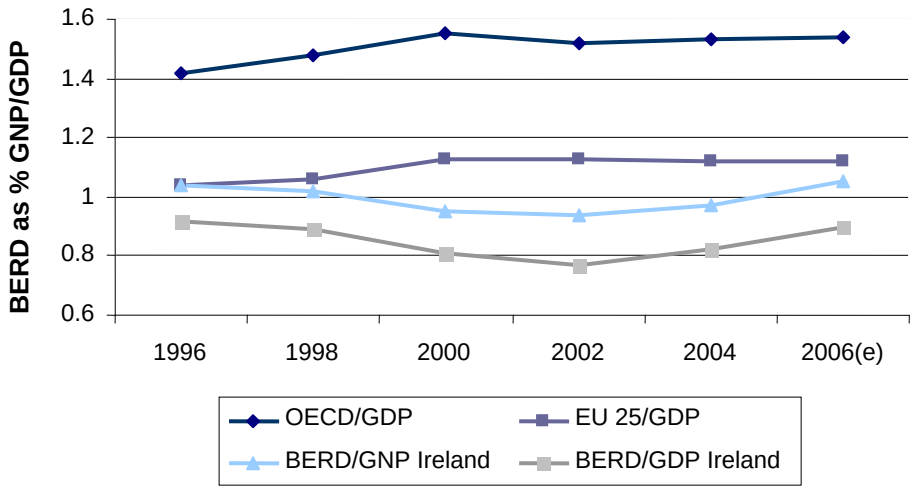
Source: Forfás, Report on Expenditures on R&D, 2007

Note: * GDP data in Ireland are inflated by the transfer pricing policies of large multinationals, therefore, the use of GNP as a base is the more relevant measure of economic activity for international benchmarking purposes. ** Latest EU/OECD data is 2004/2005 using GDP PPP Methodology

Ireland's performance in the higher education sector (measured by HERD) is in line with both the EU and OECD averages at 0.4 per cent of GNP/GDP.

On other R&D indicators, Ireland's relative position is better; for example, the number of researchers as a proportion of total employment is in line with the EU average, at 6.0 researchers per 1000 employed.

Figure 2.4: Business Sector Performed R&D (BERD) as a proportion of GNP/GDP. 1996-2006



Source: Derived from the Survey of Business Expenditure on R&D 2005/0-6 (Forfás) and the Main Science and Technology Indicators, 2006/2 (OECD)

Note: 2006 figures are Forfás estimates.

2.2.2 EU Lisbon Strategy

The EU's Lisbon Strategy for growth and jobs (often referred to simply as the Lisbon agenda or strategy) constitutes the European Union's overarching economic and social policy framework. The Strategy was originally launched by EU Heads of State and Government, in March 2000, with the ambitious objective that the EU would become the most competitive, knowledge-based economy in the world by 2005. Following a review process, the strategy was re-launched in spring 2005 with a tighter focus on the policy challenges posed by globalisation and supported by new governance arrangements.

At the Spring 2006 European Council, four priority areas for action at both EU and national level were agreed: R&D and innovation, the right business environment, investment in people, and energy and climate change. Increasing investment in research and development and enhancing Europe's innovation performance are seen as critical to enable Europe to compete effectively with the US, Japan and emerging economies such as China. In the area of R&D and innovation, the key target – originally agreed at the Barcelona summit in 2002 - is for expenditure on R&D to increase to 3 per cent of GDP by 2010 thereby closing the gap between Europe and other leading economies such as the US and Japan in this field.

Implementation of the Lisbon Strategy is based on a set of broad economic policy guidelines covering macroeconomic, microeconomic and employment aspects agreed at EU level. On the basis of these guidelines, each Member State draws up a National Reform Programme (NRP) setting out how it proposes to pursue the agreed policy guidelines. These programmes are then subject to a process of multi-lateral surveillance at EU level. Ireland's Reform Programme was submitted to the European Commission in October 2005. Under the innovation policy guidelines, the Reform Programme re-iterates the targets adopted in the earlier National R&D Action Plan, including that of an increase in Gross R&D expenditure to 2.5 per cent of GNP by 2013.[5] Subsequent progress reports on the implementation of the NRP were submitted to the Commission in October of 2006 and 2007. The recent report provides an update on innovation policy developments and performance with particular reference to the Strategy for Science, Technology and Innovation and the associated funding committed through the NDP 2007-2013.

[5] *Building Ireland's Knowledge Economy – The Irish Action Plan for Promoting Investment in R&D to 2010'* (July 2004

2.2.3 Strategy for Science, Technology & Innovation

The *Strategy for Science, Technology and Innovation 2006–2013* (SSTI) was launched in June 2006. It constitutes the Government's overall innovation policy framework and builds on the earlier *National R&D Action Plan 2004.* The Strategy is set in the context of addressing the challenges and opportunities arising from the Government's objective to develop the knowledge economy. In its own words, the Strategy "represents Ireland's first comprehensive strategic approach to developing STI on a whole of Government basis" (Page 13). The vision underpinning the Strategy is that "Ireland by 2013 will be internationally renowned for the excellence of its research, and will be at the forefront in generating and using knowledge for economic and social progress, within an innovation driven culture" (page 21). Two overarching objectives are set: firstly, the building of a sustainable world class research system across all disciplines and, secondly, the doubling of PhD output. The Strategy address the various aspects of the innovation policy agenda in an integrated manner including, *inter alia,* the commercialisation of research outputs, R&D in the enterprise sector and various public sector areas and the development of an interest in science in the primary and secondary levels of the education system. It also addressed issues around the implementation and coordination of the Strategy described at Section 2.4 below.

It is important to remember that SFI was established following the Forfás led Technology Foresight process in the late nineties and not the SSTI. However, the Foundation's original objective to raise research excellence in Ireland is fully consistent with SSTI, with SFI being the principal agency funding a large number of the new Principal Investigators required under the Strategy.

2.2.4 National Development Plan

The National Development Plan (NDP) 2007-2013 *Transforming Ireland* sets out the Government's public investment intentions for the period to 2013. The Enterprise, Science and Innovation Priority is one of 5 main investment priorities included in the plan with a total indicative investment allocation of €20 billion. One of the key objectives of this priority is to fully implement the SSTI in the period to 2013.

The priority includes 7 separate programmes including a specific Science, Technology and Innovation programme with projected funding of just over €6 billion. In turn, this programme comprises 8 sub-programmes, one of which – the World Class Research STI sub-programme – relates to the higher education sector. This sub-programme provides for continued investment in the Programme for Research in Third Level Institutions (PRTLI), SFI, the research councils and a number of other initiatives.

Specifically, the NDP sees SFI as "central to Ireland's goal of becoming a global knowledge-based economy". It envisages a continued focus by SFI in the areas of Biotechnology and Information and Communication Technologies and a continuation of the Research Professor Awards and CSET programmes. The NDP indicates that the next call for CSET proposals will also target the funding of one CSET on an all-island basis. It also refers to a new SFI-operated Strategic Research Clusters (SRC) initiative "which will create clusters of internationally competitive researchers from academia and industry, particularly Irish-based industry".

2.3 Overview of Related R&D Programmes

2.3.1 Introduction

This sub-section outlines the main other, non-SFI funded publicly-funded R&D programmes. The presentation here is based on the structure outlined in the NDP in respect of the Science, Technology and Innovation (STI) programme which was introduced above. In addition to the World Class Research STI sub-programme under which SFI is funded, the programme includes an additional 7 sectoral sub-programmes as follows:

- Enterprise STI;
- Agri-Food Research;
- Energy Research;
- Marine Research;
- Geoscience;
- Health Research;
- Environment Research.

We focus on those elements which are of most relevance to SFI activity. These are the remaining higher education R&D funding under the World Class Research STI sub-programme and the funding of in-company R&D under the Enterprise STI sub-programme. The remaining sub-programmes have a specific sectoral focus and are administered by the relevant public sector agency (e.g., the Marine Institute in the case of the Marine Research Sub-Programme and the Environmental Protection Agency in the case of the Environment Research Sub-Programme).

2.3.2 HEA and Research Councils

In addition to SFI activity, the Programme for Research in Third Level Institutions (PRTLI), administered by the Higher Education Authority, and the three research councils, the Irish Research Council for the Humanities and Social Sciences, the Irish Research Council for Science, Engineering and Technology and the Irish Energy Research Council are supported under the NDP World Class Research STI sub-programme.

The PRTLI was launched by the HEA in 1998. The stated objectives[6] of the programme are as follows:

- To enable a strategic and planned approach by third-level institutions to the long-term development of their research capabilities, consistent with their existing and developing research strengths and capabilities.
- To promote the development of high quality research capabilities in third-level institutions, thus enhancing the quality and relevance of graduate output and skills.
- To provide support for outstandingly talented individual researchers and teams within institutions and the encouragement of co-operation between researchers both within the institutions and between institutions having particular regard to the desirability of encouraging inter-institutional co-operation within the two parts of the binary system and within Ireland, the EU and internationally.

[6] As outlined on the HEA website, www.hea.ie/prtli

PRTLI awards are evaluated by a panel of international researchers and scholars and are judged under a number of categories including strategic planning and focus, inter-institutional collaboration, research quality and the impact of research on teaching and learning. The current allocations have supported circa 850 researchers, 550 post-graduate researchers and 300 post-doctoral researchers.

As indicated in the NDP, the PRTLI is the critical mechanism in providing the core physical infrastructure through which overall delivery of the SSTI will be delivered. In terms of human capital contributions, the NDP envisages that the main contributions of the PRTLI will be as follows:

- Funding the early stage flow into the pipeline of postgraduate students and early stage researchers;
- Funding graduate education initiatives and "enhanced quality postgraduate training";
- Encouraging interaction between the research environment and education and training at both postgraduate and undergraduate levels; and
- Collaboration between higher education institutions.

As regards the research councils, the NDP indicates that these will aim to stimulate internationally recognisable excellence by "providing interlinked research supports for both early stage researchers and small research teams". The key output from the research councils will be postgraduate students and trained researchers including post doctorates. The NDP states that the Councils' activities will complement the PRTLI and that they will work with the HEA to maximize synergies between their respective activities.

2.3.3 Enterprise STI Sub-Programme

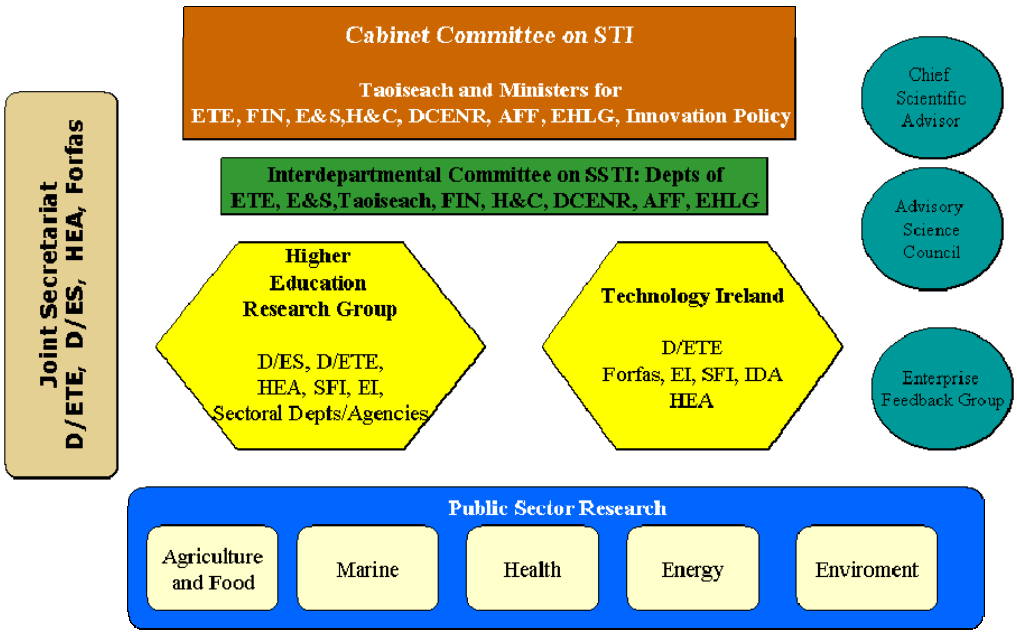
The NDP provides for funding of €1.3 billion under this sub-programme for promoting the development and use of STI in Irish-based enterprises. The sub-programme, which is mainly delivered by Enterprise Ireland, has three main elements:

- *Transforming R&D Activity in Enterprise*: here the main aims are to get more firms to undertake R&D and to increase the quantum and quality of research undertaken by existing R&D performers. These objectives will be pursued through implementation of the long-standing R&D Capability and Competitive schemes. For smaller companies, two schemes will be implemented – a *Knowledge Acquisition Grants Scheme* and an *Innovation Vouchers Scheme.* The Plan indicates an intention to develop a more holistic and systematic approach to company support stating that "The goal of promoting in company R&D will be best achieved by a simple, coherent scheme that can be accessed by firms at all stages of development".
- *Industry/Higher Education Institutes (HEI) Collaboration*: the Plan indicates a lead role for Enterprise Ireland (EI) to promote such collaborations through programmes such as the *Innovation Partnership Scheme* and the *Industry-led Networks*. Under this element, EI will also support the establishment and development of applied research centres in the Institutes of Technology.
- *Realising the Commercial Potential of Ireland's Research Community*: the overall aim of this element is to ensure that publicly funded research is taken forward to the product development and production stages. To this end, a number of interventions are to be supported by Enterprise Ireland including a Commercialisation Fund, an Intellectual Property Fund and the construction and development of campus-based business incubation centres at the Institutes of Technology and universities. In addition, and of more particular relevance to SFI activity, EI is to support each third level institution in developing its own Technology Transfer Office.

2.4 Coordination Arrangements

A number of institutional arrangements have been put in place by Government in an effort to monitor and coordinate the wide range of R&D interventions summarised above. The implementation structures supporting these arrangements are described in the figure below.

Figure 2.5: SSTI Implementation Structures



Source: Strategy for Science, Technology and Innovation 2006–2013

At the apex of these arrangements is the Cabinet Sub Committee (CSC) on Science, Technology and Innovation. Under the CSC, the Interdepartmental Committee (IDC) on STI, chaired by the Department of Enterprise, Trade and Employment (with the Department of Education and Science acting as Deputy Chair), has overall responsibility for driving and monitoring the implementation of the SSTI and the supporting NDP interventions and reporting to the CSC. In turn, three sub-committees report to the IDC. These are the Higher Education Research Group, Technology Ireland and, more recently, an ad hoc Health Research Group has been established.

SFI is represented on Technology Ireland (TI) which is responsible for enterprise R&D activity. TI is chaired by the Assistant Secretary in the Office of Science and Technology/Department of Enterprise, Trade and Employment and its particular focus is to ensure coherence between the enterprise development agencies and to drive a co-ordinated approach to addressing enterprise-related objectives set out in the SSTI. It is also participates in the work of the Higher Education Research Group (HERG) which has responsibility for ensuring coherence between the PRTLI, SFI-funded programmes and other relevant funding streams. The SSTI notes that the HERG "will have a particular responsibility for ensuring a good fit between infrastructural investments in the institutions and research and postgraduate education programmes". The HERG is chaired by the Department of Education and Science with the Department of Enterprise, Trade and Employment acting as Deputy Chair.

An issue that arises in the context of the wider research development framework in Ireland is whether there is effective coordination between funding agencies. The HEA and SFI - among a number of other agencies – are actively involved in funding research activity in the university sector. Notwithstanding the varying remit of these agencies, while the NDP and SSTI delineate a high-level division of labour between funding agencies, there are inevitable challenges in the ongoing co-ordination of planning and programme/funding activities. This may be most apparent at the level of beneficiary institutions which interact with these agencies on a day-to-day basis. Outside the formal arrangements under SSTI/NDP, the degree of 'on-the-ground' co-operation and information sharing is an important issue and is considered in more detail in Section 5.

2.5 Summary and Implications

The section commenced the review by considering aspects of the wider context in which the SFI programmes operate, with a focus on issues regarding the policy consistency and validity of SFI activities and their coherence and linkages with other publicly-funded R&D interventions. The following points from this assessment are highlighted:

- The analysis suggests that the types of advanced research programmes operated by SFI are consistent with the Government's overall innovation policy objectives as enunciated in the SSTI. Through the NDP, the Government has committed substantial resources to the implementation of the SSTI over the period 2007-2013. The Government's policy approach and commitment of resources is also consistent with EU level policy under the Lisbon agenda process.
- Historically, Ireland exhibited clear under-performance in relation to R&D funding and activity relative to its European and international counterparts. Since the late-1990s, however, a radical transformation has taken place in the research funding landscape and there have been substantial increases in R&D expenditures – not only in the public and education sector but also, encouragingly, in the business sector. SFI, along with HEA (via the PRTLI), has played an important role in this turn-around. Notwithstanding these very positive achievements, Ireland remains in catch-up mode relative to its EU counterparts. However. State expenditures on R&D, equivalent to 1.6% of GNP in 2006, remain below the EU average of 1.8%, highlighting the importance of further progress if Ireland is to maximise its international position in the research field.
- An issue that arises in the context of the wider research development framework in Ireland is whether there is effective coordination between funding agencies. The HEA and SFI - among a number of other agencies – are actively involved in funding research activity in the university sector. Notwithstanding the varying remit of these agencies, while the NDP and SSTI delineate a high-level division of labour between funding agencies, there are inevitable challenges in the ongoing co-ordination of planning and programme/funding activities. This may be most apparent at the level of beneficiary institutions which interact with these agencies on a day-to-day basis. Outside the formal arrangements under SSTI/NDP, the degree of 'on-the-ground' co-operation and information sharing is an important issue.

3 Review of Funding Activities and Human Capital Development

3.1 Introduction

This section focuses on the analysis and review of both the extent and nature of funding committed by SFI across its research programmes, and the immediate implications of this funding in terms of SFI's contribution to supporting research staff and human capital development.

3.2 Review of SFI Research Funding

To enable the rigorous assessment of value for money related to SFI's research programmes, it is necessary to relate the outputs and impacts of these programmes to the extent and mix of funding provided. We begin this section by examining SFI's funding commitments over the period since the commencement of its activities in 2001.

3.2.1 Analysis of funding commitments

Overall Funding Commitments

Table 3-1 overleaf presents a summary of annual grant funding committed by SFI each year over the period 2001-2006. In total over this period €681.2 million of research grant funding has been committed by the agency. The large scale of commitments is comparable to that rolled out under Cycles 1-3 of the Programme for Research in Third Level Institutions (PRTLI), which amounted to €605 million over the period 2000-2006[7].

[7] Higher Education Authority, 2007, see: http://www.hea.ie/index.cfm/page/sub/id/543

Table 3-1: Overall SFI Research Programme Funding Committed – 2001-2006 – € Million

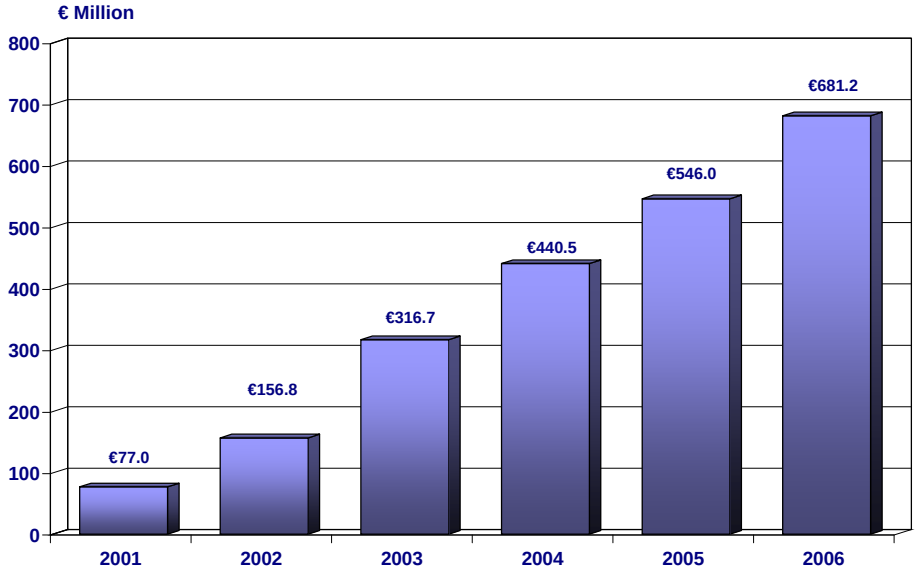
	2001	2002	2003	2004	2005	2006	Total
Overall Funding Committed	77.0	79.7	160.0	123.7	105.6	135.2	681.2

Source: Indecon analysis of SFI data

Figure 3.1 provides a graphical depiction of the annual level of funding commitments by SFI between 2001 and 2006. The figure highlights the rapid build-up of funding over what has been a short time period.

It is also noteworthy that over the period 2001-2006 SFI funding allocated was equivalent to 18.6% of total Government Budget Appropriations or Outlays on R&D (GBAORD).[8]

Figure 3.1: Overall SFI Research Programme Funding Committed – Annual Cumulative Total since 2001 - € Million

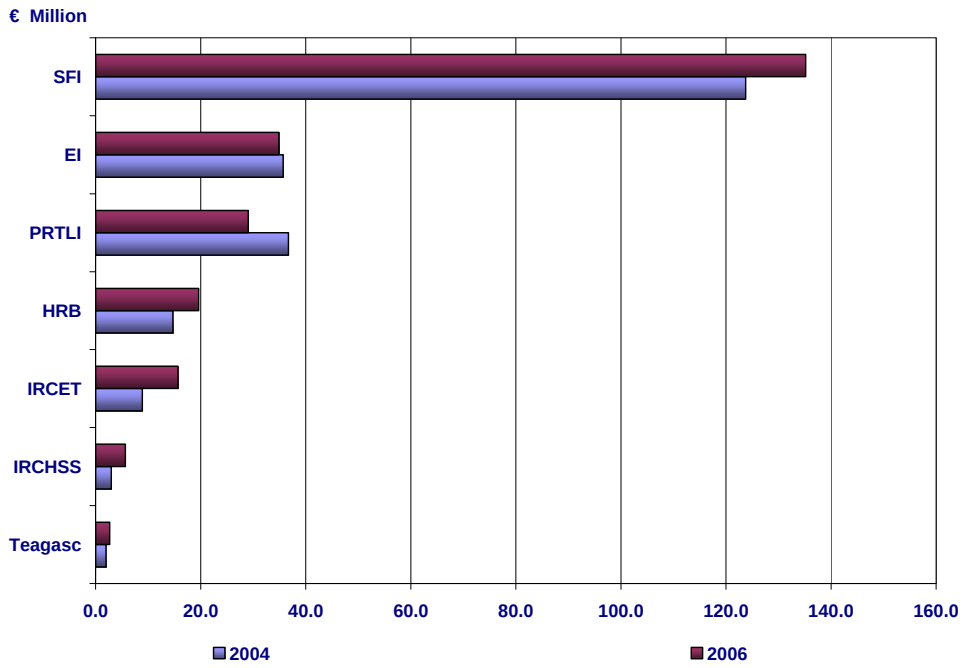


Source: Indecon analysis of SFI data

[8] See Forfás, http://www.forfas.ie/publications/forfas_annrpt06/stats/knowledge.html.

Figure 3.2 provides further evidence of the comparative scale of funding nationally by reference to the extent of funding allocated by SFI and other public research funding bodies in the higher education sector in Ireland. Based on data for 2004 and 2006, it is notable that the level of funding committed provided by SFI has been substantially ahead of that allocated by other Irish research funding bodies, indicating the importance of the agency within the context of public research funding in the higher education sector in Ireland.

Figure 3.2: Comparative Analysis of Higher Education Sector Funded Research by State Sponsored Bodies in Ireland – 2004 & 2006 - € Million



Source: Forfás Higher Education R&D Survey 2004 & 2006

Funding Commitments by Directorate

It is also instructive to consider the scale and pattern of research funding committed by SFI within each of the agency's directorates. Table 3-2 displays the breakdown of SFI grants committed within the Biotechnology (BIO), Information and Communications Technology (ICT), and Frontiers Engineering and Science (FES) directorates over the period 2001 to 2006.

Table 3-2: Breakdown of SFI Grants Committed by Directorate – 2001 – 2006 - €'000

Directorate	2001	2002	2003	2004	2005	2006	Total
BIO	19,309	33,464	81,360	34,835	36,570	45,414	250,952
% of Total	*25%*	*42%*	*51%*	*28%*	*35%*	*34%*	*37%*
ICT	57,711	46,191	77,946	59,709	36,169	48,162	325,888
% of Total	*75%*	*58%*	*49%*	*48%*	*34%*	*36%*	*48%*
FES and Other*	0	80	660	29,195	32,826	41,578	104,339
% of Total	*0%*	*0%*	*0%*	*24%*	*31%*	*31%*	*15%*
Total SFI Funding	**77,020**	**79,735**	**159,966**	**123,739**	**105,565**	**135,154**	**681,179**

Source: Indecon analysis of SFI data
* Other refers to Conferences and Workshops, the Annual Overheads Investment Plan, E-journals, China/Ireland etc.

The figures above indicate that a total of €251 million in funding was committed to projects within the Biotechnology directorate between 2001 and 2006, while funding allocated within the Information and Communications Technology directorate amounted to €325.9 million. Funding committed within the Frontiers Engineering and Science directorate and other awards came to €104 million over the same period. The variation in the scale of funding allocated between the ICT and BIO sectors is noteworthy and is likely to reflect a combination of timing and variations in the volume and characteristics of research project funding applications between the sectors.

Within each of SFI's directorates, funding is awarded across a range of programmes and disciplines. Table 3-3 outlines the total funding commitments between 2001 and 2006 by research focus area within the ICT sector. The largest funding allocations have been evident in the case of the Nanotechnology and Software Engineering & Artificial Intelligence areas, accounting for 18.1% and 16.2% of total ICT directorate commitments over this period. Other sectors that have accounted for 10% or more of total commitments include IC Research and Semiconductors.

Table 3-3 Total ICT Commitments by Research Focus Area – 2001–2006 - €'000

Sub Directorate	**Funding Commitments €'000**	*% of Total ICT Commitments*
Nanotechnology	59,118	*18.1*
Software Engineering & Artificial Intelligence	52,882	*16.2*
IC Research / Semiconductors	37,466	*11.5*
Transmission Systems	32,090	*9.8*
Photonics	29,588	*9.1*
Networking & Communications System	24,536	*7.5*
Advanced Manufacturing	22,414	*6.9*
Computer Modelling & Visualisation Systems	22,204	*6.8*
Knowledge & Web Base Systems	19,975	*6.1*
Storage	13,726	*4.2*
Information Systems	8,755	*2.7*
Language Technologies	3,134	*1.0*
Total ICT Directorate	**325,888**	***100***

Source: Indecon analysis of SFI data

The equivalent analysis for the BIO sector is presented in Table 3-4 overleaf and indicates that the largest component of funding allocated over the period 2001-2006 within this directorate was the Molecular and Cell Biology area, which accounted for 30% of overall commitments in the directorate over this period. Other growing areas of research within the biotechnology field include Sensors and Devices (13.6% of funding allocated), Bioinformatics/Systems Biology (12.4%). In addition, the Agri-food, Immunology and Neuroscience fields were each allocated in the region of 11% of total BIO directorate commitments between 2001 and 2006.

It should be noted that the pattern of funding that has emerged, in terms of the fields of research supported by SFI since its establishment in 2001, reflect the demand for funding arising from the growth of different research fields and demand for funding, evident through the project proposals submitted to SFI, which may vary significantly on an annual basis as researchers and research teams explore new areas and avenues.

Table 3-4 Total BIO Commitments by Research Focus Area – 2001–2006 - €'000

Sub Directorate	**Commitments €'000**	***% of Total BIO Commitments***
Molecular & Cell Biology	75,283	*30.0*
Sensors/Devices	34,036	*13.6*
Bioinformatics/Systems Biology	31,176	*12.4*
Agri-food	28,787	*11.5*
Immunology	28,688	*11.4*
Neuroscience	28,382	*11.3*
Pharmaceutical Chemistry	12,484	*5.0*
Microbiology	10,915	*4.3*
Other	1,201	*0.5*
Total BIO Directorate	**250,952**	***100***

Source: Indecon analysis of SFI data

Funding Commitments by Programme Area

It is important to also examine the pattern of research funding committed by SFI across the agency's different funding programmes.

SFI has, since its establishment, operated a wide range of different research funding programme and supports, and the main programmes were described in Section 1 of this report. The vast majority of funding programmes are cross-sectoral in nature, funding research projects in the ICT and BIO areas.

Table 3-5 overleaf presents a breakdown of the overall extent of funding committed by SFI across 17 different programmes and supports over the period 2001-2006. The figures demonstrate that the main programmes, in terms of the scale of funding committed to-date, have been the Investigators/Principle Investigators programme, the Centre for Sciences, Engineering and Technology (CSETs), the Research Frontiers programme and the Research Professorship programme. A more detailed description of each of SFI's main funding programmes and associated funding is presented in the subsequent analysis.

Table 3-5: SFI Funding Committed by Programme/Support – 2001-2006 – €'000

Programme	Total Funding Committed -2001-2006 - €'000	*% of Total*
Investigators/Principal Investigators*	326,610	*47.9%*
CSETs	137,695	*20.2%*
Research Frontiers*	70,982	*10.4%*
Research Professor/Research Professor Recruitment award*	39,275	*5.8%*
Centres [1]	28,908	*4.2%*
President of Ireland Young Researchers (PIYRA)*	13,405	*2.0%*
Research Fellows	13,123	*1.9%*
Annual Overheads Investment Plan**	10,869	*1.6%*
Maths Initiative	10,150	*1.5%*
E-Journals	9,000	*1.3%*
ETS Walton	5,837	*0.9%*
Principle Investigators Careers Advancement (PICA)	5,288	*0.8%*
UREKA*	5,030	*0.7%*
Conferences and Workshops	1,859	*0.3%*
STAR Supplement	1,548	*0.2%*
WISER (excl. PICA)	820	*0.1%*
China/Ireland	700	*0.1%*
Other	80	*0.0%*
All Programmes and Supports	**681,179**	***100%***

Source: Indecon analysis of SFI data

[1] Centres refer to the Tyndall Institute (Cork) and the Irish Centre for High-End Computing (ICHEC) (NUI Galway)

*Including related supplements

** Note: The Annual Overheads Investment Plan (AOIP) commenced in 2005. Previously overhead-related supports were counted as part of individual funding programmes, primarily the Investigators/Principal Investigators programme.

Annual profile of funding

It is instructive to consider the annual profile of funding commitments channelled through SFI's programmes. We focus in this instance on the major funding programmes, namely the Investigator/Principal Investigator Programme and the CSETs. Table 3-6 overleaf describes the level of funding committed by SFI through its Investigator/Principal Investigator Programme over the period 2001-2006.

Table 3-6: SFI Funding Committed – Investigator/Principle Investigator Programme Funding – 2001-2006 - €'000

Programme	2001	2002	2003	2004	2005	2006	Total
Investigators/Principal Investigators*	77,020	63,878	69,833	38,160	21,368	56,351	326,610
% of Annual Total SFI Funding	*100%*	*80.1%*	*43.7%*	*30.8%*	*20.2%*	*41.7%*	*47.9%*

Source: Indecon analysis of SFI data
* Including related supplements

The PI programme targets the fields of science and engineering that are the basis for the ICT and BIO sectors and is designed to support researchers with excellent reputations that are well established in their fields. The individual grants that are awarded range from €50,000 to €1,000,000 per annum for direct cost support for up to five years. This award, which was the first programme operated by SFI after its establishment, accounted for the largest proportion of funding commitments since the commencement of SFI, amounting to a total of €326.6 million or 47.9% of total funding allocated between 2001 and 2006. The programme continues to operate on a rolling, open call basis.

As noted previously, the second largest component of SFI funding relates to the Centres for Science, Engineering, and Technology (CSETs) Campus-Industry Partnership mechanism.

The CSET mechanism links both scientists and engineers in partnerships that cross between academia and industry and deal with crucial research questions. The CSETs also aim to help to develop new and existing Irish-based technology companies, attract industry which could contribute to Ireland's economic capacities and output and also to increase educational and career opportunities in science and engineering in Ireland. Over the period 2001-2006, the mechanism has funded the following research groups:

- CRANN and CTVR at Trinity College Dublin
- BDI group at Dublin City University
- REMEDI and DERI groups at NUI Galway
- APC group and Tyndall Institute at UCC
- LERO group at University of Limerick.

The annual breakdown of funding committed through the CSET mechanism is described in the table below. A total of €137.7 million in funding was committed by SFI to CSET projects over the period 2001 to 2006, which is equivalent to 20.2% of total SFI funding over the period.

Table 3-7: SFI Funding Committed – CSET Mechanism - 2001-2006 - €'000

Programme	2001	2002	2003	2004	2005	2006	Total
CSETs	0	997	76,055	23,522	30,155	6,966	137,695
% of Annual Total SFI Funding	*0.0%*	*1.3%*	*47.5%*	*19.0%*	*28.6%*	*5.2%*	*20.2%*

Source: Indecon analysis of SFI data

The allocation of funding through the CSET mechanism is seen by SFI as crucial to the development of an integrated research network that helps contribute to the overall knowledge economy. In order to achieve this strategic objective the CSETs must provide active collaboration; demonstrate flexibility in responding to new research opportunities and exhibit outstanding research quality.

In the remainder of this report we evaluate the extent and quality of research personnel funded through the CSET and PI programmes, their activities and outputs, and the emerging impacts of their research.

Other programmes and supports

In addition to the Investigators/Principal Investigators programme and the CSET mechanism, SFI has also operated a range of other research funding supports. The annual funding commitments under these programmes and supports are described in the table overleaf and discussed in the subsequent paragraphs.

Table 3-8: SFI Funding Committed – Other Programmes* -2001 – 2006 (€ '000)

Programme	2001	2002	2003	2004	2005	2006	Total
Research Frontiers	-			19,014	24,468	27,500	70,982
Research Professor/Research Professor Recruitment award*	-	-	12,670	16,673	4,385	5,547	39,275
Centres [1]				9,752	8,225	10,931	28,908
President of Ireland Young Researchers (PIYRA)	-	-	-	4,760	4,916	3,729	13,405
Research Fellows	-	13,123	-	-	-	-	13,123
AOIP	-	-	-	173	7,616	3,080	10,869
Maths Initiative	-	-	-	-	-	10,150	10,150
E-Journals	-	-	-	9,000	-	-	9,000
ETS Walton*	-	1,657	748	1,111	890	1,431	5,837
Principal Investigators Career Advancement Award (PICA)	-	-	-	-	-	5,288	5,288
UREKA	-	-	-	302	2,174	2,554	5,030
Conferences and Workshops	-	-	410	697	530	222	1,859
STAR Supplement	-	-	-	325	750	473	1,548
WISER (excl.PICA)	-	-	-	-	88	732	820
China	-	-	250	250	-	200	700
Other	-	80	-	-	-	-	80
Total	**-**	**14,860**	**14,078**	**62,057**	**54,042**	**71,837**	**216,874**
% of Annual SFI Funding	*-*	*19%*	*9%*	*50%*	*51%*	*53%*	*32%*

Source: Indecon analysis of SFI data
Note: [1] Centres refer to the Tyndall Institute (Cork) and ICHEC (NUI Galway).

Over the 3-year period between 2004 and 2006, a total of almost €71 million in funding was committed on the *Research Frontiers* programme (RFP), equivalent to 10% of overall SFI funding commitments since 2001. The programme, which was taken over by SFI from the previous Basic Research grants scheme run by Enterprise Ireland, was designed to support high quality, novel exploratory research in the third level sector and covers the subject areas of Science, Mathematics and Engineering, impacting diverse fields and developing educational benefits that enhance and further national scientific progress.

The *Research Professor/Research Professor Recruitment Award* aims to attract to Ireland outstanding researchers, with particularly distinguished international reputations. Up to €500,000 per annum for a two year period is the scale of the grant allocation under this programme. The table on the previous page describes the extent of funding committed on this programme between 2001 and 2006. In total, SFI channelled €39.3 million through this programme, representing 5.8% of overall SFI funding over this period.

The *President of Ireland Young Researchers Award* (PIYRA) programme accounted for €13.4 million over the period 2004-2006 (2% of total SFI funding). This is one of SFI's prestigious awards for young researchers and is targeted at outstanding engineers and scientists who have already demonstrated the potential for leadership at the frontiers of knowledge. The programme offers young researchers from all over the world the chance to conduct their research in Irish third level institutions.

While the *Research Fellows* Programme only received funding in 2002, the amount committed was reasonably substantial, at €13 million or 2% of total SFI funding over the period 2001-2006.

The *Maths Initiative* committed funding in 2006. These awards amounted to €10.1m. This programme is aimed at encouraging mathematical research that has a potential impact on enterprise, science, engineering, and mathematical education.

The *ETS Walton* programme offers funding to leading international scientists who wish to undertake research in Ireland for up to 12 months. The programme has a number of aims including the strengthening of connections to and collaborations with the international research community and enhancing Irelands reputation and culture as a home of first class research. Total funding commitments amounting to €5.8 million have been awarded by SFI since 2002 to researchers in receipt of ETS Walton awards, representing 1% of total SFI funding.

The *Principal Investigators Career Advancement Award* (PICA) programme supports female researchers at all levels to follow research careers. It specifically recognises the different needs of individuals who have interrupted their careers for maternity, adoptive, carers or parental leave. Its main objectives are to increase the participation rate of women taking part in international, competitive research, to improve the working environment for and adapt to the needs of individuals in research arenas, to increase Ireland's participation in internationally competitive research and stimulate further investment in first rate individual researchers. The programme was open to both male and female researchers' with funding available of up to €200,000 per annum for up to three years. The PICA programme received total commitments of €5.2m during 2006, its first year of operation.

The *Undergraduate Research Experience and Knowledge Award* (UREKA) supports participation by undergraduate students in any of the research areas funded by SFI. It aims to develop the active research skills of students and stimulate their interest in science and engineering by providing them the opportunity to conduct research activities in an excellent environment. The programme is designed to attract highly motivated and capable undergraduates which will form a potential pool of future PhD students. This programme was allocated a total of €5m over the period 2004-2006; the programme was not funded for the years 2001 through 2003.

The *Annual Overhead Investment Plan (AOIP) is* a programme offered by SFI which contributes to the indirect costs incurred by research bodies associated with hosting SFI-funded research programmes. The purpose of these funds is to facilitate Irish research bodies in planning strategically for the overall development of research support services and infrastructure for the benefit of researchers. These funds are targeted to help the supported bodies develop their research capacity and support systems.

The programmes funding commitments are outlined in Table 3-8 (page 37). Funding was committed in 2004, 2005, and 2006 and amounted to €10.86m in total.

The *Secondary Teachers Assistant Researchers Award (STAR)* programme aims to engage teachers interests in science as researchers, to develop connections between second and third level education institutions and to disseminate new skills and knowledge which can be passed on to pupils. Operational since 2004, €1.5 million in funding has been committed to this programme to-date.

The *Research Professor Recruitment award* (previously known as the Research Professor award) is aimed at research bodies which are engaged in pro-active recruitment processes for Professorial Chairs (or similar research leadership positions) in SFI's strategic research areas. The award contributes funding of up to €0.5 million per annum for up to two years to successful host research institutions to support the start-up costs of researchers that these institutions plan to recruit. Since 2003, SFI committed a total of €38.1 million in funding to this programme, equivalent to 6% of total funding commitments over this period. The programme also continues to operate on a rolling open call basis. This programme became operational in 2006 receiving €1.2m in funding that year.

The objective of boosting the representation of women in research is supported directly or indirectly through a number of SFI's programmes, one of which is the *Women in Science and Engineering Research (WISER)* programme. The objective of these programmes is for SFI to encourage and participate in the development of sustainable mechanisms and practices which will ensure that women have an equal opportunity to compete on the basis of their scientific expertise, knowledge and potential. Awards totalling €820,000, excluding the PICA programme, have been made since 2005 under the collective WISER banner.

The *China-Ireland Research Collaboration Fund* provides for exchanges of leading researchers at third level institutions in Ireland and China working in the fields underpinning BIO and ICT. This award has committed €700,000 over the period concerned.

3.2.2 Researcher funding sources

An issue in relation to the assessment of value for money of SFI's funding of research activities in Ireland concerns the extent to which funding from SFI figures in the overall mix of funding generated by researchers and research groups. A related issue concerns the extent to which success in accessing SFI funding, through providing a positive signalling effect, increases the opportunity for researchers to leverage funding from other public and private research funding organisations.

In relation to the overall mix of funding accessed by researchers and research groups, Indecon's survey of funded researchers asked respondents to specify the breakdown of their current funding accessed from SFI versus other Irish and international sources, and the equivalent breakdown of funding prior to researchers' receipt of SFI funding.

A definitive assessment of the impact of SFI funding and the movements in different research funding sources relative to overall researchers funding would necessitate a detailed analysis over the last decade or so of the absolute levels of funding by source, including Irish, EU and other international sources, and industry funding for research. While this data was not available to the consultancy team during the course of this review, it is useful to consider the movements in the proportionate mix of funding accessed by researchers before and after the receipt of SFI funding.

Indecon's survey research requested researchers to indicate the proportionate breakdown of their funding across seven categories, namely SFI funding, other Irish funding, EU Framework Programme (FP) funding, other EU funding, other international funding, industry funding and other funding.

Table 3-9 below outlines the results. These figures relate to proportionate and not absolute funding, and should be interpreted within the context of the increase in overall research funding that has taken place over the period under review. Before SFI funding came on-stream, on average, 48% of respondents budgets were funded by other Irish funding sources, 23% by direct European Union sources, 14% by International sources, 10% by other EU sources, 2% by industry and 3% from other sources.

Table 3-9: Source of Funding for SFI Funded Researchers Before and After SFI

	Other Irish	EU FP	Other EU	Other International	Industry	Other*	SFI	Total
Prior to SFI Funding - Average %	48%	23%	10%	14%	2%	3%	-	100%
After SFI Funding – Average %	21%	7%	0.05%	6%	2%	0.2%	63%	100%
Difference (Percentage Points)	*-27*	*-16*	*-10*	*-8*	*0*	*-3*	-	-

Source: Indecon Analysis of Survey data

The post-SFI landscape has changed and Indecon's research indicates that SFI funding now accounts for on average 63% of the researchers' current budgets. This realignment of funding sources towards SFI has resulted in a *proportionate* decline in funding from other Irish funding sources from 48% to 21% of research budgets, reflecting the impact of SFI funding.

The impact of SFI funding can also be seen by reference to other funding sources and it is also notable that the relative proportion of funding accessed from European Union sources and other international sources has also decreased proportionately. Industry funding among SFI researchers has remained constant as a proportion of overall research budgets.

In relation to funding from EU sources, the primary source of research funding is the EU Framework Programme (FP). The overall and sectoral pattern of EU FP funding received by Ireland across the FP4-FP6 programmes (i.e. over the period 1994-2006) is described in the table below.

Table 3-10: EU Framework Programme Funding - Sectoral Breakdown Funding Allocated to Irish Participants - € Million

Sector	FP4 (1/01/94-21/12/98)	FP5 (1/01/98-31/12/02)	FP6 (17/12/02-29/12/06)
Higher Education	€90.6	€86.2	€127.9
Private Industry (Irish Owned)	€50.1	€22.2	€26.7
Private Industry (Foreign Owned)	€7.5	€3.2	€9.6
Commercial Semi State	€5.6	€3.0	€0.7
State Research / Developmental Institutes	€19.2	€8.2	€14.6
Other	€17.5	€11.7	€13.4
Total	**€190.5**	**€134.5**	**€192.9**

Source: Forfás

The figures above indicate that FP funding allocated to the Irish higher education sector fell from €90.6 million under FP4 to €86.2 million under FP5 before rising to €127.9 million under FP6. While these figures are subject to final confirmation, they indicate that the overall absolute level of FP funding increased substantially over the 2002-2006 period and the proportionate movement in funding implied by the figures presented from Indecon's survey of researchers should be interpreted within this context. The figures include all FP funding receipts, including funding accessed by SFI-funded researchers and other applicants, and do not therefore provide a conclusive picture in relation to the impact of SFI funding on the proportionate breakdown of funding accessed by SFI-funded researchers.

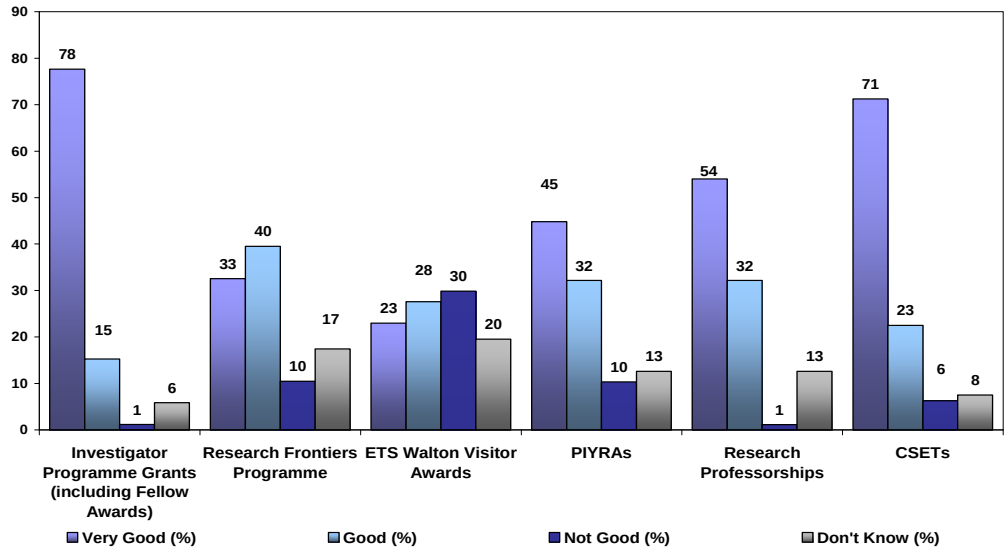
Notwithstanding the above observations, while we believe it is too early at this juncture to reach definitive conclusions regarding the progression of the mix of funding accessed by SFI-supported researchers, this is an issue that requires ongoing monitoring going forward. It is also the case that the initial ramp-up of SFI funding in the early days of its operation would be expected to result in an initial rapid increase in the proportion of research budgets accounted for by SFI funding and that the proportion of funding accessed through other sources may experience an initial decline as new funding comes on-stream.

Of importance, however, is the need to maximise the overall value for money of public funds devoted to research activities in the State. Apart from short-term movements, over the medium- to longer-term, as research projects achieve financial sustainability, a more balanced funding mix should prevail, which would be characterised by a reduced dependency on any one source of funding. This highlights the need to ensure that researchers maximise the leverage opportunities offered through the positive signalling and other benefits deriving from SFI support.

3.2.3 Views of researchers

As Figure 3.3 overleaf reveals the vast majority of surveyed researchers within their respective programmes perceived SFI's funding mechanisms to be either 'very good' or 'good'. These positive views register as considerably impressive in the case of the PI type programmes and CSETs in particular. The programme which funded researchers considered least favourable was the ETS Walton Visitor award.

Figure 3.3: Views of Funded Researchers - Perceived Merits of SFI Funding Mechanisms

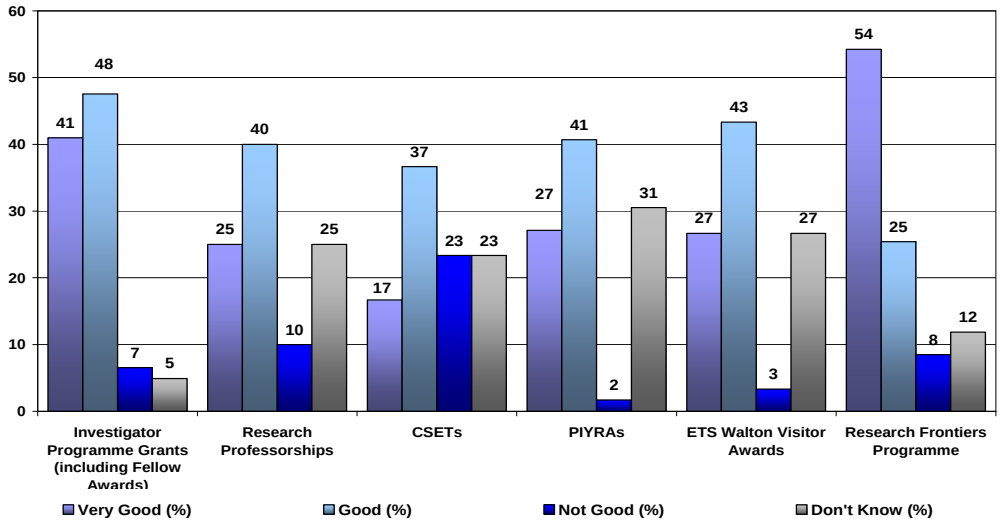


Source: Indecon Survey of SFI-funded Researchers

Number of respondents = 88

Of note in Figure 3.4 overleaf, which tracks the views held by respondents who were unsuccessful in attracting SFI funding, is that even those researchers who did not succeed in accessing funding through SFI still perceived the merits of the various programmes in a substantially positive light. This applies in particular to both the Research Frontiers and PI programmes. On average, across all programmes upwards of 75% applicants in some cases perceived the merits of these programmes as either very good or good.

Figure 3.4: Views of Unsuccessful Applicants - Perceived Merits of SFI Funding Mechanisms



Source: Indecon Survey of Unsuccessful Applicants for SFI funding

Number of respondents = 67

3.2.4 Views of industry

It is also instructive to complement the above analysis by considering the views of industry on the effectiveness of SFI funding programmes. As part of this review, a survey was undertaken among industry located in Ireland. This included multi-national firms with a presence in Ireland and Irish-based firms who are formal partners on SFI-funded programmes or who have engaged with SFI-funded researchers and research teams. With the objective of assessing wider awareness issues, responses received to the survey also included Irish-based firms who have had no direct involvement with SFI programmes.

Table 3-11 overleaf summarises the findings from Indecon's survey research with leading companies and SFI industry partners. It is notable that a majority of companies are of the view that SFI's Investigator/Principal Investigator programme, its CSET mechanism and the Research Professor programme are either 'very effective' or 'effective' in terms of their impacts. A more mixed picture emerges in relation to firms' views on other programmes such as PIYRA, ETS Walton and Research Frontiers.

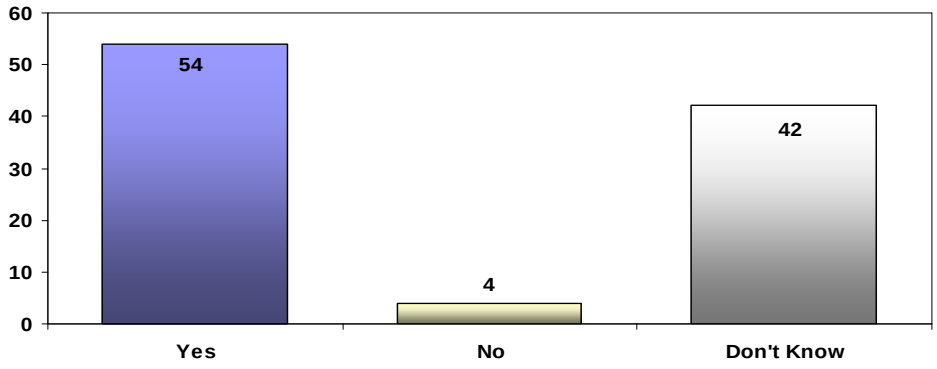
Table 3-11: Perceived Effectiveness of SFI Funding Mechanisms (%), Views of Industry

	Very Effective (%)	Effective (%)	Neither Effective Nor Ineffective (%)	Ineffective (%)	Very Ineffective (%)	Total (%)
Investigator Programme Grants (including Fellow Awards)	13	63	13	13	0	100
Research Professorships	25	38	25	13	0	100
Centres for Science, Engineering and Technology (CSETs)	55	27	9	9	0	100
President of Ireland Young Researchers Awards (PIYRAs)	0	43	43	14	0	100
ETS Walton Visitor Awards	0	44	44	11	0	100
Research Frontiers Programme	17	0	67	17	0	100

Source: Indecon Survey of Leading Companies and Industry Partners
* Based on responses from 27 firms

Figure 3.5 overleaf describes the views of leading companies and industry partners in Ireland on whether firms believe that substantive improvements in relevant research have come about as a result of SFI. The vast majority of surveyed leading companies and industry partners are of the view that improvements in their respective field of research has come about as a consequence of SFI funding and or influence.

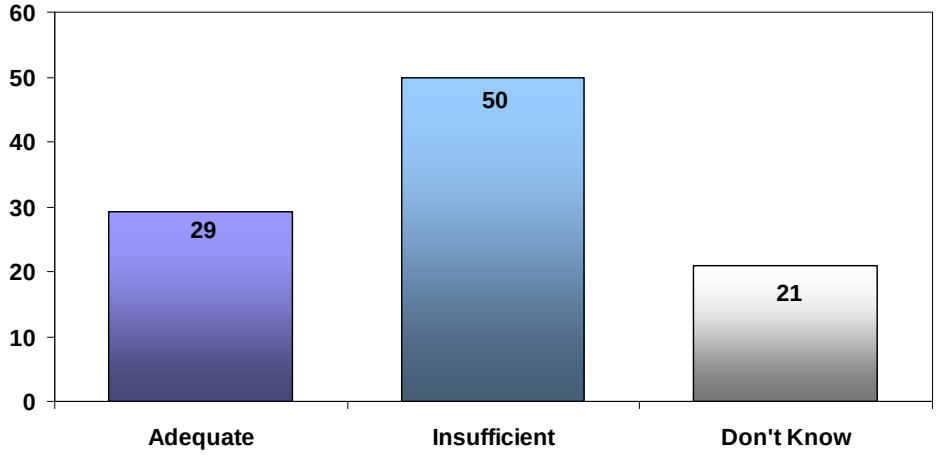
Figure 3.5: View of Industry as to whether Substantive Improvements in Relevant Research have Come About as a Result of SFI Funding/Influence



Source: Indecon Survey of Leading Companies and Industry Partners

However despite this perceived positive overall influence, only 29% of those surveyed were of the view that adequate funding is allotted to applied research at present, with half of those asked stating that they believed funding levels in this area were insufficient at present (see figure below).

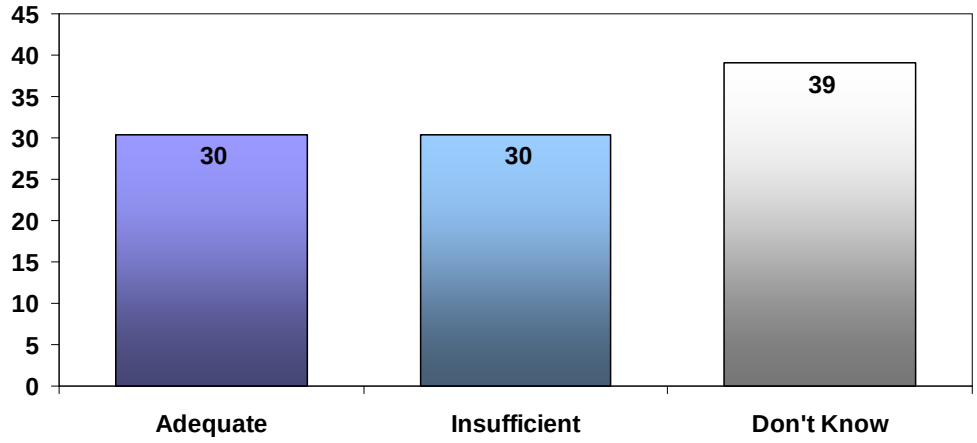
Figure 3.6: Views of Industry on Adequacy of Funding allocated to Applied Research



Source: Indecon Survey of Leading Companies and Industry Partners

Surveyed leading companies and industry partners displayed considerably more uncertainty with regard to the sufficiency of funding allocated to basic/fundamental research, with 39% of respondents unsure as to whether funding was sufficient or not and only 30% stating they believed current levels to be sufficient (see figure below).

Figure 3.7: View of Industry on Adequacy of Funding allocated to Basic/Fundamental Research,



Source: Indecon Survey of Leading Companies and Industry Partners

3.3 Contribution to Human Capital Development

A key issue concerns the extent to which research funding channelled through SFI is contributing towards the development of the human capital base in research in Ireland. In this section we assess the immediate outputs of SFI research funding in relation to the number and type of research personnel supported through SFI's programmes.

3.3.1 Number of Research Personnel

Table 3-12 below describes the number of senior research staff/group leader awards funded through SFI's programmes. These figures correspond broadly with the number of senior-most researchers funded by SFI. While there is considerable variation on an annual basis, the number of group leader awards funded reached an initial peak of 70 in 2003 before falling back to 39 in 2005. The annual number of group leader awards made increased again in 2006 to 75. In cumulative terms (and not adjusting for terminations and renewals), SFI funded a total of 307 awards at group leader level by 2006.

Table 3-12: Annual Number of Group Leader Awards Funded by SFI – 2001-2006

Researcher Category	2001	2002	2003	2004	2005	2006
Annual No. of Group Leader awards funded by SFI*	11	64	70	48	39	75
Cumulative No. of Group Leader awards funded by SFI*	11	75	145	193	232	307

Source: Indecon analysis of SFI Data

* It should be noted that the figures presented above differ in terms of definition from the targets set out in the Government's SSTI insofar as they relate to the actual annual number of BIO and ICT sector senior researcher/group leader *awards* and do not adjust for annual terminations and renewals. Furthermore, the above figures *include* ETS Walton awards (not counted for the purposes of the SSTI targets but specified in the terms of reference for this review) but *exclude* 2 awards during 2006 made under the Maths Initiative (included in the SSTI definitions).

Group leaders would typically lead teams of more junior researchers, including post docs and PhD students. The number of post doctoral researchers employed in research teams funded through SFI programmes is described in the table below. The number of post-docs employed has increased considerably over time with the figure reaching 490 in 2006.

Table 3-13: Number of Post-Docs Employed in Research Teams Funded by SFI – 2001-2006

Researcher Category	2001	2002	2003	2004	2005	2006
No. of Post-Docs as at year-end	0	41	117	341	434	490

Source: Indecon analysis of SFI Data

The number of PhD students employed as part of SFI-funded research teams is shown in the table below. PhD numbers have risen even more dramatically over the course of 2001-2006 with a total of 530 students in receipt of funding and working with SFI teams in 2006.

Table 3-14: Number of PhD Students Employed in Research Teams Funded by SFI – 2001-2006

Researcher Category	2001	2002	2003	2004	2005	2006
Number PhD Students	0	24	120	301	506	530

Source: Indecon analysis of SFI Data

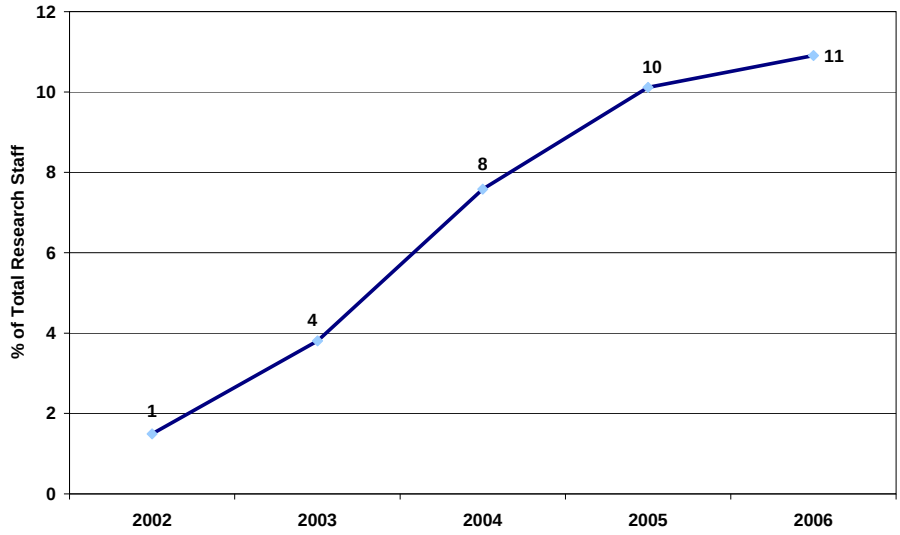
A disaggregated breakdown of research staff, including group leaders, post docs and PhD students, within the ICT, BIO and FES directorates is provided in Annex 3.

3.3.2 SFI-funded Research Staff in a National Context

Of importance in relation to the overall contribution of SFI to the generation of human capital in research is the scale of the above figures on staffing funded/supported in terms of national developments in this area. We consider this issue below.

Firstly, we consider the total number of research staff supported by SFI as a percentage of the total number of research staff supported in the business, public and higher education sectors in Ireland. SFI's share of this indicator has increased over the period 2002 – 2006 from 1% to 11%. Figure 3.8 outlines this trend.

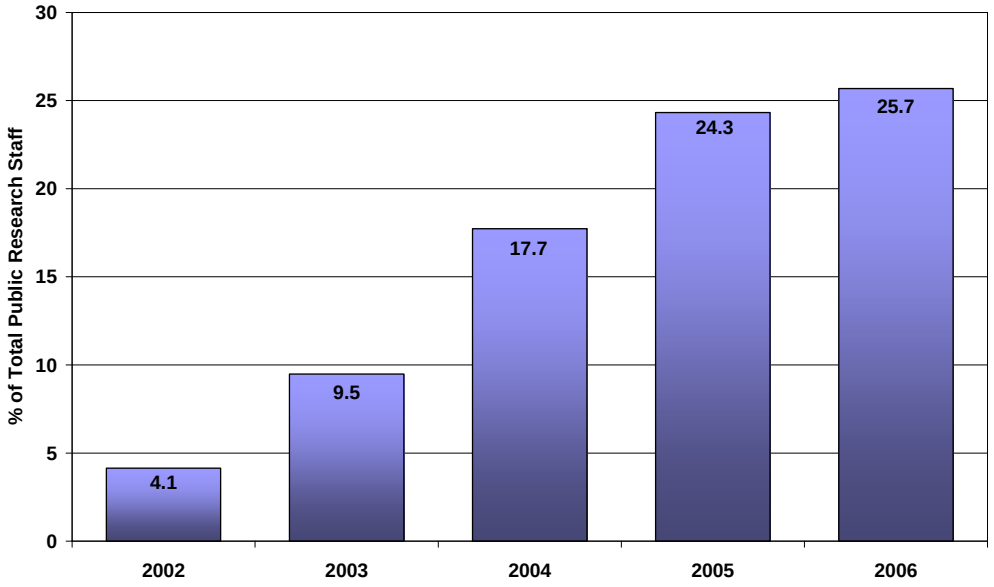
Figure 3.8: SFI Research Staff Supported as a % of Research Staff Supported in Ireland - 2002 – 2006*



Source: Indecon Analysis of SFI and Forfás data
SFI research staff includes group leaders, post-doc researchers and PhD students as per preceding tables.

Figure 3.9 below outlines the total number of SFI research staff supported as a percentage of the total number of research staff supported across the public sector as a whole. The trend below has risen steadily over the period and the number of SFI supported researchers is now equivalent to almost 26% of the total number of supported researchers in the public sector. This is evidence of the scale of SFI supports and the number of individuals that avail of funding through the Foundation.

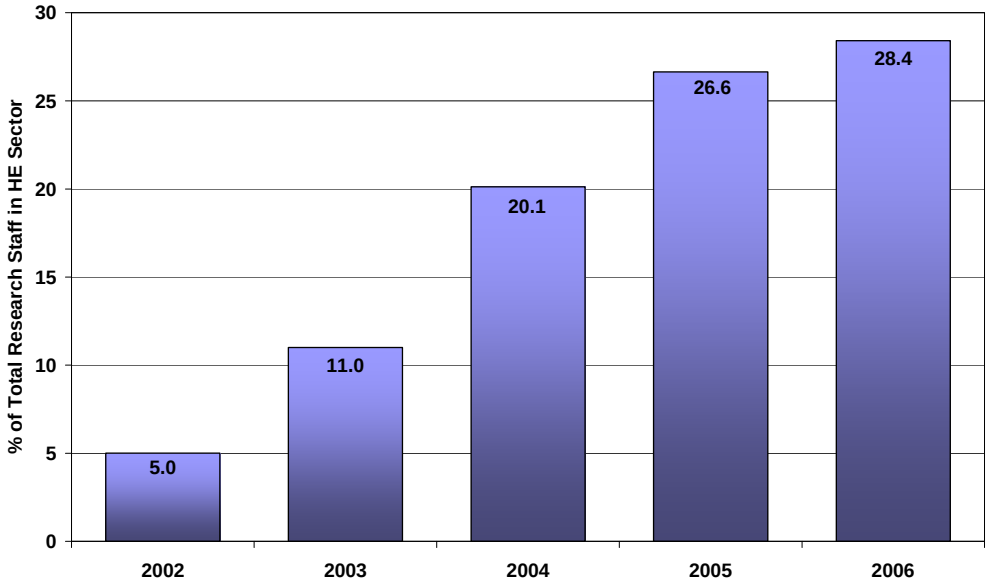
Figure 3.9: SFI Research Staff Supported as a % of Total Public Research Staff – 2002 - 2006



Source: Indecon Analysis of SFI and Forfás data

A similar but more marked position is evident if the number of supported research staff in SFI is outlined as a percentage of only the number of research staff in the higher education sector is reviewed. The results are presented in Figure 3.10 overleaf, indicating that by 2006 SFI-funded research staff accounted for over 28% of research staff in the higher education sector.

Figure 3.10: SFI Research Staff Supported as a % of Research Staff in Higher Education Sector - 2002 - 2006



Source: Indecon Analysis of SFI and Forfás data

The analysis above highlights the importance of SFI in terms of its contribution to the development of research staff and their expanding role within the higher education and wider publicly funded and overall research sectors in Ireland. While positive, these developments must also be viewed within the context of the 'ramp-up' phase of SFI's operations and, in particular, the need, going forward, to maintain progress commensurate with the achievement of targets set out in the government's Strategy for Science, Technology and Innovation. We revisit this important issue in Section 5 when we assess the effectiveness and impact of SFI funding.

3.3.3 Origin of SFI-funded Researchers

One of the aims of SFI is to encourage world class research in the fields of biotechnology and ICT. It is thus of importance to establish the extent to which the programme has succeeded in attracting leading researchers from overseas and from within indigenous Irish research community.

Table 3-15 below provides an indication of the numbers and proportion of overseas researchers which have come to Ireland to take up SFI funding. According to the figures, the number of awards made by SFI to overseas-origin PI-level researchers ranged between 5 in 2001 and a peak of 19 in 2003. Two features of this data are noteworthy. Firstly, the number of awards made to non-Irish national researchers who came to Ireland from overseas – 69 in total between 2001 and 2006 – was equivalent to over 79% of the overall number of awards made to researchers who came to Ireland from overseas. Second, the number of awards made to researchers who came to Ireland from overseas equated to 28% of the overall number of group leader awards over this period. The analysis indicates that although the primary group of funded researchers have been Irish-based, SFI has been successful in attracting overseas researchers – including non-Irish researchers – to Ireland.

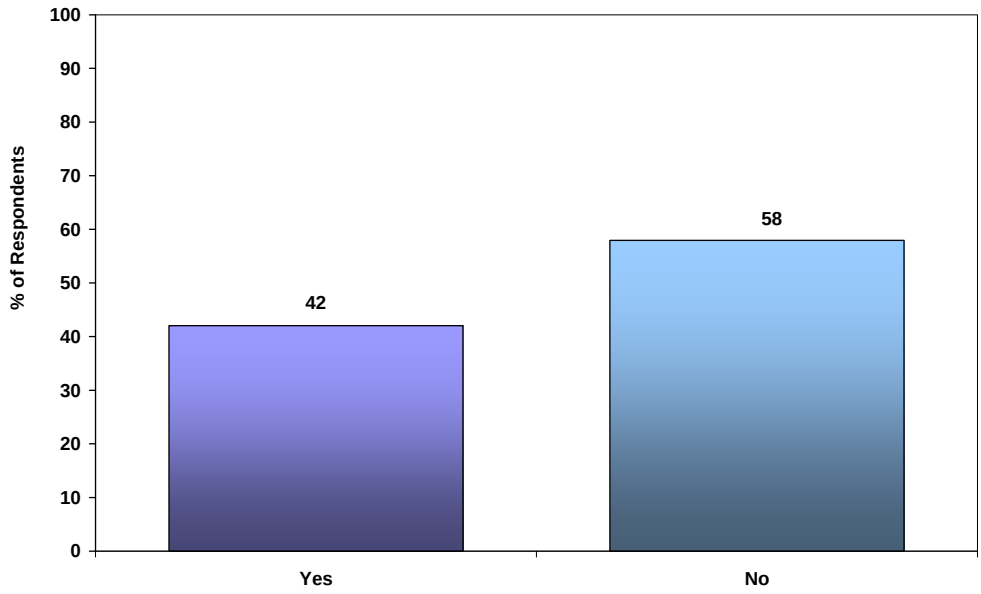
Table 3-15: Annual Number of SFI-funded Awards to PI-level Researchers by Origin of Researcher

	2001	2002	2003	2004	2005	2006
Awards to Overseas Irish National	2	3	6	1	3	3
Awards to Overseas Non-Irish National	3	15	13	14	10	14
Total awards to Overseas-origin Researchers	**5**	**18**	**19**	**15**	**13**	**17**
Total awards to Irish-based Researchers	**6**	**46**	**51**	**33**	**26**	**58**
Annual Total No. of Group Leader Awards	**11**	**64**	**70**	**48**	**39**	**75**
Overseas-origin as % Total	***45%***	***28%***	***27%***	***31%***	***33%***	***23%***

Source: Indecon analysis of SFI data

An alternative perspective on the extent to which SFI has succeeded in bringing non-Irish researchers to Ireland can be had by considering the evidence from Indecon's survey of SFI-funded researchers. Figure 3.11 below summarises findings from the Indecon survey in relation to whether researchers moved to Ireland specifically to take up their current position following award of funding. The survey research indicates that a substantial proportion of researchers – 42% - indicated that they moved to Ireland following award of SFI funding. As one of the major objectives of SFI is to attract world class researchers, this is an achievement of the programme.

Figure 3.11 Views of Funded Researchers-Whether SFI Researchers Moved to Ireland Specifically to Take up Current Position



Source: Indecon Analysis of Survey of SFI Funded Researchers

N=88

A very high proportion (42%) of researchers moved to Ireland specifically to take up their current SFI-funded position. As one of the objectives of SFI is to encourage world class researchers to use Ireland as a base to conduct their activities, this finding is positive, but a challenge for the programmes is to ensure that a significant percentage of these researchers remain in Ireland.

3.4 Summary of Key Findings

This section analysed and reviewed both the extent and nature of funding committed by SFI across its research programmes, and the immediate implications of this funding in terms of SFI's contribution to supporting research staff and human capital development. The key findings are as follows:

Funding commitments and funding mix

- Between 2001 and 2006, SFI has committed €681.2m in funding across 17 research programmes and supports. The scale and rapid build-up of funding over what has been a short time period can be seen by reference to other research funding programmes, notably the PRTLI, which provided €605 million over Cycles 1-3 between 1999 and 2006, and the fact that SFI funding was equivalent to 18.6% of total Government Budget Appropriations or Outlays on R&D (GBAORD) over the period 2001-2006.
- 37% of SFI funding has been allocated through its Biotechnology (BIO) Directorate, while 48% and 15% respectively has been committed through the Information and Communications Technology (ICT) and Frontiers Engineering and Science (FES) Directorates.
- In terms of research programmes, the largest proportion of funding between 2001 and 2006 (€326.6 million or 47.9%) has been allocated through the Investigator/Principal Investigator programme, while a further €137.7 million or 20.2% of funding commitments have been directed towards the CSETs (Centres for Sciences, Engineering and Technology). The balance of funding commitments, €216.9 million or 32% is spread across a number of other programmes, which include the Research Frontiers programme (€71 million) and the Research Professor/Research Professor Recruitment award (€39.3 million).

- SFI has become the main source of funding for researchers funded by its programmes and, on average, SFI funding now accounts for of the order of 63% of current funding among these researchers. While EU FP funding, for example, has increased in absolute terms, the evident realignment of funding sources towards SFI over the period under review has reduced the importance of other Irish funding sources, which have declined in proportionate terms. We believe it is too early at this juncture to deliver a definitive conclusion on the progression of the funding mix accessed by SFI-supported researchers. However, it will be important, going forward, to maximise the overall value for money of public funds devoted to research activities in the State. Apart from short-term movements, over the medium- to longer-term, as research projects achieve financial sustainability, a more balanced funding mix should prevail, which would be characterised by a reduced dependency on any one source of funding. This highlights the need to ensure that researchers maximise the leverage opportunities offered through the positive signalling and other benefits deriving from SFI support.

Human capital contribution

- A key issue concerns the extent to which research funding channelled through SFI is contributing towards the development of the human capital base in research in Ireland. In cumulative terms (and not adjusting for terminations and renewals), SFI funded a total of 307 awards at group leader level by 2006. In addition, the number of post-docs employed reached 490 in 2006. SFI has also played an important role in relation to the development of PhD graduates and PhD numbers have risen even more dramatically over the course of 2001-2006, with a total of 530 students in receipt of funding and working with SFI teams in 2006.
- The scale of SFI's contribution is also evident by reference to national developments in this area. By 2006 SFI-funded research staff accounted for 28% of research staff in the higher education sector and 26% of overall public sector research staff, highlighting the contribution of SFI to human capital development in Ireland.

- Although the primary group of funded researchers have been Irish-based, SFI has been successful in attracting overseas researchers to Ireland and the number of awards made by the Foundation to researchers who came to Ireland from overseas equated to 28% of the overall number of group leader awards made between 2001 and 2006.
- While clearly very positive, the developments in relation to human capital development supported by SFI must also be viewed within the context of the 'ramp-up' phase of the Foundation's operations. Going forward, it will be important to maintain progress commensurate with the achievement of targets set out in the government's SSTI.

4 Evaluation of Programme Outputs

4.1 Introduction

This section reviews in detail the extent and range of outputs which have come about as a result of SFI funding. It investigates in turn the extent and types of research output produced and the nature of collaborative activity engaged in by SFI-funded researchers, and then finally examines the emerging commercialisation activities and outputs engaged in by SFI-funded researchers.

4.2 Review of Research Outputs

In assessing the impact of SFI funding, it is important to note that in the case of the majority of research groups, funding derives from a range of sources, including SFI, other agency and industry related funding. The net result of this is that it is difficult to isolate the specific impact of SFI funding from that of other funding sources. However, the timing of changes in research activity, outputs and quality can provide evidence of presence or otherwise of 'structural shifts' which may coincide with the commencement of SFI funding.

A detailed assessment of research outputs and the quality of these outputs is presented as part of the assessment of the quality of research in Section 5. In this section we present a range of headline metrics pertaining to the nature of research outputs produced by SFI-funded researchers and research groups. These include:

- Outputs of journal-based peer review articles published by SFI-funded researchers
- Outputs in relation to international conference presentations or papers delivered by SFI-funded researchers.

4.2.1 Presentations Conducted and Publications

The table below highlights the evolution of the annual overall number of journal-based peer reviewed articles published by researchers between 2002 and 2006. The number of articles published in internationally recognised journals increased from 453 in 2003 to 1,308 in 2004, an impressive rise of 189%. The figure then decreased slightly in 2005 to 1,252 rising again to a series peak of 1,318 in 2006. These statistics provide evidence of rapid acceleration evident in journal article outputs, between 2003 and 2004 in particular, across all sectors of funded researchers. This must be seen, however, within the context of the start-up phase of SFI. It is natural that there would be a large increase in output in the early stage of the project, as the initial investment levels would structurally shift output levels. A disaggregated breakdown across the ICT and BIO directorates is provided in Annex 3.

Table 4-1: Number of Articles Published in Journals by SFI-funded Researchers

	2002	2003	2004	2005	2006
Total Journal Articles Published	135	453	1,308	1,252	1,318

Source: Indecon analysis of SFI data.

Table 4-2 outlines the number of conference based presentations in both the ICT and BIO sectors from 2002-2006. The total number of presentations delivered by SFI-funded researchers has increased year on year across the period 2002-2006; the number of presentations was 79 in 2002, 407 in 2003, 1,318 in 2004, 1,554 in 2005 and a considerable 1,720 in 2006. These figures represent a rise of over 2,000% over the period examined.

Table 4-2: Number of International Presentations given by SFI-funded Researchers

	2002	2003	2004	2005	2006
Total Presentations given	79	407	1,318	1,554	1,720

Source: Indecon analysis of SFI data.

To provide a relative analysis of these outputs, the ratio of research articles to SFI-funded group leaders is presented in the table below. The average output of journal-based publications of research leaders accelerated sharply between 2002 and 2005, reflecting the 'ramp-up' phase of SFI's programmes, before declining in 2006.

Table 4-3: Ratio of Journal-based Research Articles published to Number of Research Group Leaders*

	2002	2003	2004	2005	2006
Total articles published/number of researchers	2.4	7.2	30.4	35.8	19.4

Source: Indecon analysis of SFI data.
** Note: These publications refer to those in refereed journals only.*

Table 4-4 below outlines the ratio of international conference presentations to the number of SFI-funded research group leaders across the 2002-2006 period. Over the period 2002-2006, the ratio of international conference presentations conducted to supported research group leaders increased considerably from an average of 1.4 per group leader per annum to an average of 25.3 per group leader per annum.

Table 4-4: Ratio of International Conference Presentations to Number of SFI-funded Research Group Leaders

	2002	2003	2004	2005	2006
Total conference presentations/number of researchers	1.4	6.5	30.7	44.4	25.3

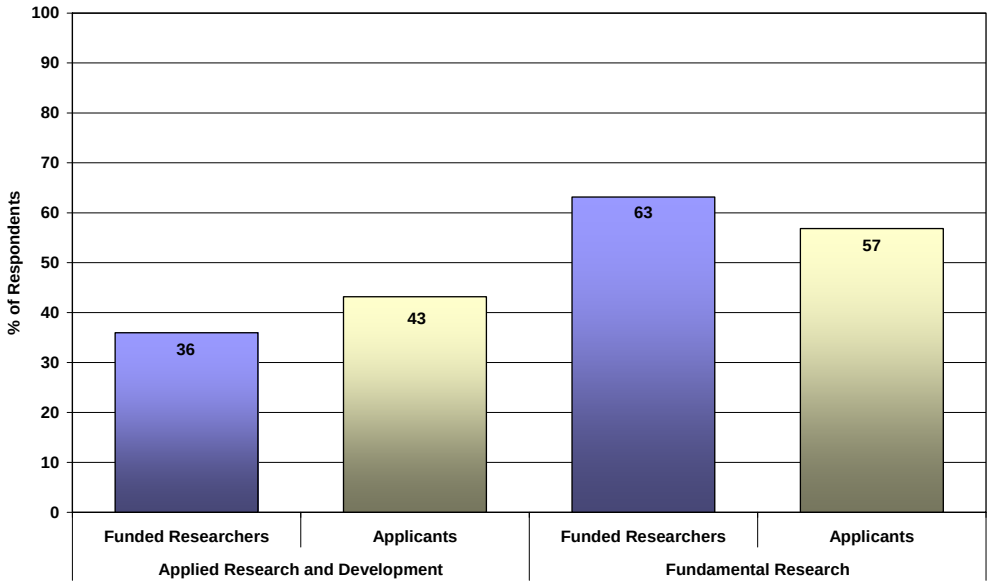
Source: Indecon analysis of SFI data.

While the above ration analysis suggests a decline in researcher productivity in 2006, we would caution against an over-reliance/emphasis on one year of data, which is likely to reflect lags in publication rates relative to researcher numbers in any given year. Of importance is the longer term trend in this (and similar output variables) and further ongoing examination of this important aspect would be required in the future as new information comes to light before a definitive assessment of research productivity levels can be made. The productivity of SFI researchers is examined further as part of the assessment of research performance and quality in Section 5.

4.2.2 Views of researchers and industry on focus of SFI

Of importance within the context of SFI's activities concerns the appropriateness of its focus on basic/fundamental research as opposed to applied research. The figure below describes the views of researchers on the important issue of whether SFI should continue to support applied research or fundamental/basic research. Researchers - both those successfully funded by SFI and unsuccessful applicants – are of the view that SFI ought optimally to support fundamental/basic research over applied research.

Figure 4.1 Views of Researchers on Whether SFI should Continue to Support either Applied Research or Fundamental Research?



Source: Indecon Survey of SFI Funded Researchers and Unsuccessful Applicants for SFI funding

4.3 Review of Collaboration Activity

Supporting the development of wide-ranging and deep collaborative linkages is an objective of SFI and other major research funding programmes (e.g. PRTLI). Collaboration may take various forms and involve different levels of linkages, including those between researchers/research groups and academic partners, and between researchers/groups and industry partners. Moreover, collaborations may take place nationally and/or internationally.

In the case of some SFI programmes (e.g. CSETs), evidence of strong industry and academic collaborative linkages is a prerequisite to receipt of SFI funding.

Academic collaborations

The Table below highlights the levels of collaborative activity engaged in by SFI researchers indicating whether the collaboration was with another Irish or an international academic institution.

Table 4-5: Number of Academic Institution Collaborations by SFI-funded Researchers

	2002	2003	2004	2005	2006
No. of Collaborations with Irish Academic Institutions	9	40	164	177	196
No. of Collaborations with Overseas Academic Institutions	21	125	362	449	467

Source: Indecon analysis of SFI data

These figures point to very significant numbers of academic collaborations, while the number of linkages has increased continuously year-on-year from 2002-2006, both in terms of collaborations with Irish-based institutions and linkages with institutions overseas. It is notable that activity has been weighted more in favour of international linkages. This may be due to the greater scope provided from international academic markets in the areas of focus of SFI research, although Irish-based linkages have begun to develop at a faster pace more recently.

Industry collaborations

The table below highlights the cumulative annual number of industry-based interactions involving SFI-funded researchers over the period 2002-2006, identifying the breakdown between interactions involving indigenous Irish firms, interactions located in Ireland involving multi-national firms with Irish bases, interactions overseas involving multi-national firms with Irish bases, and interactions with other firms located overseas.

Table 4-6: Number of Collaborative Interactions with Industry among SFI Researchers and Research Groups

Nature of Collaborative Interactions with Industry	**Cumulative Number of Interactions**					
	2002	**2003**	**2004**	**2005**	**2006**	***2006 - % of Total***
Interactions with **indigenous Irish firms**	3	24	46	50	73	*27.7*
Interactions **in Ireland** with Multi-national companies with Irish bases	1	17	60	65	73	*27.7*
Interactions **overseas** with Multi-national companies with Irish bases	0	6	12	36	29	*11.0*
Interactions with other firms **located overseas**	3	14	68	80	89	*33.7*
Total No. of Interactions in Ireland	4	41	106	115	146	-
% of total	*57.1*	*67.2*	*57.0*	*49.8*	*55.3*	-
Total No. of Interactions Overseas	3	20	80	116	118	-
% of total	*42.9*	*32.8*	*43.0*	*50.2*	*44.7*	-
Total Industry Interactions	**7**	**61**	**186**	**231**	**264**	***264***

Source: Indecon analysis of SFI data

These figures, which pertain to all interactions in which SFI researchers are participating (including interactions as part of other funding programmes), indicate that by 2006, the cumulative number of interactions with industry involving SFI researchers reached 264. Of this total, 146 interactions (55.3%) in total involved interactions in Ireland with indigenous Irish firms and foreign-owned firms with bases in Ireland, while 118 interactions (44.7%) were with firms located overseas.

While information in relation to the scale of firms involved was not available to the review team, of importance is the extent of interaction between SFI researchers/research groups and indigenous Irish firms. The overall number of such interactions has increased. However, although we are supportive of international linkages with industry, our analysis raises concerns over the comparative extent to which SFI-funded research has to-date engaged successfully with Irish-based, indigenous firms and further progress in this area is required if SFI researcher is to generate significant economic spin-offs involving Irish-based, indigenous industry. We also believe changes are required in relation to the nature of strategic information collated by SFI to clarification not only in relation to the number of interactions with industry but also the number of companies involved.

4.3.1 Views of industry on collaboration activities

The analysis presented above focuses on the extent of collaborative linkages that have emerged through SFI funded researchers/research groups. However, of importance is not only the extent of linkages, but in particular, the quality of these linkages in terms of their depth and the nature of the interaction involved. The views outlined below represent those expressed within the Indecon Survey of Leading Companies and Industry Partners, in which respondents were asked to rank the importance they attached to a number of SFI objectives. Of those surveyed, a total of 76.5% stated they felt the promotion of partnerships was either 'most important' or 'important'.

Table 4-7: Views of Industry on the Importance of SFI objectives

	Most Important (%)	Important (%)	Least Important (%)	Total (%)
Develop Human Capital	47.1	35.3	17.6	100.0
Support Strong Ideas	17.6	23.5	58.8	100.0
Promote Partnerships	35.3	41.2	23.5	100.0

Source: Source: Indecon Survey of Leading Companies and Industry Partners

4.4 Review of Commercialisation Activities

The extent to which SFI-funded research contributes to the development of significant economic spin-offs through commercialisation of research outputs, constitutes an important objective of the SFI funded initiatives. SFI programmes have been focused to-date on supporting basic research in the ICT and BIO areas. However, as research progresses, an important medium-to longer-term goal is to generate significant Intellectual Property (IP) which has the potential to be translated into commercially viable spin-off activities.

It is important to note, however, that lags between basic research activities and research outputs which are translational into IP may be significant, while these lags may also differ between sectors and disciplines. The recent establishment of SFI programmes may mean that significant IP is only beginning to emerge. Notwithstanding these lags, areas of SFI-funded research may generate positive wider economic spin-off activities at an earlier stage including, *inter alia*, through the attraction of commercial and inward investment among multinational corporations (discussed in further detail later in this section).

It should be noted the level of activity – in terms of patents granted - is influenced by the lags inherent in the process of applying for patents. We understand that typical patent application procedures may take between 3-6 years, depending on the nature and complexity of the case involved; an average in Ireland of approximately 4 years is typical.

The table below describes the annual numbers of patent applications *filed* by SFI-funded researchers/research groups in the ICT and BIO sectors.

Table 4-8: Extent of Commercialisation Activity by SFI-funded Researchers – Numbers of Patents Filed

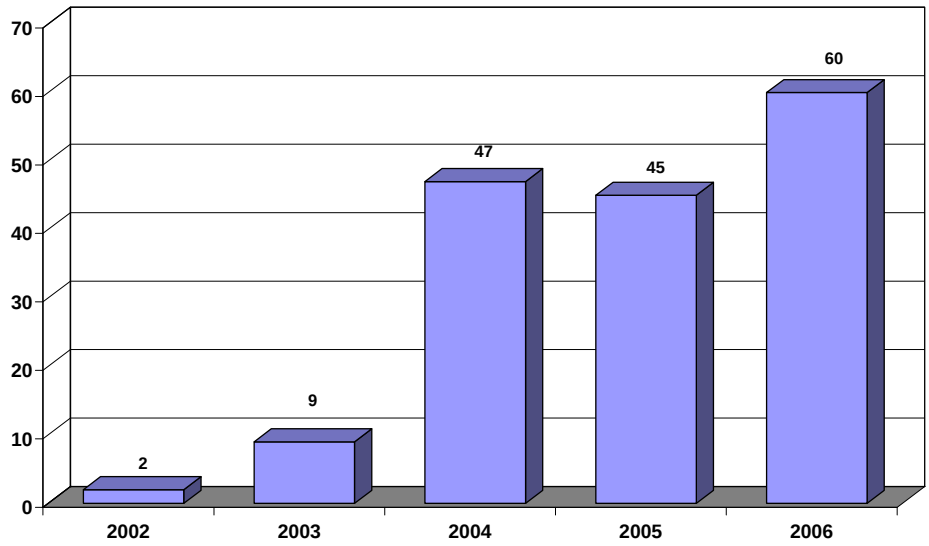
Commercialisation Activity	2002	2003	2004	2005	2006
Number of Patents Filed –					
ICT Sector	1	4	11	12	35
BIO Sector	1	5	36	33	25
Total	2	9	47	45	60

Source: Indecon analysis of SFI Data

This indicates that the level of patent application activity has accelerated since 2004. Overall, across both the ICT and BIO sectors, a total of 60 patent applications were filed by SFI-funded researchers and research groups during 2006. This compares with 45 applications during 2005 and 47 during 2004. The faster rate of patent activity in the BIO sector than in the ICT area is likely to partly reflect the fact that many ICT outputs may not be patentable while other ICT outputs may not be patented for strategic reasons.

The figure below highlights the annual movement in overall (ICT plus BIO sector) patent applications filed by SFI funded researchers and research teams over the period 2002-2006. Though further evidence will be required going forward in relation to both the nature of patent activity among SFI researchers (including whether patents are single patent office, triadic etc.) and whether more recent applications result in successful outcomes, the figures suggest that significant commercialisation activity is emerging in terms of patent applications.

Figure 4.2: Commercialisation Activity - Annual Movement in Numbers of Patents Filed by SFI-funded Researchers/Research Groups



Source: Indecon analysis of SFI data

4.4.1 Views of Researchers and Industry

It is useful to complement the previous analysis by considering the inputs of SFI-funded researchers and also industry partners and leading companies operating in Ireland on the area of commercialisation of research.

In relation to the issue of time lags between funding and the anticipated commercialisation impacts of research outputs, while actual time lags vary by field and discipline, it is instructive to consider the typical commercialisation lags experienced by researchers. The Indecon survey findings summarised below indicate that the most significant commercialisation outputs from research are rarely evident until a 5-10 year period, on average, has elapsed. Time lags differ between the ICT and BIO areas, with a greater proportion of researchers (28%) in the ICT sector indicating that commercial impacts may emerge within a 5-year timeframe than is the case in the BIO sector (9%), which is line with normal expectations in each area.

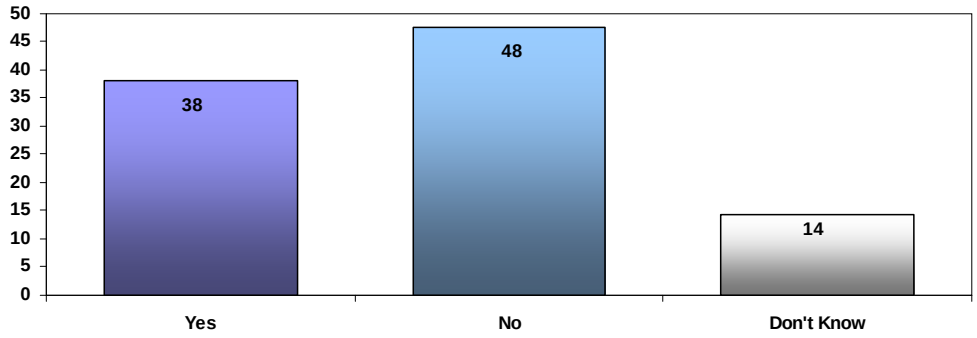
Table 4-9: Anticipated Time Frame over which Commercial Impact from Research is Expected – Views of Funded Researchers

Time Period	*% of Total Responses by Sector*	
	ICT	***BIO***
< 5 Years	*28%*	*9%*
5 - 10 Years	*48%*	*74%*
10+ Years	*24%*	*18%*
Total Responses	*100%*	*100%*

Source: Indecon Survey of SFI Funded Researchers

It is also instructive to consider the views of companies in relation to the work of SFI and how this has impacted on company strategy. Of industry partners and leading companies surveyed by Indecon, it is notable that a significant proportion (38%) stated that SFI has had a significant impact on their company's own research strategy or investment portfolio.

Figure 4.3 Views of Industry: Whether Company's Research Strategy or Investments have Changed as a Result of the Work of SFI



Source: Indecon Survey of Leading Companies and Industry Partners
* Based on responses from 27 firms

4.5 Summary of Key Findings

Within the context of the level of SFI-funding committed to date, in this section we examined extent and range of outputs which have come about as a result of SFI funding, including in relation to research outputs produced, the nature of collaborative activity and the emerging commercialisation activities and outputs engaged in by SFI-funded researchers. In interpreting the findings from the assessment, it is important to highlight the short time period since the establishment of SFI and the fact that research teams and associated research outputs did not begin to emerge until 2004/05. Consequently, the effective time window through which the assessment of outputs, impact and effectiveness of SFI funding could be examined is constrained. Notwithstanding this issue, the key findings in relation to emerging research outputs, collaboration and commercialisation activities are as follows:

- SFI-funded researchers and research groups have forged and are engaged in extensive **collaboration activity** involving linkages with academic institutions and industry, both in Ireland and overseas. By 2006, the cumulative number of collaborative linkages with academic institutions reached a total of 663. It is notable that these linkages have been weighted more in favour of international linkages.

- In relation to **collaboration with industry**, by 2006 a cumulative total of 264 interactions with firms located in Ireland and overseas were evident. Of this total, 146 interactions (55.3%) in total involved interactions in Ireland with indigenous Irish firms and foreign-owned firms with bases in Ireland, while 118 interactions (44.7%) were with firms located overseas. While information in relation to the scale of firms involved was not available to the review team, of importance is the extent of interaction between SFI researchers/research groups and indigenous Irish firms. The overall number of such interactions has increased. However, although we are supportive of international linkages with industry, our analysis raises concerns over the comparative extent to which SFI-funded research has to-date engaged successfully with Irish-based, indigenous firms and further progress in this area is required if SFI researcher is to generate significant economic spin-offs involving Irish-based, indigenous industry.
- We examined the nature of **research outputs**, looking in particular at (i) the number of refereed journal articles published by funded researchers in internationally recognised journals and (ii) the number of conference based presentations delivered by these researchers. While of greater importance to the assessment of effectiveness is the *quality* of research produced (examined in detail in the next section), the findings reveal that journal publication rates have increased significantly both in absolute terms and relative to the number of researchers funded.
- We believe it is too early in the vast majority of cases to discern significant **commercialisation** and IP outputs. However, the available data in relation to one measure of commercialisation, namely patenting activity, indicates an acceleration in activity from 2004 onwards, with the annual number of patents filed rising to 60 during 2006 bringing the total since 2001 to 163. Gains in intellectual property advances arising from the allocation of research funding of this nature often occur with a considerable lag, however, and it will be important that significant outputs in terms of patents granted are forthcoming in future years.

- Overall **collaborative, research and commercial outputs** have risen substantially over the 2002-2006 period. Despite this it is important not to fully attribute all these gains to the incidence of higher SFI funding, as there are a constellation of other exogenous factors, including other funding sources which may also have contributed to these impressive gains. Having qualified this point appropriately, however, in light of the significant funding allocations made by SFI which outweigh all other sources, we feel it reasonable to attribute most of these gains to the increased incidence of SFI funding.

5 Evaluation of Programme Effectiveness and Impact

5.1 Introduction

In this section we examine the impact and effectiveness of SFI's programmes. A core element in this section considers the performance and impact of SFI's activities through a detailed assessment of the quality and quantity of research outputs produced by SFI-funded researchers and research groups. We then consider the evidence in relation to emerging wider economic impacts from SFI-funded research activities. Finally, this section also reviews programme management and monitoring procedures.

5.2 Assessment of Research Outputs and Quality

5.2.1 Objectives of assessment

To support the assessment of the effectiveness of SFI's research funding programmes, an in-depth analysis of the outputs of SFI researchers and the quality of this research was completed. In what is known in the research field as a *bibliometric* assessment, this exercise entailed the collation and detailed analysis of researcher and related publication outputs data with the objective of addressing the following evaluation issues:

- Has SFI funding impacted on the quality of research outputs? In particular:
  - How do SFI-funded research outputs compare with other Irish-origin research outputs in similar disciplines in terms of measurable quality?
  - How do SFI-funded research outputs compare with international outputs in similar disciplines in terms of measurable quality?
- Has SFI funding impacted on author productivity?

5.2.2 Methodological approach

Research database

The main data sources utilised for this study for the purposes of identifying SFI-related research publications and related metrics were Scopus and Thompson ISI. These are large-scale, internationally recognized bibliographic and citation databases.

The Scopus database focuses on the sciences, technology, engineering and medicine (STEM) and is compiled by the Anglo-Dutch publisher, Elsevier. Among the features of Scopus that were judged advantageous for the purposes of this exercise are the following:

- Indexing of a large number of sources and inclusion of detailed citation information, thus enabling publication impacts to be broadly understood;
- Wide coverage of the conference literature (especially important for understanding research productivity and impact in ICT) and of European science in general; and
- Scopus has developed software that automatically disambiguates author names, using unique personal identifiers. (This is an important consideration, since we are dealing here with a relatively small number of SFI-funded individuals and need to build as comprehensive picture as possible of their contribution to the literature both in the years leading up to and those following their first SFI award.)

Preliminary comparisons of Scopus-generated author bibliographies with publications lists derived from SFI annual reports were very encouraging, with typically 90% overlap between the two sets, Scopus recovering more documents for both sectors.

For this exercise, we complemented the outputs from the Scopus database with selected metrics from the Thomson ISI database, specifically in relation to the identification of Journal Impact and Immediacy Factors, and related international journal rankings.

The table below indicates the range of variables sourced from the Scopus and ISI databases for the purposes of this assessment in relation to SFI-funded researchers and other researchers. A full glossary of terms referred to in this section is provided in the Annex 1 (page 141-144).

Table 5-1: Fields in the Research Database*

Database field	Sample of SFI Researchers	Other Researchers
Author name	✓	✓
Type of SFI award (e.g. CSET)	✓	
Author status (e.g. Professor)	✓	
Hirsch index	✓	
Year of first SFI award	✓	
Publication year	✓	✓
Total citations received	✓	✓
Early citation rate	✓	✓
Source journal / conference	✓	
ISI indexing status (yes/no)	✓	
ISI Impact Factor for source journal	✓	
ISI Immediacy Index for source journal	✓	
Impact	✓	
Broad subject area	✓	✓

Source: Bibliometric Assessment of SFI Research Outputs
* Refer to Glossary of Terms at outset of this report for definitions of variables

Sampling approach and time period of assessment

It is important to highlight that the short time period since the establishment of SFI and the fact that research teams and associated research outputs did not begin to emerge until 2004/05 mean that the effective time window through which the assessment of research performance could be examined is constrained. Ideally, a period of at least 10 years of research publication data would be required to underpin a robust assessment.

Moreover, the time lags inherent in commencing and completing a research project, having a paper accepted and corrected, then published and indexed in a database such as Scopus or ISI mean that it is not practical to evaluate research impact (yet) for researchers entering the SFI system after 2005.

For the above reasons, a number of different techniques are employed in this assessment to enable the review team to form a judgment regarding the emerging performance of SFI-funded researchers. However, given the data constraint, the results presented in this section should be interpreted with caution.

For this evaluation, researchers who gained their first SFI award during the period 2003-2005 are included, the intention being to update the findings of the previous bibliometric study completed as part of the Brook Evaluation (2005).[9] Comprehensive Scopus bibliographies were downloaded for 114 SFI researchers (57 in BIO and ICT respectively) for the publication years 1998-2007 and pertaining to researchers who received their first SFI award between 2003 and 2005 (see further discussion overleaf in relation to before/after analysis of impact of SFI funding) . This amounts to a 50% random sample of researchers over this period in each case.

The reason for collecting a full decade of publication data for each researcher was to facilitate tests of productivity and research impact *before and after SFI* funding, as well as to help build a more rounded picture of their track record and outputs to-date. The project database is flagged at the article level with additional information supplied by SFI: the nature of the award (e.g. CSET, PI), the current status of the researcher (professorial or sub-professorial) and the year of their first SFI award.

Publication types assessed

For the purposes of this assessment, all the main research publication formats were included, where relevant, namely articles, conference papers, letters, notes and reviews.

Exclusion of self-citations

It is important to highlight that in analyzing citations of publications released by SFI-funded researchers, all self-citations were excluded to ensure full impartiality of results.

[9] Forfás (2005), *Op. Cit*. Bibliometrics assessment annex.

Statistical tests applied

Where appropriate, the statistical test used to test differences between groups (e.g. the performance of researchers before and after SFI funding) is a one-way analysis of variance (ANOVA).

Before/after analysis of impact of SFI funding

In order to model `before' and `after' effects of SFI funding intervention, each publication in the project database is flagged with the year that the research first obtained an SFI award, 2003, for example. On the basis that it is very unlikely that any real publication impact could or should be expected in that year, `after' is defined as publications for 2004 onwards. Publications `before' SFI funding are those that lie in the range 1998-2002. Any publications during 2003 are *excluded* from all 'before' and 'after' scenarios in this assessment.

5.2.3 Assessment of quality of SFI-funded research

The first element of our assessment of the impact of SFI-funded research outputs focuses on examining the quality of these outputs by reference to the following aspects:

- Benchmarking of quality of SFI-funded research outputs with that among non-SFI-funded researchers based in Ireland, based on comparison of the extent to which research publications are cited within a short-term timeframe (early citation impact); and,
- Comparison of SFI-funded outputs to international standards, as measured by the quality ranking of journals in which research outputs are published (journal impact), and by reference to the comparative quality of SFI research outputs measured at the article level (the impact of 'virtual' SFI journals).

Comparison of SFI-funded research with non-SFI-funded research

National benchmarking based on early citation rates

As part of this study we compared the *quality* of research outputs by SFI-supported researchers with that of all other (non-SFI-funded) researchers based in Ireland. The key research question is whether SFI researchers, as measured by their early citation performance, are generating a greater impact than their colleagues.

The main finding of the assessment is that SFI authors enjoy a significant advantage over non SFI-funded researchers based in Ireland, in terms of early citation of their published research outputs. A direct comparison between SFI-award recipients and other researchers based in Ireland and working in the same discipline shows that SFI researchers receive significantly more citations in the first three years following publication. This advantage can be quantified as follows: BIO authors attract 26% more citations than their colleagues; ICT authors attract an additional 31%. This strongly suggests that the SFI response mode and other funding mechanisms are successfully targeting the best Irish and overseas research talent.

Table 5-2 below and Table 5-3 overleaf outline these results in relation to both the ICT and BIO sectors. This citation analysis is based on a sample of three years beginning in 2003.

Table 5-2 Comparison of Early Citation Rates between SFI and all Other Researchers in Ireland by Subject (Based on Publication Year 2003)

Scopus subject area	SFI Authors	Other Irish	All Irish
Agriculture and Biological Sciences	1.79	0.86	1.20
Biochemistry, Genetics and Molecular Biology*	3.56	2.42	2.87
Immunology and Microbiology*	3.04	2.30	2.58
Pharmacology, Toxicology and Pharmaceutics	1.92	1.67	1.75
Neuroscience**	1.82	3.13	2.59
All BIO**	**2.87**	**2.14**	**2.41**
Computer Science	0.65	0.57	0.60
Materials Science**	1.51	1.05	1.22
Physics	1.37	1.32	1.34
All ICT*	**1.44**	**1.19**	**1.28**

Source: Bibliometric Assessment of SFI Research Outputs
Notes: *, **, & *** indicate statistically significant differences between SFI and comparators at 1%, 5%, and 10% levels of confidence respectively.
This method uses a three year citation window starting in 2003 - n= 2,247 papers of all document types.

On average in BIO sector disciplines, the papers of SFI-funded authors published during 2003 have been cited 2.87 times in the subsequent 3-year period to publication, which is statistically significantly higher than citation rates among non-SFI-funded authors in the sector (2.14 times). In the ICT sector, significant early citation advantage among SFI-funded researchers is also evident.

The better research performance supported by SFI funding is also likely to reflect the fact that SFI awards may have attracted higher quality researchers in the first instance, as well as providing these researchers with the resources to devote the time required to produce high quality research outputs.

The table below compares the quality of research outputs by SFI-funded researchers with those of all other Irish scientists, discipline by discipline. The quality yard-stick used here is the early citation rate (see glossary). This citation analysis is based on a sample of three years beginning in 2004.

Table 5-3: Quality Assessment of SFI-funded Research Outputs - Comparison of Early Citation Rates between SFI and all Other Researchers in Ireland by Subject (Based on Publication Year 2004)

Scopus subject area	SFI Authors	Other Irish	All Irish
Agriculture and Biological Sciences	1.23	1.49	1.41
Biochemistry, Genetics and Molecular Biology	3.04	2.68	2.84
Immunology and Microbiology	2.95	3.02	2.99
Pharmacology, Toxicology and Pharmaceutics***	2.42	1.47	1.82
Neuroscience	3.14	2.49	2.82
All BIO**	**2.59**	**2.21**	**2.36**
Computer Science	0.87	0.74	0.80
Materials Science***	1.72	0.90	1.11
Physics**	1.62	1.12	1.33
All ICT***	**1.63**	**1.15**	**1.33**

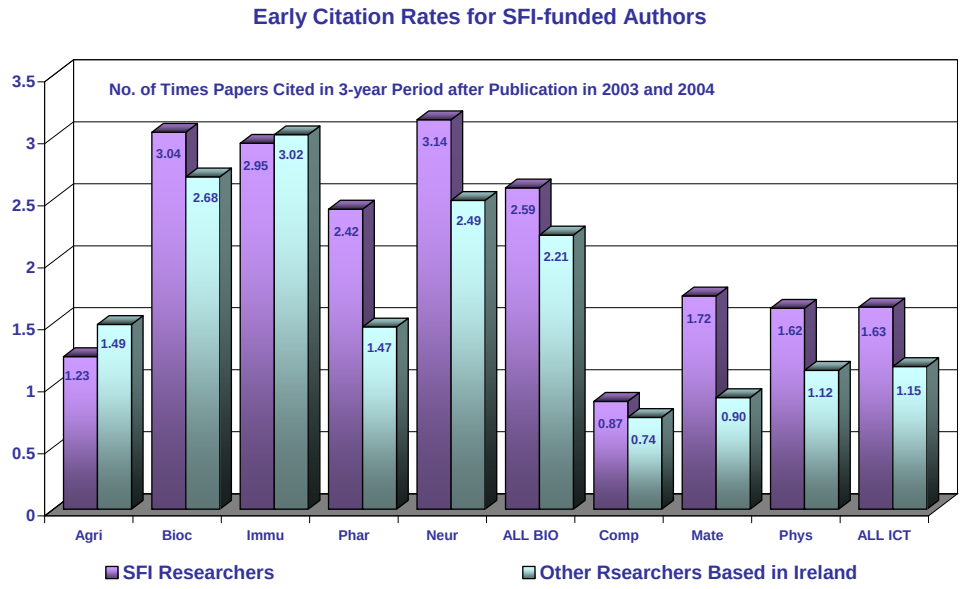
Source: Bibliometric Assessment of SFI Research Outputs
Notes: *, **, & *** indicate statistically significant differences between SFI and comparators at 1%, 5%, and 10% levels of confidence respectively.
This method uses a three year citation window starting in 2004 - n= 2,819 papers of all document types.

Based on 3-year citation rates post-2004, the analysis indicates that the quality of SFI-supported research is higher across the vast majority of disciplines and, statistically, there is a significant difference between SFI and non-SFI funded research outputs on average at the overall ICT and BIO sector levels.

If both 2003 and 2004 publication outputs are taken together, SFI researchers in the BIO sector attract, on average, approximately 26% more early citations than would be expected if there was no difference between these authors and their fellow non-SFI-funded scientists based in Ireland. The relative advantage among SFI-funded researchers in the ICT sector is 31%.

Figure 5.1 highlights the positive differential in early citation rates between SFI-funded and non-SFI-funded researchers based in Ireland in specific ICT and BIO disciplines. In 7 of the 9 areas considered, SFI funded authors have higher levels of citation.

Figure 5.1: Comparative Response to SFI-funded Research Publications in ICT and Biotechnology Disciplines - Citation Rates Achieved in 3-year Period after Publication in 2003 and 2004



Source: Bibliometric Assessment of SFI Research Outputs

Comparison of SFI Funded Outputs to International Standards

International benchmarking by destination journal quality

In comparing the performance of SFI-funded research outputs with international standards, we firstly examine whether SFI funding has made a difference to the publishing behaviour of BIO researchers as inferred from the percentile rankings. Table 5-4 below outlines the calculations of the quality of the destination of published BIO articles, before and after SFI funding was awarded to the sample of researchers. As the figures given are in percentile rankings, a figure of 1 would indicate publication in the top percentile. The only subject area which has incurred a statistically significant change is in Microbiology. There is a slight overall increase for the BIO sector overall. However, this is not statistically significant.

Table 5-4: Quality of Destination Journal of Published BIO Articles, before and after SFI Funding (by subject) Percentile Ranking (1 = Top Percentile)

ISI Subject Area	Before/ After SFI funding	Mean	Median	Standard Deviation
Immunology	Before	14.5	7.8	14.9
	After	12.2	7.8	8.7
Microbiology**	Before	37.0	26.1	28.0
	After	33.8	21.3	26.8
Molecular and cell biology	Before	27.1	19.3	20.5
	After	25.2	20.1	17.2
Neuroscience	Before	23.8	16.5	20.5
	After	23.9	16.3	18.7
Pharma	Before	17.7	15.8	14.0
	After	20.8	15.8	17.9
All BIO	**Before**	**24.2**	**16.4**	**21.5**
	After	**24.1**	**16.3**	**21.3**

Source: Bibliometric Assessment of SFI Research Outputs
**Indicates that the difference before and after is statistically significant at the 5% confidence level.

Table 5-5 outlines the percentage of published BIO articles by SFI funding programme that were ranked in the two highest brackets of destination journal quality. The results indicate that 10.8% of all SFI-funded publications in the BIO sector were published in the top 5% of international journals. Nearly 30% of all SFI articles in the BIO sector were in the top 10% of international journals. One particularly impressive statistic is that nearly 50% of BIO articles published from the CSETs was in the top 10% of international journals.

Table 5-5: Percentage of SFI-funded BIO Research Articles Published in Top 5% and Top 10% of Journals by Destination Journal Quality

Percentile Ranking	CSET	PI	PIYRA	RP	All SFI
Top 5%	20.4	10.4	8.8	8.4	10.8
Top 10%	46.5	25.6	24.2	29.7	27.8

Source: Bibliometric Assessment of SFI Research Outputs

Table 5-6 overleaf examines whether the increase in the percentile ranking, as displayed above, has been linked to the allocation of SFI funding on the basis of a before and after comparison of the quality of destination journals in which SFI-funded research outputs are published. The results indicate that the improvement is strongly associated with intervention in the form of an SFI award, and suggests that ICT researchers have changed their publishing behavior and targeted higher-ranking journals following their award. The difference in percentile ranking before and after SFI funding for the whole ICT sector is statistically significant at the 1% level. The difference is also significant for the subject areas of Electrical Engineering, Materials Science and Physics. This is a very favorable finding in relation to the quality of output in the SFI funded ICT sector.

Table 5-6 Quality of Destination of Published ICT Articles, before and after SFI funding (by subject) Percentile Ranking (1 = Top Percentile)

ISI Subject Area	Before/ After SFI funding	Mean	Median	Standard Deviation
Computer Science	Before	27.4	20.8	23.7
	After	24.3	23.3	17.1
Electrical Engineering*	Before	46.2	45.1	28.6
	After	35.8	26.7	25.3
Materials Science*	Before	40.6	41.1	26.7
	After	22.4	13.4	14.5
Physics	Before	24.3	10.7	20.0
	After	9.4	5.7	10.4
All ICT*	**Before**	30.9	25.5	23.1
	After	21.7	14.0	21.8

Source: Bibliometric Assessment of SFI Research Outputs
*Difference before or after SFI funding statistically significant at 1% confidence level

Table 5-7 below outlines the percentage of ICT articles that are published in the two highest levels of destination journal quality. 9.6% of all SFI funded publications in the ICT sector were published in the top 5% of international journals and 22.8% were in the top 10% of international journals.

Table 5-7 Percentage of SFI-funded ICT Research Articles Published in Top 5% and Top 10% of Journals by Destination Journal Quality

Percentile Ranking	CSET	PI	PICA	PIYRA	RP	Walton	All SFI
Top 5%	28.1	3.8	29.4	n/a	4.1	7.6	9.6
Top 10%	50.0	14.7	54.9	11.8	10.2	26.7	22.8

Source: Bibliometric Assessment of SFI Research Outputs

In terms of individual SFI programmes, it is notable that 28.1% of ICT-related research published by researchers affiliated to the CSET research centres has been published in the top 5% of journals while 50% was published in the top 10% of journals in their fields. A significant proportion (14.7%) of ICT-related research published by researchers funded through the PI programme has also figured in the top 10% of journals, while the PICA programme also appears to have funded high quality research outputs.

The results in the above tables points to the fact that SFI-funded ICT-related research outputs are published extensively in the top tier of international journals, and also, that the destination of publications has improved since the inception of SFI funding. On the basis of these metrics, SFI researchers appear to be making a very significant impact on research in their respective fields.

5.2.4 Research quality benchmarking at article level

The findings above strongly suggest that SFI-funded researchers are achieving high quality outputs and are creating a significant impact on the world's literature in their respective areas of research. The above analysis is, however, focused on one measure, namely relative journal rankings which do not reflect the specific impact of SFI articles.

To complement this assessment, we also apply an innovative approach to the assessment of the comparative international quality of SFI-funded research outputs, which is based on the calculation of *virtual impact factors*. This is a measure of how many recent citations an article in a particular group of authors attracts on average (in this case we focus on citations during 2006). This is based on the construction of a series of *virtual journals* of SFI-funded research publications across 10 disciplinary areas/research fields.

The term 'virtual' simply refers to the fact that the level of aggregation here is not at journal level but at the level of groups of research papers defined by nationality or funding source. As in the analysis throughout this section, self-citations are excluded and all document types included (including conference papers).

This approach is best understood through the following questions:

- If all the papers published by SFI-supported researchers were re-assembled as a virtual journal (e.g. SFI Proceedings in Physics), what would that journal's impact factor/quality be?

- Which real journals in that field are closest to the constructed SFI virtual journals, in terms of citation performance and other quality benchmarks?

As the majority of researchers have a very good understanding of the position of top journals in their respective fields, this approach provides a robust method to compare the quality of SFI-funded research in different disciplines.

The impact factors are constructed for publications contained within each virtual journal, where a 2006 virtual impact factor, for example, records the ratio of the number of citations received during 2006, to papers published in 2004 and 2005.

The numerator in the virtual impact factor calculation is the number of citations received in 2006 (restricted to those citations that accrue to recent papers published in 2004 and 2005). The denominator is the number of papers published in the virtual journal in 2004 and 2005. The use of this indicator enables us to directly compare the performance of SFI-funded researchers in the BIO and ICT sectors with their national colleagues.

By comparison with standard journal impact factors, the virtual impact factor is constructed at article level and therefore measures the real performance of SFI-funded researchers as opposed to the overall performance of the journals in which they publish.

It is important to highlight that the calculation of impact factors on a virtual journal basis exactly mirrors the internationally agreed approach applied by ISI/Thomson Scientific in relation to the classic journal impact factor.

SFI virtual journal impact assessment

The table overleaf compares the impact of SFI-funded research outputs and that of non-SFI researchers in Ireland based on impact factors calculated for virtual SFI journals across 8 subject areas in the ICT and Biotechnology fields. The impact factors in each case are indexed so that they equal to 100 across each discipline among researchers in Ireland as a whole (i.e. including the research outputs of SFI and non-SFI researchers), allowing direct relative comparison of the performance of the former group.

Table 5-8: SFI Research Impact: National Comparison of Quality of SFI BIO and ICT Research Outputs in Ireland (2006 Citations of 2004/2005 Publications) – Virtual Impact Factors – Index: Ireland=100

Scopus Subject Area	SFI Research Outputs	All Irish Research Outputs
Agriculture and Biological Sciences	109	100
Biochemistry, Genetics and Molecular Biology	115	100
Immunology and Microbiology	109	100
Pharmacology, Toxicology and Pharmaceutics	110	100
Neuroscience	133	100
All BIO	**116**	**100**
Computer Science	126	100
Materials Science	148	100
Physics	118	100
All ICT	**129**	**100**

Source: Bibliometric Assessment of SFI Research Outputs

As is evident form the analysis, in all subject areas analysed, SFI funded researchers were also ahead of their non-SFI funded Irish colleagues in terms of the quality of their research outputs as measured by comparative quality of SFI-funded research and that of research in the same disciplines published across Ireland. In particular, it is notable that the impact of SFI research outputs in the BIO sector was, on average, 16% above the norm in Ireland, while SFI research in the ICT sector was 29% above the Irish average.

5.2.5 Productivity of SFI Funded Researchers

One of the main indicators of the effect of funding levels on journal outputs is the productivity of the researchers receiving the awards. This section looks at productivity per researcher, with productivity defined as publications of all document types including conference papers per researcher per year.

Table 5-9 outlines the trends in researcher productivity by funding programme for SFI funded BIO researchers. Overall, for BIO sector, researcher productivity has increased from 3.93 publications per researcher per annum in 2001 (when the first of SFI's programmes commenced) to 5.85 units in 2007.

Table 5-9 Trends in Research Productivity by Funding Programme, BIO Researchers (Publications per Researcher per Annum)

Year	CSET	PI	PIYRA	RP	All BIO*
1998	9.67	3.90	0.58	4.60	4.67
1999	12.00	3.45	1.14	5.80	4.61
2000	10.00	3.83	1.86	6.00	4.83
2001	12.67	3.62	1.43	5.80	3.93
2002	9.00	3.55	1.57	5.00	4.22
2003	7.67	3.82	2.29	8.40	4.47
2004	8.00	4.88	2.43	8.20	5.11
2005	11.33	4.86	2.29	9.80	5.23
2006	8.67	4.93	2.86	10.00	5.55
2007(e)	9.67	5.10	3.03	10.40	5.85

Source: Bibliometric Assessment of SFI Research Outputs
* Estimated compound average growth rate over period 1998-2007 = 2.5%
2007 figures are estimated
Yellow shading indicates commencement year of SFI programme

Table 5-10 below describes the annual movement over the period 1998-2007 in researcher productivity by funding programme for ICT researchers. While a variety of factors can explain annual variations, over the period 1998-2007 examined, there was a substantial increase in the level ICT-related researcher productivity. In all SFI award programmes (see Table 5-10) there were increases in productivity after SFI funding programmes commenced.

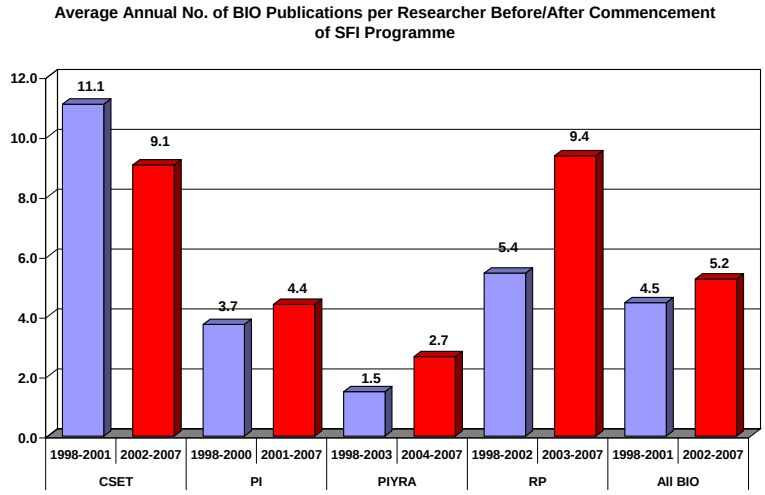
Table 5-10 Trends in Researcher Productivity by Funding Programme, ICT Researchers (Publications per Researcher per Annum)

Year	CSET	PI	PIYRA	RP	All ICT*
1998	1.75	2.7	1.5	2.33	2.48
1999	0.75	2.14	1.5	0.33	2.66
2000	1.75	1.84	1.5	2.33	2.61
2001	1.75	2.41	1	2.33	2.81
2002	1.5	2.86	0	3.67	3.17
2003	2.25	2.27	1.5	3	2.84
2004	3.75	3.45	2.5	4.33	4.23
2005	9	3.57	3.5	9.67	5.82
2006	6.43	3.87	4.5	6.67	4.72
2007(e)	6.45	4.27	3.85	7.58	5.42

Source: Bibliometric Assessment of SFI Research Outputs
* Estimated compound average growth rate over period 1998-2007 = 9.1%
2007 figures are estimated
Yellow shading indicates commencement year of SFI programme

Figure 5.2 below compares in pictorial form the average annual productivity rates of BIO sector researchers before and following the commencement of SFI's CSET mechanism and PI, RP and PIYRA programmes. In overall terms, average annual productivity rates among BIO researchers – as measured by annual publication outputs per researcher – increased by 15.5% in the period 2002-2007 compared with the period 1998-2001. At individual programme level, in absolute terms, productivity among BIO researchers affiliated to CSETs remain among the highest across SFI programmes, although it is noteworthy that average productivity rates have declined in the period following commencement of the CSET mechanism. Productivity rates among researchers who are not affiliated to CSETs but funded through the PI programme increased in the period after commencement of the programme, although comparatively speaking, it lags behind productivity rates among CSET-affiliated BIO researchers. Very significant increases in average annual productivity rates were also evident among researchers funded by the PIYRA programme and particularly the Research Professorship programme.

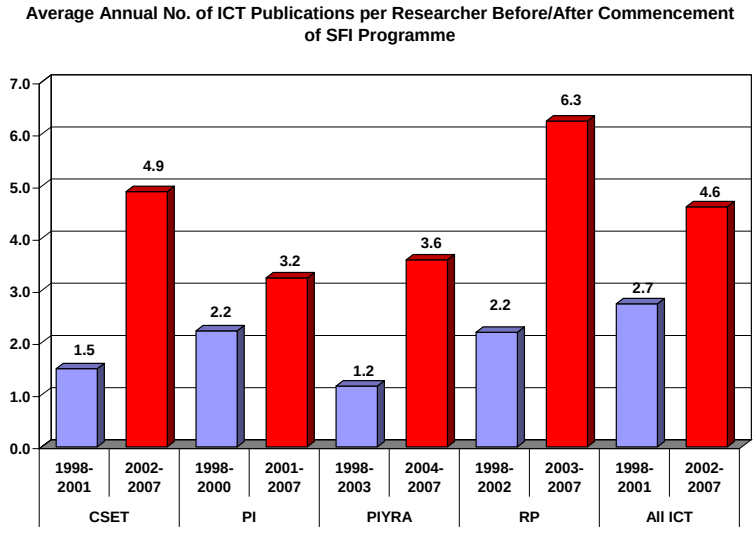
Figure 5.2: Comparison of BIO Researcher Productivity Before/After Commencement of SFI Funding Programmes



Source: Bibliometric Assessment of SFI Research Outputs

The equivalent representation of productivity among SFI researchers in the ICT area is presented in the figure below. This highlights that, in contrast to the BIO sector, productivity rates among ICT researchers increased across all programmes considered and this is most evident in relation to CSET-, PIYRA- and RP-funded researchers.

Figure 5.3: Comparison of ICT Researcher Productivity Before/After Commencement of SFI Funding Programmes



Source: Bibliometric Assessment of SFI Research Outputs

A more specific analysis of productivity levels is now considered. Table 5-11 outlines the impact of SFI funding on research productivity by document type in the ICT and BIO sectors.

Table 5-11 Impact of SFI Funding on Research Productivity, By Document Type: BIO and ICT (n = 4,158 outputs)

Document Type	Before/After SFI Funding	BIO	ICT
Article	Before	3.72*	1.69
	After	4.55*	1.79
Conference Paper	Before	0.43*	0.77**
	After	0.28*	2.08**
Editorial	Before	0.05	0.01
	After	0.04	0.08
Note or Letter	Before	0.16	0.02
	After	0.19	0.02
Review	Before	0.50	0.06
	After	0.61	0.14
All Papers	Before	4.86*	2.55**
	After	5.67*	4.11**

Source: Bibliometric Assessment of SFI Research Outputs
** Difference significant at 1% level*
***Difference significant at the 5% level*

In both the BIO and ICT sectors, there was a statistically significant increase in the productivity levels of all papers before and after SFI funding. In the BIO sectors, there were significant document specific increases in the productivity of conference papers and articles while in the ICT sector, there was a statistically significant increase in the productivity in relation to conference papers.

5.2.6 Overall conclusions from assessment of quality of SFI research

It is instructive to summarise the main conclusions from the assessment of SFI-funded research outputs and quality, as presented above. The key findings from the assessment are as follows:

- **SFI-funded research outputs are published extensively in the top tier of international journals:**
  - A significant proportion of papers published by SFI award holders (27.8% of papers in the Biotechnology (BIO) sector and 22.8% in the Information and Communications Technology (ICT) area) are accepted and published in the top 10% of international journals in their specialist fields. At individual SFI programme level, looking at the two main SFI programmes – the PI and CSET programmes – an impressive performance is evident. Almost 26 per cent of PI programme-funded publications in the BIO area and 15 per cent in the ICT sector are published in the top 10 per cent of international journals.
  - Looking at the relevant presented cohorts, before and after the first SFI award, SFI funding has been associated with significant improvements in the quality of the destination journals for microbiology, electrical engineering and materials science researchers in particular.
  - On average, ICT researchers improved their position in the international journal rankings by almost eight percentage points following an SFI award.
- **SFI authors enjoy a significant early citation advantage over non SFI funded researchers in Ireland:**
  - A direct comparison between SFI award recipients and other Irish researchers working in the same disciplines shows that SFI researchers receive significantly more citations in the first three years following publication.
  - Biotechnology authors attract 26% more citations than their non-SFI-funded colleagues; ICT authors attract an additional 31%.

- **SFI Funding has coincided with an increase in publication productivity levels of researchers:**
  - Author productivity has increased in the case of both Biotechnology and ICT authors but especially in ICT, where productivity (as measured by papers per researcher per annum) has followed an annual compound growth rate of 9.1%.
  - Moreover, the increase in author productivity has been associated with the period of increased funding rolled out by SFI.
  - Comparisons of the same cohorts before and after receiving an SFI award show that Biotechnology researchers increase their annual productivity by nearly 17% on average, and ICT researchers increase annual productivity by 61%.
  - Focusing on the two main SFI programmes, a strong increase in author productivity is evident for PI researchers in both the BIO and ICT sectors. Under the CSET programme, a very strong productivity increase is also evident in the ICT sector.

5.3 Assessment of Wider Economic Impacts

In evaluating the impacts and effectiveness of SFI's research funding programmes, in addition to the issue of the quality of research teams and research outputs emerging from this funding, it is also important to consider whether any actual or potentially significant wider economic impacts are evident as a result of SFI's activities.

In this section we consider the following economic aspects:

- The potential longer term benefits for the Irish economy arising from the investment in human capital in research supported by SFI;
- The extent of any linkages between SFI's funded research projects and inward investment activity in Ireland; and
- The extent of any economic impacts emerging through commercialisation and innovation activities supported through SFI's programmes.

5.3.1 Economic benefits of investment in human capital

Development of Human Capital and SSTI Goals

The third area of potential wider economic benefit arising from the investment in R&D supported by SFI relates to the development of human capital. As noted above in relation to inward investment, the development of a high skilled human capital base will impact on Ireland's attractiveness as a location for investment. However, SFI also plays a role more generally in this area through its contribution to the achievement of the goals set out in the SSTI. This document in particular set out targets for the expansion in both the number of researchers and the number of PhD graduates out to 2013. A summary of these national targets are set out in the table overleaf. Over the life of the strategy, it is envisaged that the number of principal investigators in the science and engineering area would expand by 350 by 2013, while the annual number of PhD graduates in the sector would grow to 997 compared with 543 in 2005. Critical to ensuring that these benefits are realised is the need to retain researchers in Ireland and we discuss this issue further in Section 6.

Table 5-12: SSTI National Targets for Numbers of Researchers and PhD Graduates in the Science and Engineering Sector

Indicator	2005	2006	2013
Cumulative increase in annual number of new Science & Engineering Principal Investigators appointed	-	40	350
Annual number of Science & Engineering PhD graduates	543	606	997

Source: Strategy for Science, Technology and Innovation, 2006-2013, *published July 2006.*

In terms of achievements to-date, the table below presents a preliminary assessment of progress to-date by SFI in relation to the achievement of SSTI targets concerning the number of PI-level researchers.

Table 5-13: Preliminary Assessment of SFI Progress in Relation to Achievement of SSTI Targets for Number of Principal Investigator-level Researchers - 2003-2013

Indicator	Net Annual Increase	Cumulative Net Increase
Overall SSTI target for Number of PI-level researchers – 2013	-	350
SSTI target for Number of SFI-funded PI-level researchers - 2013	30	240
SFI progress (to year-end)		
2005	-	200
2006	36	236
2007	48	284

Source: SFI analysis and SSTI

The figures shown above, which pertain to the net movement in the number of PI-level staff funded in each year and take account of additions and terminations, indicate that by the end of 2007, SFI had funded a total of 84 net new PI-level researchers (36 in 2006) and 48 in 2007). While these figures indicate that the Foundation was ahead of the annual target of 30 new PI-level staff in 2006 and in 2007, given the variability of staff movements on an annual basis, we believe it is premature at this stage to reach a definitive conclusion in relation to SFI's progress and contribution towards the achievement of the overall SSTI target for 2013 in this important area of human capital development in research. However, this is an area that requires ongoing focus if the Foundation is to meet its targets in relation to the roll-out of the SSTI.

In relation to PhD graduates, official data was not available at the time of this review on the numbers of PhDs graduating to-date through SFI-funded research programmes. However, the data reviewed in Section 3 on PhD student numbers indicated that there were 530 students working within SFI research teams during 2006. In sustaining increasing numbers of PhD graduates through SFI programmes, however, it will be necessary to ensure that sufficient numbers of PIs are also in place to supervise these students and our scenarios also set out the implied growth in PI numbers required to achieve the projections for PhD graduates.

5.3.2 Inward investment impacts

Another area where potential wider economic impacts could emerge through the investment taking place in research supported by SFI relates to inward investment/foreign direct investment activity in Ireland.

As in the case of commercialisation and innovation activities, the fact that SFI's activities are still at an early stage of development mean that it is premature to draw any definitive linkages between the funding that has been committed across the agency's research support programmes and developments in relation to inward investment.

Notwithstanding this, during the course of this review, detailed discussions were held with IDA Ireland and these interactions highlighted a number of aspects which merit reference within the context of potential wider economic impacts. In particular, according to IDA Ireland:

- "The funding of Principal Investigators and of the CSETs has acted as a strong reference sell for IDA client companies who have visited Ireland over this period. They have also given the wider industrial community the belief that there will be a steady stream of high quality employees in the future. This confidence in the Irish ecosystem has led to many companies establishing their own in-house R&D centres in Ireland."
- "While it is difficult to ascertain the direct impact of SFI on the level of IDA Ireland-funded R&D investment, it should be noted that these researchers have become part of IDA reference itinerary programme for new companies."
- While many of these introductions had led to the establishment of industry-academic collaborations, they have also led to new partnerships between companies involved in the CSETs who would not have previously worked together (for example, BDI at DCU). This could not only be a significant benefit to the companies but should embed their operations further in Ireland as it becomes a preferred location for R&D investments."

SFI-funded researchers and particularly the major CSET-funded groups have formed strong collaborative linkages with IDA Ireland-assisted foreign-owned multi-nationals in Ireland. In many cases these partnerships constitute formal arrangements within the CSET agreements. Some examples of such linkages include:

- The partnership between CTVR at Trinity College Dublin and Alcatel-Lucent (formerly Bell Labs) and Xilinx;
- The partnership between GSK and the APC group at UCC;
- The partnership between Becton Dickinson and BDI at DCU.

To the extent that these partnerships contribute to embedding the activities of major foreign-owned firms in Ireland and also through supporting the development of skilled human capital in research, this would impact on shaping the attractiveness of the State as a location for overseas firms to invest in R&D activities. We understand that IDA has recently begun to achieve significant success in attracting R&D-related investment projects to Ireland and that the existing build-up of science and research activities in the State is playing an important role in this process. The recent statement by the IDA's chief executive notes this aspect:

> "Particularly pleasing has been the continual investment in R&D projects and in the last twelve months the results of a determined national policy to establish a substantial foundation of world class science and technology has come to fruition in a series of significant industrial and academic research collaborations that would not have been possible in the not so distant past."[10]

The extent to which these benefits can be maximised and contribute to significant longer-term benefits for Ireland will, however, be dependent upon the evolution of SFI's programmes (and particularly the CSET and Strategic Research Cluster (SRC) mechanisms) and the effective development and management of deep collaborative linkages and emerging IP.

[10] IDA Ireland, End of Year Statement, 2007.

5.3.3 Commercialisation and innovation activities

In Section 4 we reviewed the available indicators in relation to commercialisation activities emerging from SFI-funded research groups. It was highlighted that there was an increase in patent activity evident among SFI-funded research groups during 2005, when a total of 18 patents were granted for various developments. However, with the exception of 2005, the number of patents granted in other years has remained low. It was noted that this must be seen within the context of the typical timeframes over which significant IP outputs – and particular those that have commercial application – are likely to emerge. While IP development cycles can be shorter in the ICT area, international experience indicate that patentable outputs typically do not emerge within the biotechnology area until a period of 10 years or so has elapsed following initial research.

Given the establishment of SFI in 2001 and the fact that many programmes did not get off the ground in earnest until 2003/04 (with some of the CSET groups not commencing until more recently), we believe it is too early in the vast majority of cases to discern significant commercialisation and IP outputs.

The review team's detailed discussions and site visits to major research groups throughout the country highlighted the close-to-market or potentially commercially applicable components of some of the research projects underway. Some examples include the activities of the APC group at UCC, the LERO centre at the University of Limerick or the BDI group at Dublin City University.

Our discussions with industrial partners within the CSETs have also noted how the close collaborative relationships that have developed between their staff and CSET research teams have benefited firms in terms of identification and subsequent development of mutually beneficial areas of research. As jointly developed research projects proceed, it is likely that significant IP will emerge and in terms of the value of any commercialisation outputs and IP, this may include immediate revenues through patent royalties, which could benefit research groups and their host third-level institutions.

Potentially significant wider economic benefits could also result through the eventual wider application of new technologies or processes and related investment and other spin-offs. However, the extent of wider economic benefits will be dictated by, among other factors, the effectiveness of commercial management of research groups and the structuring of IP agreements. Where IP is locked up within agreements structured on establishment of CSETs, for example, the inclusion of additional new industry partners at a later stage may be hindered and this may constrain new areas of potential significance.

Overall, while we would reiterate that the current review takes place at a relatively early stage in the life of SFI to permit the identification of significant commercialisation impacts, the developments emerging particularly in the CSET-funded groups would indicate that, assuming effective management of IP, there are potential economic impacts which may emerge.

A similar examination a further 5 years from the present juncture would, we believe, present a more meaningful opportunity to examine commercialisation and innovation impacts arising through SFI's programmes.

5.4 Programme Management and Monitoring

5.4.1 Introduction

In this section we consider the issues of ongoing management and monitoring by SFI of the range of research funding programmes administered by the agency. In particular, we examine the following aspects:

- The application and peer review process underlying decision-making on the allocation of programme funding;
- The extent of satisfaction among applicants and funded researchers of the management of implementation of programmes by SFI; and
- The approach to and effectiveness of ongoing reporting and monitoring of research programmes by SFI.

5.4.2 Application and Peer Review process

The nature and effectiveness of the processes and procedures underlying the operation of SFI's decision-making on research grant allocation were considered as part of the previous review of SFI undertaken by Sir Richard Brook, published in 2005. This included a detailed external assessment of the Peer Review process.[11]

Given that the Peer Review process has undergone recent examination and does not form a specific element in the terms of reference for the current value for money review, we do not have any significant grounds to re-open this issue in this report. Overall, through our understanding of the process and review criteria applied by SFI, discussions held with the research community and the inputs of the international academic advisers to this review, we remain in broad agreement with the findings of the 2005 review which highlighted particular strengths of the process as including the emphasis on international peer review and the professional backgrounds of the SFI personnel involved. We would concur with the finding that the process meets international standards and, in particular, we would reiterate that this should remain a key element in ensuring a continued emphasis on funding research excellence.

Ultimately, the effectiveness of this process can be assessed on the basis of the quality of researchers funded by SFI's programmes, as measured by their research outputs.

However, the above is not to suggest that there is no room for modifications and improvements in specific areas and we return to this issue in Section 6. One aspect that we would note at this juncture is the potential for the wider application of peer review beyond the application/funding decision stage. In particular, we believe there may be merit in the peer review mechanism forming part of the *ex post* assessment of the quality of research staff funded and their research outputs once projects have reached the end of their funding cycles, within the context of the ongoing evaluation of the effectiveness of SFI's programmes.

[11] Forfás, Op. Cit.

In addition to facilitating the ongoing evaluation of effectiveness and value for money, an ex post assessment mechanism would input to Foundation decision-making on future strategic direction, in terms of programme mix and focus, and associated funding strategy and allocations. This would also serve both an accountability and 'lesson-learning' purpose. Research would be assessed against a range of criteria including research quality, project management, cost effectiveness and, critically, wider economic benefits, including commercialisation outcomes and spin-offs.

There are also other aspects of the application process which relate to the extent of user satisfaction with the management and implementation of SFI's programmes, and we examine these issues further below.

5.4.3 User Satisfaction with Management and Implementation

An aspect of the overall management of research programmes by SFI that we have given specific consideration to in the context of this review concerns the issue of the experience with and satisfaction levels of users with the management and implementation by SFI of its programmes. We have considered this issue through our consultations/discussions with SFI and with researchers throughout the course of the review, and on the basis of the findings of new primary research with SFI-funded researchers and unsuccessful applicants, undertaken as part of the review process.

Two specific aspects of management and implementation that we believe merit closer examination within the context of the overall effectiveness and value for money achieved through SFI's programmes include:

- In relation to implementation, the experience and satisfaction of users with the funding application process; and
- In relation to management, the capacity of SFI as an organisation to ensure effective interaction between its staff and the research community.

In the case of both of the above aspects, as part of this review the views of researchers who have been successfully funded by SFI and also the inputs of unsuccessful applicants were sought in relation to a number of aspects. These views and inputs were gathered both through detailed discussion with researchers and through the inputs of researchers in the form of responses to Indecon's survey programme.

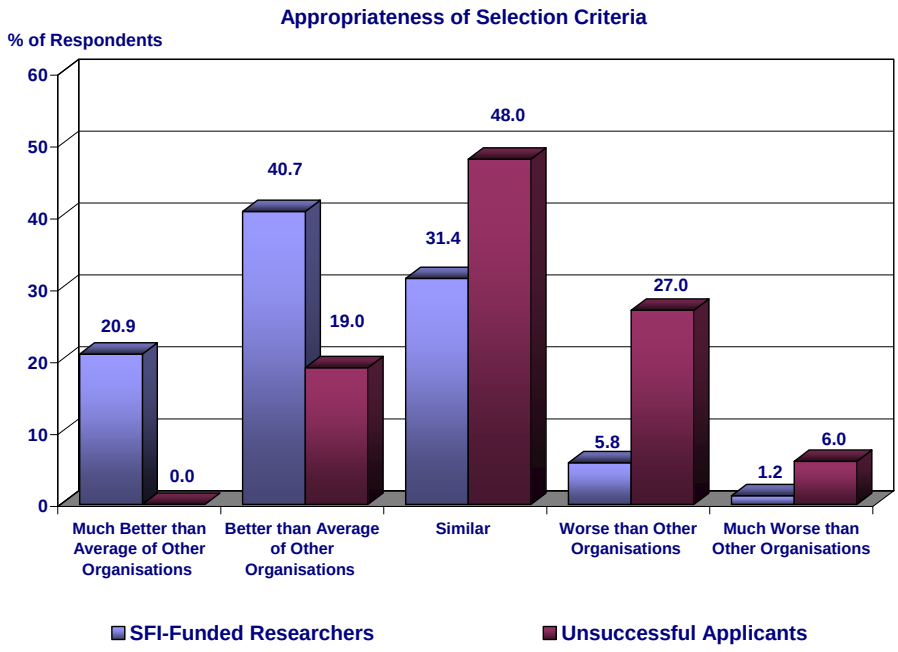
Aspects of the funding application process highlighted by both successful and unsuccessful applicants include:

- The extent of transparency in the application process, including clarity in relation to prior indication of probability of successful funding under pre-specified criteria (e.g. if recommended by peer reviewers)
- The overall appropriateness of selection criteria
- The administrative procedures involved in the application process
- The Peer Review process
- The scoring system used to rate funding submissions
- The time required to complete the review process
- The extent and quality of communication between SFI and applicants.

The extent to which each of the above or other features of the application process for SFI funding figured positively or negatively in the experience of applicants is likely to be coloured by the outcome of the application process and it is important to interpret the findings from our discussions and survey research in this context. However, it is instructive to consider the findings from our survey research on some of the issues highlighted above.

In the figure overleaf we compare the views of SFI-funded researchers and unsuccessful applicants in relation to the appropriateness of the selection criteria applied by SFI in its decision-making process on funding submissions. Perhaps not surprisingly, researchers that have been successful in accessing SFI funding tend to be considerably more positive in relation to how they rate the appropriateness of the selection criteria compared to those used in other research funding organisations. However, it is notable that a very significant proportion of unsuccessful applicants (19%) consider that SFI's selection criteria are better, in their experience, than the standards typically set by other funding bodies.

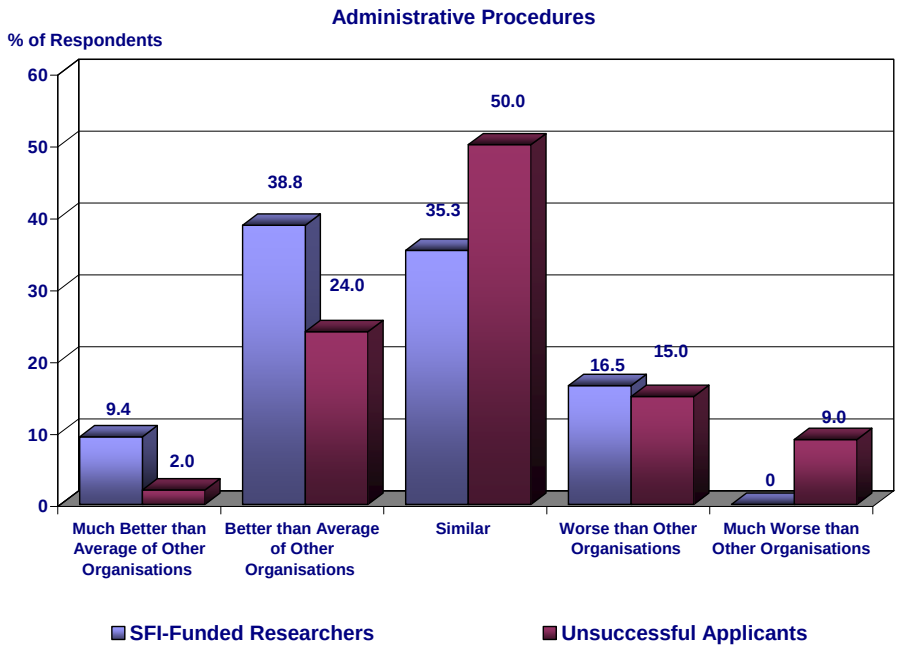
Figure 5.4: Views of SFI-funded Researchers and Unsuccessful Applicants on Appropriateness of Selection Criteria Compared with Other Funding Organisations



Source: Indecon Survey of SFI-funded Researchers and Indecon Survey of Unsuccessful Applicants for SFI Funding
N= 88 SFI-funded research and 67 unsuccessful applicants

The next figure overleaf considers the views of the research community in relation to their experience with and rating of the administrative procedures operated by SFI as part of its application process. Here it is notable that a lower proportion of SFI-funded researchers than in the case of the above aspect rate the agency as being much better or better than other funding organisations in relation to administrative procedures. In particular, a higher proportion (16.5%) of successfully funded applicants considers that SFI is worse than other funding bodies in terms of their burden of administrative procedures experienced by applicants.

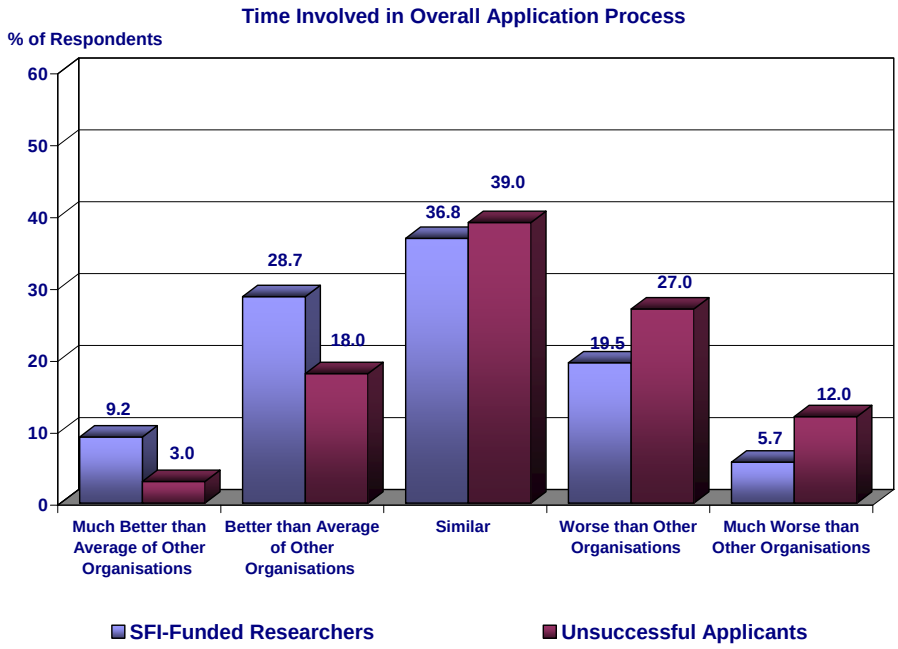
Figure 5.5: Views of SFI-funded Researchers and Unsuccessful Applicants on SFI Administrative Procedures Compared with Other Funding Organisations



Source: Indecon Survey of SFI-funded Researchers and Indecon Survey of Unsuccessful Applicants for SFI Funding
N= 88 SFI-funded research and 67 unsuccessful applicants

The views of researchers in relation to the issue of the time required to reach a decision on a funding proposal are summarised in the figure overleaf. In this case, comparable proportions of both SFI-funded researchers and unsuccessful applicants rated SFI as being similar to other funding bodies in relation to the time involved in the overall application process. However, it is notable that the proportion of unsuccessful applicants who considered SFI as being either worse or much worse than other bodies is higher than the proportion of successfully funded researchers who rated the agency as being better or much better in this regard.

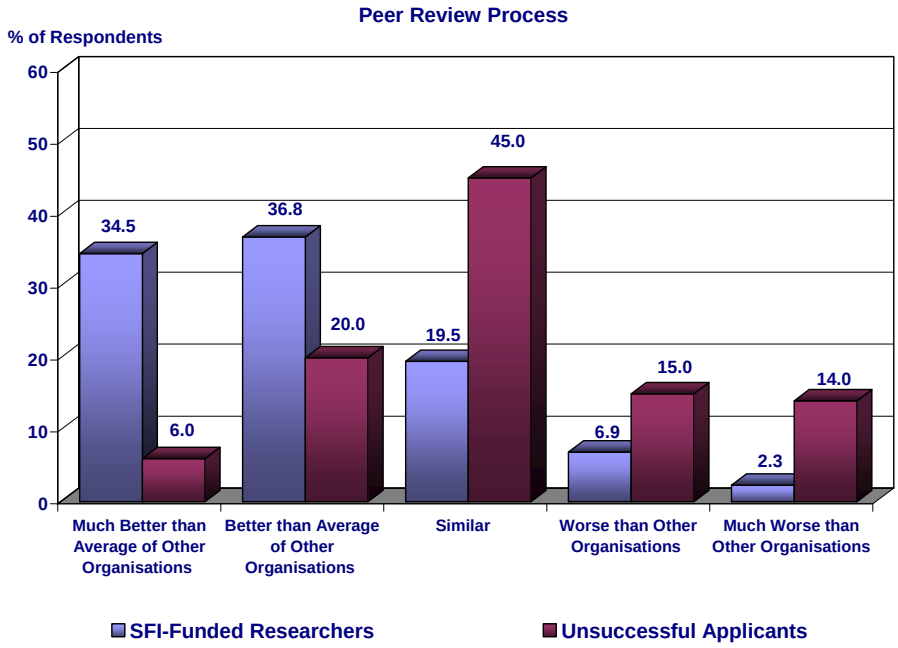
Figure 5.6: Views of SFI-funded Researchers and Unsuccessful Applicants on Time Involved in Overall Application Process Compared with Other Funding Organisations



Source: Indecon Survey of SFI-funded Researchers and Indecon Survey of Unsuccessful Applicants for SFI Funding
N= 88 SFI-funded research and 67 unsuccessful applicants

In relation to the peer review process, the findings from Indecon's survey research among SFI funding applicants, described in the figure overleaf, indicate that the majority (71.3%) of successfully funded researchers rate the process as being better than that operated by other funding bodies, compared with 26% among unsuccessful applicants.

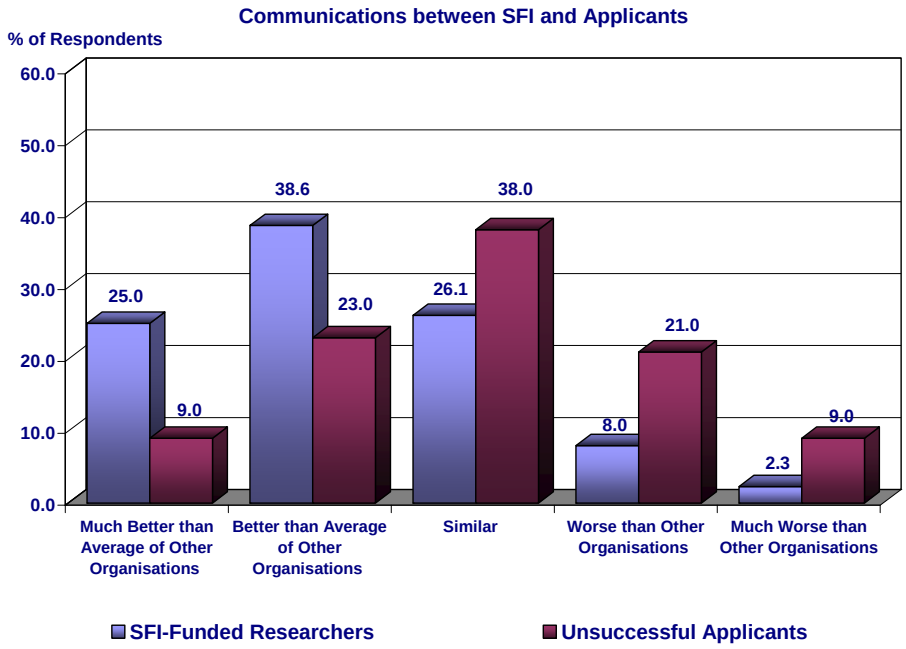
Figure 5.7: Views of SFI-funded Researchers and Unsuccessful Applicants on SFI's Peer Review Process Compared with Other Funding Organisations



Source: Indecon Survey of SFI-funded Researchers and Indecon Survey of Unsuccessful Applicants for SFI Funding
N= 88 SFI-funded research and 67 unsuccessful applicants

The next figure overleaf considers the issue of interaction between SFI and researchers in terms of communications. Again, while there is a predictable variation between successfully funded researchers and unsuccessful applicants for SFI funding, it is nevertheless notable that most SFI-funded researchers responding to the survey are of the view that SFI is similar or better than other research funding bodies in terms of the effectiveness of its communications with researchers.

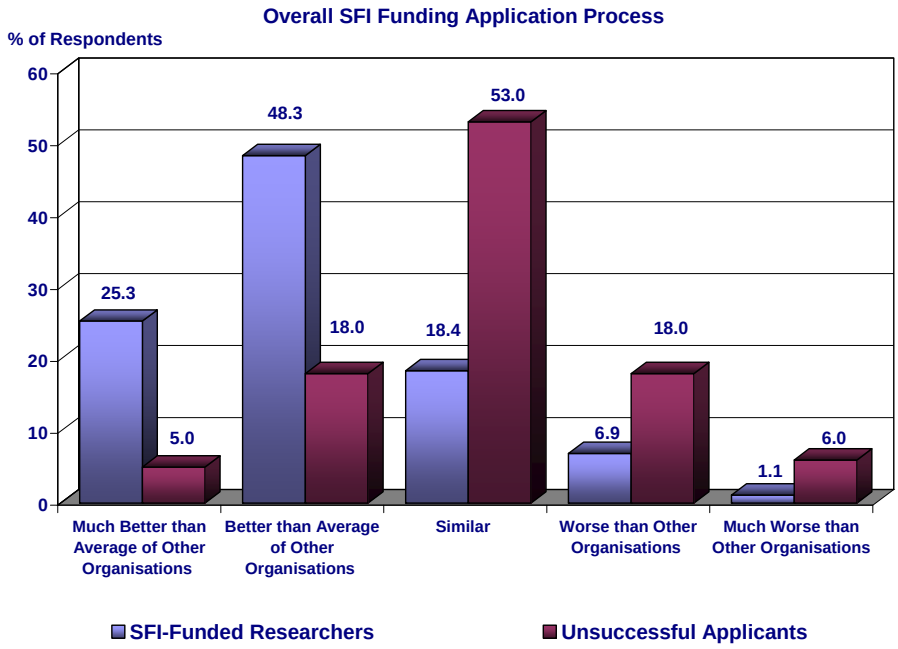
Figure 5.8: Views of SFI-funded Researchers and Unsuccessful Applicants on Communications Between SFI and Funding Applicants Compared with Other Funding Organisations



Source: Indecon Survey of SFI-funded Researchers and Indecon Survey of Unsuccessful Applicants for SFI Funding
N= 88 SFI-funded research and 67 unsuccessful applicants

The overall views of researchers who applied for SFI funding in relation to the application process are described in the figure overleaf. While the majority of successful applicants appear to be positive in relation to the application process overall, the picture among unsuccessful applicants is more mixed, with 23% of respondents of the view that SFI is better or much better while 24% consider the agency to be worse or much worse and 53% rate SFI's application process as similar to other bodies.

Figure 5.9: Views of SFI-funded Researchers and Unsuccessful Applicants on the Overall SFI Funding Application Process Compared with Other Funding Organisations



Source: Indecon Survey of SFI-funded Researchers and Indecon Survey of Unsuccessful Applicants for SFI Funding
N= 88 SFI-funded research and 67 unsuccessful applicants

Overall, while there are predictable variations between successful and unsuccessful applicants, the evidence from our survey research and discussions with researchers has been broadly positive in relation to how researchers rate SFI on a range of aspects.

5.4.4 Reporting and Monitoring

The final aspect of programme management and monitoring that we consider concerns the approaches applied in relation to ongoing reporting and monitoring of research programmes and their underlying activities. In this section we consider the following aspects:

- The nature and effectiveness of ongoing reporting requirements for funded researchers
- The usage of performance measures and indicators to monitor and assess ongoing activities, effectiveness and value for money.

Reporting requirements

In relation to ongoing reporting, in the case of every research project or research group/centre funded, a progress report is required to be completed and submitted to SFI one year after commencement and annually thereafter up to project completion. The current format constitutes a detailed report which requests information on activities over the previous year in relation to the following aspects:

- Background information, including the identity of the principal investigator(s) involved in the project, the host institution, the title of the research project/programme funded and the duration of the programme;
- Breakdown of Research and Support Staff associated with the project during the reporting period;
- Breakdown of Students Graduating during the reporting period;
- Scientific Information on research undertaken;
- Strategic Information, including the value to Ireland produced by the research undertaken;
- Details re Academic, Industrial and other interactions during the reporting period;
- Knowledge Dissemination, including details of publications released;
- Financial information including details re current budgets and other funding sources; and
- Programme feedback including changes research teams would like to see in SFI policy or operation.

External site/peer review visits

In addition to the annual reporting requirement described above, each research project is also subjected to an external peer review site visit, which takes places approximately mid-way through the project funding period. In the case of the CSETs and centres, this involves an intensive process over a number of days. A number of groups have now reached a point where they are approaching the end of the 5-year cycle of funding for CSETs and are currently undergoing a further renewal stage review visit.

One issue that was highlighted to the review team during visits and discussions with researchers and research groups concerns the administrative requirements placed on researchers resulting from the intensity of and level of information gathering required to facilitate these visits. It was also felt that some aspects of the external peer review process as part of this site visits may be repetitive, although we would reiterate our view that would be merit in extending the peer review process

While the review requirements will impact on researchers, we would emphasise the importance of ensuring that a rigorous approach is maintained to ensure that full accountability and value for money is achieved.

Effectiveness and usage of reporting

An important issue concerns the effectiveness and usage of reporting within the context of facilitating the ongoing monitoring of the activities, outputs and emerging impacts of SFI funding. This was an issue highlighted also by the international academic advisors on this review and pertains both to the annual reporting requirement and the periodic site visit mechanism.

While a balance should be struck between the level of detailed information/data sought and the ongoing administrative requirements facing research teams, a key issue concerns the ability of SFI to track the activities, outputs and impacts of funded researchers and research teams on an ongoing basis.

Our understanding is that the annual reporting requirement constitutes the primary mechanism by which SFI currently monitors the activities of funded researchers and research teams on an ongoing year-to-year basis. We would raise two specific issues in this area, within the context of facilitating the ongoing monitoring and evaluation of the effectiveness of SFI's programmes.

Firstly, a reliance on the annual reporting mechanism may present some difficulties where the reporting requirement does not meet with full compliance, both in terms of the provision of information and data to the level of detail and format required, and in relation to the prompt submission of reports. During the course of this review, for example, the team had access to partial data in some cases owing to the fact that a full set of annual progress reports was not available from all research projects.

Secondly, in the case of progress reports submitted, there were a number of instances where reporting requirements, in terms of the level of detail specified, were not fully met.

Once the annual reports are submitted to SFI, we understand that each report is examined by programme officers within each directorate and followed up where required. One factor which was highlighted to our team was that, owing to staff issues at various times, outstanding reports may not have been completed fully in all cases.

There appears to be a reliance on the annual reporting mechanism as the primary source of information and data available to SFI to facilitate ongoing monitoring and evaluation. This means there is an inherent lag in the system, whereby a full picture on staffing, collaborative activities, research outputs/publications and commercialisation activities for a given year may not be available until the following year.

It is important to stress that these issues do not relate to ongoing governance and auditing functions within SFI, which meet stringent standards. However, reflecting the scale of funding committed by SFI across its programmes, it is appropriate that management information systems are developed to a level where senior management can provide an accurate, up-to-date picture on research projects underway and progress towards achievement of strategic and operational goals. .

Performance measures and indicators

The issue of reporting also relates to the application of performance measures and indicators to support the ongoing monitoring and evaluation of the effectiveness of SFI's programmes.

Performance indicators serve a number of functions, both internal to an organisation and external. Internally, they support the ongoing monitoring of activities, outputs and emerging impacts, with the objective of informing decision-making on future direction. Externally, they facilitate the flow of information to stakeholders such as government, industry and of course potential clients (or researchers in the case of SFI).

To be useful, however, performance indicators need to exhibit some specific features, including:

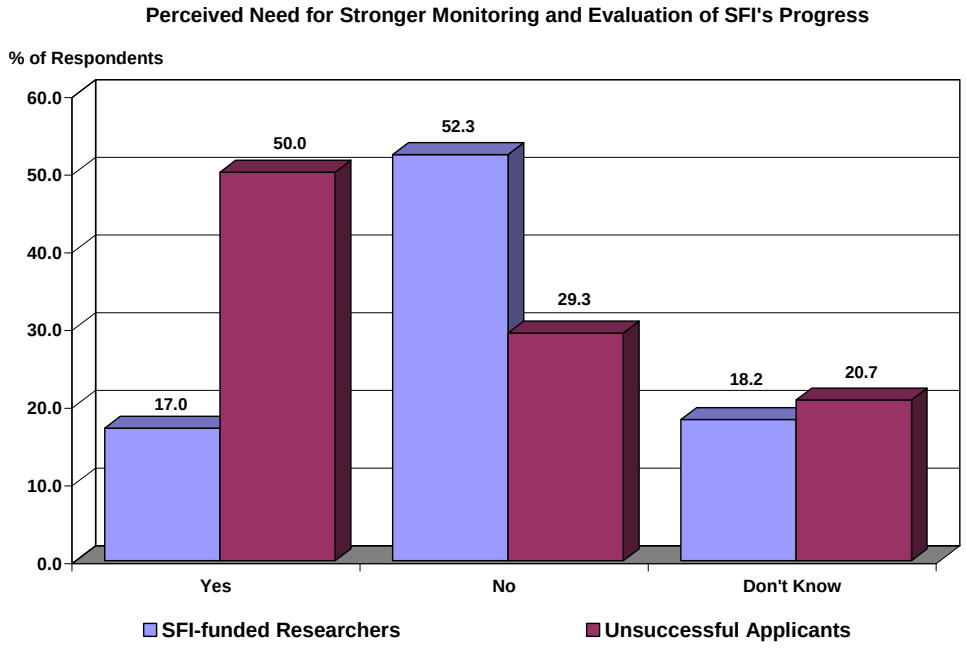
- The indicators should be **relevant** to the programme (or activity) in question; in other words, they should capture programme outputs or objectives. (Ideally, the task of articulating programme objectives and defining indicators should be approached as part of the same undertaking).
- The indicators should be **well-defined,** such that the meaning of the indicators would be generally clear to potential users of the information (e.g., officials in government departments or interested external parties) who might not necessarily be familiar with the programme;
- There should be a degree of **linkage** between the programme (or activity) in question and the indicators; this means that changes in the value of the indicator should be attributable (at least in part) to the programme;
- The **data** that forms the basis of the indicator needs to be available in a timely manner (such that it is useful for monitoring purposes) and any data collection costs (including time costs) should be proportionate to the usefulness of the indicator;
- Where **targets** are set, a balance should be aimed for such that these are realistic yet challenging for the programme management and implementation authorities.

The desirable qualities of good indicators are often summarised by the SMART acronym, i.e., the indicators should be:

- Specific;
- Measurable;
- Achievable;
- Realistic; and
- Timely.

As described earlier, a number of elements of information and data are currently requested by SFI as part of the annual reporting procedure and we believe that this is reasonably comprehensive. We also understand that the current report format represents an expansion in the level of detail tracked compared with reporting requirements at the outset of SFI's establishment. However, we would stress the importance of ensuring that data collected from the researchers is aggregated by SFI into overall programme, directorate and agency level indicators which can inform ongoing monitoring and management functions.

Figure 5.10: Perception on whether Stronger Monitoring and Evaluation of SFI's Progress is needed or not



Source: Indecon Survey of SFI-funded Researchers and Indecon Survey of Unsuccessful Applicants for SFI Funding
N= 88 SFI-funded research and 67 unsuccessful applicants

5.4.5 Organisational capacity within SFI

In Section 1 we described previously the scale of funding committed by SFI across its research programmes over a 4-5-year period. While this roll-out of funding has been successful, it does, however, underscore the need for effective management of existing projects and research teams, in addition to the processes supporting the funding of new research proposals, if value for money is to be achieved going forward.

In this context, an aspect which was highlighted in our discussions with both successfully funded researchers and research groups, and by unsuccessful applicants for SFI funding, concerns the continuity of approach and interaction with researchers operated by the agency.

We understand that a number of changes in staffing have occurred within SFI since its establishment, including changes of personnel at both programme manager and senior management level. These changes in staffing at SFI have reflected a variety of factors, including the use of part-time contracts for some staff. Where this has occurred, particularly at programme officer and manager level, researchers have suggested there were changes in process and procedures and in the approach to interaction with applicants and funded researchers alike. This was an issue highlighted also by the international academic advisors on this review and one which we believe merits closer attention going forward if the Foundation is to successfully manage the growing research base that it has successfully developed to-date.

5.5 International Comparative Position of SFI

As part of this review, consideration was also given to identifying the international comparative position and features of SFI vis-à-vis its counterparts and similar targeted research funding programmes in other countries. In particular, the inputs of the international academic advisors were sought on this issue.

One aspect which was considered concerns the strategic focus of SFI and it was noted in this respect that the origins and establishment of the Foundation drew significantly from the structures and approaches applied by research funding bodies in other countries and the Foundation has drawn extensively on the experience of international funding agencies/bodies across a number of countries in relation to the development and introduction of a range of best practice approaches to the attraction of research excellence and the development of academic research-industry linkages.

Models which shaped the formation of SFI and its programmes include the National Science Foundation (NSF) and the National Institutes of Health in the US. SFI's CSET mechanism, in particular, is modelled directly on the NSF's CSET programme. The development of SFI also drew from aspects of the Deutsche Forschungsgemeinschaft (DFG) in Germany and the Research Councils and the Wellcome Trust in the UK, among other organisations.

Furthermore, SFI's funding model has itself influenced the development of approaches in other countries including, for example, the Alexander von Humboldt Foundation in Belgium.

Among the features of SFI's operation that were noted by the international advisors, in particular, included:

- The strategic focus on a targeted set of sectors and disciplinary areas of research
- The focus on funding of excellence in research, supported by a rigorous, international best practice peer review process
- A portfolio approach, entailing the provision of supports across a range of programmes targeted at different areas of research and different researcher groups
- Ongoing, rigorous review procedures including site visits by external reviewers and other mechanisms to facilitate decision-making on funding renewal among other aspects.

These features were acknowledged as strengths of the SFI approach which draw from international best practice and which we strongly believe should be maintained and further strengthened where possible going forward.

Other issues, including areas of concern that were highlighted by the international academic advisors included the following:

- The need to maintain an appropriate strategic focus in terms research areas targeted and supported, which is in line with existing and emerging strengths in Ireland and international trends;
- Evident weaknesses in the area of information/data collation and MIS systems required to facilitate ongoing monitoring, assessment and decision-making (as highlighted earlier in this section);
- Challenges in relation to organisational capacity of SFI to manage the growing research base under its remit (as discussed earlier in this section);
- Scope for further improvements in the area of dissemination of research outputs, including, for example, the use of website-based publication, newsletters, events etc. to facilitate broad public awareness of and broaden participation in SFI research;
- The use of funding mechanisms to encourage/incentivise industry collaboration and leverage of other sources of funding.

5.6 Summary of Key Findings

In this section we examined the impact and effectiveness of SFI's programmes. A core element in this section considered the performance and impact of SFI's activities through a detailed assessment of the quality and quantity of research outputs produced by SFI-funded researchers and research groups. We then considered the evidence in relation to emerging wider economic impacts from SFI-funded research activities. Finally, this section also reviewed programme management and monitoring procedures. The key findings from the assessment of these aspects are set out below.

Assessment of Research Outputs and Quality

In relation to the research outputs of SFI-funded researchers, of greater importance than the *quantity* of research outputs concerns the *quality* of these outputs. It is important to highlight that the short time period since the establishment of SFI and the fact that research teams and associated research outputs did not begin to emerge until 2004/04 mean that the effective time window through which the assessment of research performance could be examined is constrained. Based on the available evidence, however, overall the assessment indicates that:

- SFI's research funding programmes and supports are successfully targeting and attracting the highest quality research talent, both in Ireland and internationally; and
- These researchers are producing research outputs in the highest ranking international publications in their fields.

Wider Economic Impacts

In terms of broader economic impacts, our analysis suggests that it is premature at this juncture to reach a definitive judgment on the precise impact of SFI's programmes. However, there are some promising early indications of potential future impacts.

Collaboration between SFI researchers and industry has increased significantly and the CSETs, in particular, have engaged with a wide range of industrial and other partners. However, Indecon believes that further progress can be achieved in this area, particularly in relation to the development of further linkages with MNCs located in Ireland and with indigenous Irish industry.

In relation to commercialisation activity, as noted previously, we believe it is too early in the vast majority of cases to discern significant commercialisation and IP outputs at this juncture. One measure of commercialisation outputs, namely patents, has shown an acceleration in activity levels particularly from 2004 onwards and significant numbers of patent filings are evident. However, further evidence on the outputs from these filings, in addition to other measures of output and impact in this area, are required to enable a more detailed assessment of progress.

IDA Ireland has stated as part of this review that SFI funding has acted as a strong reference sell for IDA visiting companies visiting Ireland and has also noted that significant R&D investment projects have come to Ireland and have developed strong linkages with SFI CSETs in particular. Leading companies surveyed by Indecon as part of this review believe that SFI is playing a role in the development of high-skilled human capital and the contribution of SFI in this area is evident in the numbers of PhD students and prospective graduates trained within SFI teams and particularly within the CSETs.

However, there remains a requirement for continued agency involvement – including via the Technology Transfer Officers supported by Enterprise Ireland, and with IDA Ireland - to bridge the gap between SFI-funded research and commercial development of new technologies. With the first round of CSET and PI funding drawing to an end, a sharper focus on this issue will be needed in the next funding period.

Programme Management and Monitoring

We reviewed a number of aspects of SFI's implementation and management of these programmes. Drawing on that analysis and other material such as the Brook evaluation undertaken in 2005, our main conclusions are set out below.

- Overall, SFI have managed the process of ramping-up a significant increase in public funding of research in a satisfactory manner.
- As concluded in the Brook review, the approach of project selection through a peer review process has worked well and we see no reason to take issue with the earlier findings on this issue.
- An issue noted by a considerable number of informants relates to a degree of staff turnover at SFI which has affected continuity of interaction between the agency and researchers/research.
- There are ongoing challenges to ensure, where appropriate, effective inter-agency co-ordination. This includes, in particular, coordination of the SFI programmes with the PRTLI funded by the HEA (the other major source of research funding in the State). There is also a range of challenges to ensuring the synchronisation of research funding programmes and funding decisions.
- The monitoring of grant-aided research programmes could be improved in some respects. While individual research projects provide regular progress reports to SFI, there is a need at central level to aggregate this information by reference to suitable performance indicators and make this available on a regular basis.

- There is also a need for additional mechanisms of *ex-post* review, which would assess projects against factors such as research quality, project management, cost effectiveness and value for money, and wider economic benefits, and which would also input to Foundation decision-making on future strategic direction, in terms of programme mix and focus, and associated funding strategy and allocations.

International Comparative Position of SFI

As part of this review, consideration was given to identifying the international comparative position and features of SFI vis-à-vis its counterparts and similar targeted research funding programmes in other countries. In particular, the inputs of the international academic advisors were sought on this issue. The key findings were as follows:

- The origins and establishment of the Foundation drew significantly from the structures and approaches applied by research funding bodies in other countries and the Foundation has drawn extensively on the experience of international funding agencies/bodies across a number of countries in relation to the development and introduction of a range of best practice approaches to the attraction of research excellence and the development of academic research-industry linkages. These include the National Science Foundation (NSF) and the National Institutes of Health in the US (SFI's CSET mechanism, in particular, is modelled directly on the NSF's CSET programme), the Deutsche Forschungsgemeinschaft (DFG) in Germany and the Research Councils and the Wellcome Trust in the UK, among other organisations. SFI's funding model has itself influenced the development of approaches in other countries including, for example, the Alexander von Humboldt Foundation in Belgium.
- Among the features of SFI's operation that were noted by the international advisors, in particular, included:
  - The strategic focus on a targeted set of sectors and disciplinary areas of research
  - The focus on funding of excellence in research, supported by a rigorous, international best practice peer review process
  - A portfolio approach, entailing the provision of supports across a range of programmes targeted at different areas of research and different researcher groups
  - Ongoing, rigorous review procedures including site visits by external reviewers and other mechanisms to facilitate decision-making on funding renewal among other aspects.

6 Conclusions and Recommendations

6.1 Introduction

This section presents the overall conclusions and recommendations of our review. As outlined in Section 1, we structure the material under the following headings which group together the issues from the Terms of Reference:

- Conclusions around the general policy consistency and relevance of SFI programmes and their links with other related interventions in the broad innovation area are presented in Section 6.2;
- Section 6.3 concludes on questions around the management and implementation of the programmes;
- Section 6.4 sets out our conclusions on the issues of the effectiveness and impacts of the SFI programmes;
- Based on these conclusions, we present our recommendations in tabular format in Section 6.5.

6.2 Programme Validity and Policy Consistency

In Section 2, we reviewed developments in innovation policy context at both national and EU level. Based on that analysis, we conclude that the SFI programmes are consistent with national and EU policy. At EU level, the Lisbon agenda for growth and employment generation emphasises the need for Europe to improve its innovation performance and to substantially increase economy-wide R&D investment. In this respect, Ireland has achieved noteworthy increases in R&D expenditures - both in the public and business sectors – but the State continues to lag behind other countries in terms of Gross Expenditure on R&D, which is equivalent to 1.6% of GNP compared with an EU-wide average of 1.8%.

At national level, the SFI programmes are relevant to the policy of creating a knowledge-based economy. They also follow from the objectives set out in the *Strategy for Science, Technology and Innovation*. For example, the SFI programmes should contribute directly to the objectives of building a sustainable world class research system and the more operational, output-focused objective of doubling the number of PhDs. Thus, in overall terms, SFI's programmes and activities remain valid and supportive of wider economic and innovation policy objectives.

6.3 Programme Effectiveness and Impact

6.3.1 Overview

We reviewed various aspects of the performance and effectiveness of SFI activity. It is important to emphasise that the evidence on impact and effectiveness available to the review team pertains to a short period since the establishment of the Foundation. However, on the basis of emerging observable outcomes to-date, we conclude overall that programme effectiveness, assessed in terms of funding commitments (inputs), employment of researchers (activity) and research outputs, is positive and this is supported by the following findings:

- A significant volume of investment has been committed to the funding of research excellence in the key areas of ICT and Biotechnology;
- A significant ramp-up in research activity and outputs has occurred with the assembly of strong and growing research teams;
- SFI funding has succeeded in attracting highly regarded researchers to Ireland; and
- The evidence suggests that good quality science is being undertaken by SFI researchers. Both the PI programme and CSET mechanism have, in particular, funded research outputs which have been published in the highest ranked journals internationally.

6.3.2 Overall Impacts

The question of the impact of SFI activity can, in principle, be addressed at two levels. First, there is the issue of the research impact of SFI-funded activity. Secondly, there is the issue of the wider economic spin-offs and impacts. Dealing firstly with the research impact, the evidence in the form of our assessment of the quality of SFI-funded research suggests a strong comparative performance.

Among the key findings from our assessment are as follows:

- SFI researchers perform better than their non-SFI, Irish counterparts in terms of early citations
- SFI-funded research outputs are published extensively in the top quartile (25%) of international journals
- SFI funding is associated with an increase in author productivity
- At programme level, significant impacts are observable in terms of the quality of research funded through SFI's PI programme and CSET mechanism (discussed further overleaf).

6.3.3 Wider Economic Impacts

In terms of broader economic impacts, our analysis suggests that it is premature to observe precise estimates of the impact of SFI's programmes. However, there are some promising early indications of potential future impacts. Collaboration between SFI researchers and industry has increased significantly but Indecon believes more can be achieved in this area. Commercialisation activity – as measured for example by numbers of patents granted - has recently increased but remains at low absolute levels. The CSETs have engaged with a wide range of industrial and other partners. IDA Ireland is of the view that SFI funding has acted as a strong reference sell for IDA visiting companies visiting Ireland. However, there remains a requirement for continued agency involvement – including via the Technology Transfer Officers supported by Enterprise Ireland, and with IDA Ireland - to bridge the gap between SFI-funded research and commercial development of new technologies. With the first round of CSET and PI funding drawing to an end, a sharper focus on this issue will be needed in the next funding period.

6.3.4 Impacts and effectiveness at programme level

In terms of the individual SFI programmes and in line with the Terms of Reference for this review, our analysis has focused on the Principal Investigator/Investigator programme and the Centres for Science, Engineering and Technology (CSETs) mechanism. These account for the bulk (over 72 per cent) of SFI funding commitments to date. The assessment of research performance indicates that the research outputs from both programmes have performed well in terms of quality of journal destination. In particular, just under half of articles published by CSET-funded research teams in both the BIO and ICT sectors published in the top 10 per cent of international journals, while almost 26% of articles published by non-CSET, PI-funded researchers published in the top 10 per cent of journals. Moreover, in terms of research productivity, the PI programme has been associated with strong improvements in research productivity.

While it is too early to draw definitive conclusions in relation to the longer-term impacts of SFI's programmes, the assessment lends support to the view that the Foundation's key programmes have and are continuing to play an important role in building a world-class research system in Ireland. Among the key findings that emerge from the assessment include the following:

- The Foundation has been in the process, principally via its Principal Investigators/Investigators programme, of building strong research teams, including through the attraction of significant numbers of leading researchers from overseas. Achieving and maintaining critical mass will be vital in this respect;
- In terms of researcher productivity, the evidence to date points to a steady increase in the volume of research outputs funded under the Principal Investigators/Investigators programme, although further evidence on research performance, including bibliometric assessment of research quality, would be required before more definitive conclusions could be drawn;
- SFI funding provided through the CSETs mechanism has helped to create research centres of international research excellence, which in the absence of SFI funding would be unlikely to be present in Ireland;
- SFI-funded research centers have forged partnership and networking arrangements with a wide range of industrial and academic partners. However, of key importance are the outcomes that emerge from these collaborative linkages in terms of research and commercialisation activities, and wider economic impacts;

- In addition, SFI research centres, and particularly the CSETs, have acted as a reference sell for IDA visiting companies visiting Ireland;
- While a number of the researchers and research centres have been successful in securing funding from non-SFI sources, in general further progress is required to maximise the leverage from SFI and PRTLI funding, particularly in relation to non-State, EU and other international sources, and industry funding; and
- The CSETs are involved in a range of outreach activities, including educational programmes, development of links with students at first and second level and wider public awareness-raising actions. Of importance, however, is the extent to which the research groups achieve wider dissemination of research among the public generally and industry in particular.

Overall, the available evidence on the performance of the PI and CSET programmes would indicate that the programmes are performing effectively. It is also important to note that while the CSETs have been successful, the nature of the model is such that it has enabled the centres to attract a greater profile and visibility. The Principal Investigators/Investigators programme, however, has attracted the lion's share (almost 49%) of overall funding commitments over the period 2001-2006, while this core programme has also supported the largest contribution to human capital generation in terms of researcher numbers and to research outputs. An important feature is the synergistic co-existence of these two programmes/mechanisms and the future of the CSET model or similar mechanisms is dependent upon the seeding of emerging research teams and centres among the PI-level researcher population.

However, there are areas where improvements in value for money and economic impacts of future phases of SFI funding could be enhanced and these are dealt with in our recommendations, presented later in this section.

6.3.5 Discontinuation, reduction or expansion in supports

An issue raised in the Terms of Reference for this review concerns the outcomes that might result from the discontinuation, reduction or expansion of the programmes. As noted earlier, we have concentrated our analysis on the Principal Investigator (PI) and CSET programmes, which have accounted for the vast bulk of funding committed by SFI over the period 2001-2006.

As noted previously, the two programmes have generally performed well in terms of research quality (as measured by destination journal ranking) and both programmes are, in general, associated with an improvement in researcher productivity. The two programmes would also appear to sit well with the overall mission of SFI and with wider government objectives as set out in the SSTI.

It is also important to recognise the merit of SFI offering a portfolio of different programmes which can attract different types of researchers and research activities particularly up to now in the early years of SFI. However, the question of the balance of funding as between these programmes and with other SFI programmes is an issue that will come into sharper focus as funding commitments to existing projects draw to a close and decisions have to be taken on whether to agree to an additional funding round or to cease funding.

Any significant discontinuation or reduction in supports could adversely affect the build-up of research capacity in Ireland, which is needed to maintain our international competitiveness. This would be the case particularly in relation to the human capital base in research and our assessment has shown that achievement of SSTI targets would not be possible without increased outputs of PhD graduates and increased numbers of Principal Investigators/senior researchers to support the development of these graduates.

Of particular importance in relation to decisions on future funding concerns the need to maximise the overall value for money of the very substantial level of public funds devoted to research activities in the State (under the current National Development Plan (2007-2013), a total of €1.4 billion in funding has been allocated to SFI programmes). Over the medium- to longer-term, as research projects achieve financial sustainability, a more balanced funding mix should prevail, which would be characterised by a reduced dependency on any one source of funding. This highlights the need to ensure that researchers maximise the leverage opportunities offered through the positive signalling and other benefits deriving from SFI support and we believe that some weighting in funding decisions to proposals which also demonstrate access to or the potential to attract EU or other international and industry sources of funding would assist in maximising the leverage of other funding sources.

The funding provided by SFI has significant potential to support economic development in Ireland and our recommendations, set out below, are designed to maximise the impact of this important research programme.

6.4 Programme Management and Monitoring

We reviewed a number of aspects of SFI's implementation and management of these programmes. Drawing on that analysis and other material such as the Brook evaluation undertaken in 2005, our main conclusions are set out below.

Overall, SFI have managed the process of ramping-up a significant increase in public funding of research in a satisfactory manner.

As concluded in the Brook review, the approach of project selection through a peer review process has worked well and we see no reason to take issue with the earlier findings on this issue.

A specific issue noted by a considerable number of informants relates to a degree of staff turnover at SFI which has affected continuity of interaction between the agency and researchers/research.

Inter-agency interaction and co-ordination

An important issue concerns the nature of ongoing effective interaction and co-ordination between different agencies overseeing the funding and development of research activities in the State. Given the importance of the agencies in the overall research funding sphere, this applies particularly to SFI and HEA and there are ongoing challenges to ensure where appropriate the effective coordination of planning and decision-making between the two agencies. This was a particular concern highlighted by the International Assessment Committee on the Impact Assessment of the PRTLI in 2004 and was also noted in the Brook Evaluation of SFI in 2005. The issue was also highlighted by the international academic advisors on this review and in our discussions with universities and research groups.

We acknowledge that a co-ordinated approach at national level has been instituted under the framework of the SSTI and the National Development Plan, including the Higher Education Research Group which is responsible for coordination between relevant agencies. The SSTI, in particular, has included the specification of formal, quantified targets for the output of new principal investigators/group leaders in research and the associated space requirements in terms of infrastructure to support these researchers.

Outside of these formal frameworks, however, of particular importance is the extent of effective *ongoing* interaction between key agencies, including SFI and HEA, in terms of planning and decision-making. We understand that there is regular contact and dialogue between SFI and HEA officials. We also understand that the PRTLI Cycle 4 has seen closer working relations between the two agencies. Indecon would support the continuation and deepening of the process of interaction and co-ordination between the agencies at all stages to ensure that ongoing identification of space requirements is aligned with emerging demands in relation to different areas of research.

Programme Monitoring

The monitoring of grant-aided research programmes could be improved in some respects. While individual research projects provide regular progress reports to SFI, there is a need at central level to aggregate this information by reference to suitable performance indicators and make this available on a regular basis. There is also a need for additional mechanisms of *ex-post* review, which would assess projects against factors such as research quality, project management, cost effectiveness and value for money, and wider economic benefits, and which would also input to Foundation decision-making on future strategic direction, in terms of programme mix and focus, and associated funding strategy and allocations.

6.5 Overall Conclusions

This review entailed a detailed independent and rigorous assessment of the funding activities and related outputs, emerging impacts and effectiveness, and overall value for money achieved by SFI since its establishment in 2000/2001. Overall, the findings from the review must be interpreted within the context that the assessment was constrained by the very short time period of data available since the establishment of SFI and the commencement of its main programmes. In this regard, while we believe it is premature to reach definitive conclusions at this juncture, the emerging picture is positive and indicates that if current progress is maintained and if a number of emerging issues are addressed, SFI programmes hold out the prospect of delivering value for money. This is evident in the scale of funding committed, both in absolute terms and relative to overall R&D funding in Ireland, the contribution of the Foundation to the development of human capital in research, and the performance and quality of research outputs which have emerged to-date. Significant outputs and emerging impacts are also visible in relation to the development of collaborative linkages, although we would contend that further progress is required in this area, particularly in relation to the further development of linkages with industry in Ireland, including with indigenous firms.

An important issue concerns the wider economic impacts of the investment in R&D activities supported by SFI programmes. Again, while we believe it is too early to deliver a definitive judgment on the extent of wider economic benefits, the limited available data on commercialisation activities suggests that some progress is evident (measured, for example, by reference to patent filings) but further evidence of impacts will be required in this area. In relation to inward investment linkages, we understand that SFI funding has acted as a strong reference sell for IDA visiting companies visiting Ireland, while significant R&D investment projects have come to Ireland which have developed strong linkages with SFI CSETs, in particular.

6.6 Recommendations

A series of recommendations flow from the assessment undertaken and conclusions derived through this review and these are summarised in the table overleaf and are elaborated upon in the subsequent paragraphs.

Table 6-1: Summary of Recommendations

No.	Recommendation
1.	SFI should continue to implement its core mission of funding research excellence in areas where Ireland can compete effectively on a global scale.
2.	An increased focus on effective industry collaboration (see further below) and measures to enhance the commercialisation of research should form part of future management of the next phases of SFI funding.
3.	Increased focus is required to align collaborations by SFI-funded researchers with the requirements of industry based in Ireland.
4.	Mechanisms to ensure that SFI funding maximises the leverage of EU and other international sources of funding for Irish research should be introduced.
5.	The development agencies, including IDA Ireland and Enterprise Ireland, should intensify efforts to engage new and existing client companies with SFI-funded research teams/centres.
6.	SFI should consider the merits of a centrally managed database of inputs and outputs relating to SFI funded projects, which would track a range of input, output and impact indicators.
7.	A system of ex-post review, which would combine elements of the existing ex-ante peer review and interim review process but place greater emphasis on the assessment of economic impact and value for money, should be put in place for completed SFI-funded research.
8.	Continued efforts are needed to ensure effective inter-agency interaction and co-ordination including, in particular, between SFI and HEA.
9.	SFI should carry out regular, systematic bibliometric analysis of SFI-funded research outputs and publish the highlights of this analysis
10.	Measures to enhance the likelihood of top-ranking researchers remaining in Ireland should be given a high priority.

Source: Indecon

These recommendations, which also draw from the inputs of the external international advisors to the team, maintain the focus of existing SFI operations but are designed to improve the ongoing implementation and management of the Foundation's programmes and to maximise the future impact and value for money from the substantial public resources invested in SFI-supported research in Ireland.

SFI SHOULD CONTINUE TO IMPLEMENT ITS CORE MISSION OF FUNDING RESEARCH EXCELLENCE IN AREAS WHERE IRELAND CAN COMPETE EFFECTIVELY ON A GLOBAL SCALE

Since the late-1990s, a radical transformation has taken place in the research funding landscape in Ireland and there have been substantial increases in R&D expenditures. SFI, along with the Higher Education Authority (HEA) (via the Programme for Research in Third-Level Institutions (PRTLI)), has played an important role in this turn-around.

While it is premature to reach definitive conclusions at this juncture, the emerging picture in relation to SFI's outputs and emerging impacts is positive and indicates that if current progress is maintained and if a number of issues are addressed, SFI programmes hold out the prospect of delivering value for money.

Overall, however, it is important to emphasise that if the impacts of SFI funding are to be maximised going forward, continued focus on funding of research excellence is required and ongoing close attention will need to be given to ensuring that the Foundation's programmes target funding at those activities which are aligned with, and build upon, existing strengths in niche areas of research where Ireland can compete effectively on a global scale.

AN INCREASED FOCUS ON EFFECTIVE INDUSTRY COLLABORATION (SEE FURTHER BELOW) AND MEASURES TO ENHANCE THE COMMERCIALISATION OF RESEARCH SHOULD FORM PART OF FUTURE MANAGEMENT OF THE NEXT PHASES OF SFI FUNDING

The extent to which the wider economic benefits of investment in research programmes by SFI can be maximised and contribute to significant longer-term benefits for Ireland will be dependent upon the evolution of SFI's programmes and the development of effective collaborative linkages and commercialisation outcomes. Our evaluation of collaborative linkages that have developed on foot of SFI funding since the establishment of the agency in 2001 indicates a positive outcome and there has been significant progress in terms of the overall numbers of collaborations developed. However, the numbers of academic collaborations developed have been greater than those which have involved industry-based collaborative activity.

We believe that in managing the development of future phases of SFI funding, greater attention should be given to the development of deeper industry-based collaborative linkages, both in Ireland and overseas, which have a greater focus on research activities which have potential commercialisation spin-offs. This should involve an increased emphasis on early-stage collaborative identification of new areas of research by industry partners and researchers/research groups, including the extension of collaborative features of the CSETs to non-CSET-funded researchers supported by SFI through its PI and other programmes (including, for example, through the recently commenced Strategic Research Clusters (SRC) programme).

We would highlight the need for the proactive involvement of the development agencies with SFI to bridge the gap between SFI-funded research and commercial development of new technologies. Both IDA Ireland and Enterprise Ireland have an important role to play in working with SFI to take forward the research emerging from SFI-funded research groups and to identify potentially commercially viable activities and technology transfer opportunities. Notwithstanding the work underway to-date in this area – including the development of EI-funded Technology Transfer Offices (TTOs) within the universities - with the first round of CSET and PI funding drawing to an end, a sharper focus on this issue will be needed going forward if the potential economic benefits of SFI funding are to be maximised. However, we strongly support the ongoing provision of supports for fundamental research and the issue raised is one of emphasis.

INCREASED FOCUS IS REQUIRED TO ALIGN COLLABORATIONS BY SFI-FUNDED RESEARCHERS WITH THE REQUIREMENTS OF INDUSTRY BASED IN IRELAND

Our analysis of collaboration activity has indicated that a significant proportion of industry-level collaborations involving SFI-funded researchers that have developed to-date have involved linkages with industry located overseas. Of importance, in particular, is the extent of interaction between SFI researchers/research groups and indigenous Irish firms. The overall number of such interactions has increased. However, although we are supportive of international linkages with industry, our analysis raises concerns over the comparative extent to which SFI-funded research has to-date engaged successfully with Irish-based, indigenous firms and further progress in this area is required if SFI researcher is to generate significant economic spin-offs involving Irish-based, indigenous industry.

There is an important need to ensure that the involvement of and ongoing interaction between industry based in Ireland – including both international firms located in Ireland and indigenous Irish firms - and SFI-funded research teams are maximised. This is not to suggest that international collaborative activity does not yield significant benefits for Ireland and we are supportive of international linkages with industry.

We believe that future development of SFI-funded research must ensure that close linkages with Irish-based industry are fully maximised. While we acknowledge that this is a challenging area, if a proactive approach is implemented by SFI working closely with the development agencies we believe that would be likely to enhance the economic impact of SFI expenditures and would also potentially assist in retaining researchers in Ireland in the medium term.

MECHANISMS TO ENSURE THAT SFI FUNDING MAXIMISES THE LEVERAGE OF EU AND OTHER INTERNATIONAL SOURCES OF FUNDING FOR IRISH RESEARCH SHOULD BE INTRODUCED.

An issue in relation to the assessment of value for money of SFI's funding of research activities in Ireland concerns the extent to which funding from SFI figures in the overall mix of funding generated by researchers and research groups. A related issue concerns the extent to which success in accessing SFI funding, through providing a positive signalling effect, increases the opportunity for researchers to *leverage* funding from other public and private research funding organisations, and from international sources including EU Framework Programme, European Research Council and other sources.

Our investigations among researchers indicates that in the short-term, post-SFI landscape, SFI has become the main source of funding for researchers funded by its programmes and, on average, SFI funding now accounts for of the order of 63% of current funding among these researchers. This realignment of funding sources towards SFI has reduced the importance of other Irish funding sources which have declined in proportionate terms. However, while the absolute levels of EU FP funding have increased, for example, the proportion of funding generated through European Union institutions has decreased, while the proportion of funding accessed by SFI researchers from international and other sources has also decreased. On average across SFI researchers, industry funding has remained constant at a low proportion of overall funding before and subsequent to receipt of SFI funding.

To maximise the value for money from public funds, we believe that appropriate mechanisms should be considered to incentive the leverage of other domestic, non-public funding sources or international funding sources, including EU and other programmes. This could include the application of appropriate 'weighting' mechanisms in the criteria used to assess funding applications, which attach a weighting to proposals which can demonstrate actual or the strong likelihood of inclusion of funding from non-public, international and industry sources.

THE DEVELOPMENT AGENCIES, INCLUDING IDA IRELAND AND ENTERPRISE IRELAND, SHOULD INTENSIFY EFFORTS TO ENGAGE NEW AND EXISTING CLIENT COMPANIES WITH SFI-FUNDED RESEARCH TEAMS/CENTRES.

As noted previously, to facilitate the maximisation of the potential economic benefits arising from public investment in research will require ongoing focus on supporting the development of new and the deepening of existing collaborative links between research teams and industry partners. However, this also requires the identification of potential partners and mutually beneficial areas of research, supported by appropriate management and IP structures.

SFI has played an important role in supporting and fostering collaborations between funded research teams and leading companies and the success in this area is particularly evident in CSETs.

There is an important need, however, to provide ongoing support in this area to facilitate the engagement of companies in the research area and experience has shown that while this has been more successful in the case of large multi-national and indigenous companies who have clear research functions, and involving the SME sector in long-term research activities remains a challenge.

We believe there is an ongoing role for the development agencies, including Enterprise Ireland and IDA Ireland, to continue to work closely with SFI in this area to support efforts to engage both new and existing client companies with SFI-funded research teams and Indecon would recommend that measures be implemented to ensure effective ongoing co-ordination between SFI and the development agencies in this area.

SFI SHOULD CONSIDER THE MERITS OF A CENTRALLY MANAGED DATABASE OF INPUTS AND OUTPUTS RELATING TO SFI FUNDED PROJECTS, WHICH WOULD TRACK A RANGE OF INPUT, OUTPUT AND IMPACT INDICATORS

Currently, in terms of information available to SFI management and programme officers, the foundation relies almost solely on an annual progress report system which requires researchers and research groups to complete and submit a pre-specified report. The current format constitutes a detailed report which requests information on activities over the previous year in relation to a range of aspects. While the existing system has produced valuable information, there are some inconsistencies in the completion and submission of reports, and in relation to the time lags inherent in this system. Also of significance is the need to obtain more detailed information in relation to the precise nature of industry linkages/collaborations.

We recommend that SFI should consider the merits of a centrally managed database of inputs and outputs relating to SFI funded projects. This database would track a range of input, activity, output and impact indicators such as expenditure draw-down, numbers of PhD students, post-doctorates, research professors, published papers, copyrights, patents and other technology transfer metrics. In relation to collaboration activities, we also believe changes are required in relation to the nature of strategic information collated by SFI to clarification not only in relation to the number of interactions with industry but also the number of companies involved.

We believe that SFI should maintain and update such a database on an annual basis and a fixed date each year. This *census* approach would involve funded researchers and research groups/centres inputting to a database (possibly online via an intranet framework) and using a common template. As well as ensuring access to information/data on a range of aspects in a timely and consistent fashion, this would also facilitate international benchmarking of SFI activities and performance.

A SYSTEM OF EX-POST REVIEW, WHICH WOULD COMBINE ELEMENTS OF THE EX-ANTE PEER REVIEW AND INTERIM REVIEW PROCESS BUT PLACE GREATER EMPHASIS ON THE ASSESSMENT OF ECONOMIC IMPACT AND VALUE FOR MONEY, SHOULD BE PUT IN PLACE FOR COMPLETED SFI-FUNDED RESEARCH.

We recommend that a system of *ex-post* project and research programme review should be put in place for completed SFI-funded research. This would draw from the existing best practice review *ex-ante* peer review and interim review processes operated by SFI but would place additional emphasis on the assessment and evaluation of the value for money achieved from SFI funding. In addition to facilitating the ongoing evaluation of effectiveness and value for money, this would input to Foundation decision-making on future strategic direction, in terms of programme mix and focus, and associated funding strategy and allocations. This would also serve both an accountability and 'lesson-learning' purpose. Research would be assessed against a range of criteria including research quality, project management, cost effectiveness and, critically, wider economic benefits, including commercialisation outcomes and spin-offs.

CONTINUED EFFORTS ARE NEEDED TO ENSURE EFFECTIVE INTER-AGENCY INTERACTION AND CO-ORDINATION INCLUDING, IN PARTICULAR, BETWEEN SFI AND HEA

A particular aspect highlighted in our review of programme management concerns the nature and effectiveness of interaction between different State agencies overseeing the development and funding of research, and the subsequent translation of research outputs into commercialisation outcomes and wider economic impacts.

There are ongoing challenges in this area to ensure, where appropriate, the effective coordination of planning and decision-making between agencies. This applies particularly to SFI and HEA, given the importance of the agencies in the overall research funding sphere, and this was a major concern highlighted by the International Assessment Committee on the PRTLI in 2004. However, increasingly, as SFI-funded research activities reach a further stage of development, the development agencies – including IDA Ireland and Enterprise Ireland – will have a deeper role in terms of both development of collaborative linkages and the translation of research outputs.

We acknowledge the formal frameworks in place within the context of the SSTI and NDP programmes, including the setting of quantified targets for the achievement of specified outcomes in relation to human capital development and research infrastructure requirements. Outside of these formal frameworks, however, of particular importance is the extent of effective ongoing interaction between key agencies, and particularly SFI and HEA. We understand that ongoing interaction between the agencies has increased significantly. Indecon would support the continuation and deepening of this process to ensure that interaction becomes the norm at all stages of the programme and project cycle, i.e., issue of calls for proposals, evaluation and decisions on applications and project monitoring and reporting.

SFI SHOULD CARRY OUT REGULAR, SYSTEMATIC BIBLIOMETRIC ANALYSIS OF SFI-FUNDED RESEARCH OUTPUTS AND PUBLISH THE HIGHLIGHTS OF THIS ANALYSIS.

A detailed bibliometric assessment of the extant and quality of SFI-funded research outputs was undertaken as part of this review. This analysis constitutes a powerful tool which enables the identification of the productivity of researchers and the quality of their published outputs based on a range of internationally recognised peer review indicators.

We believe that SFI, as part of its ongoing monitoring and evaluation procedures, should undertake regular, systematic bibliometric reviews of funded research outputs. This approach, which would facilitate the ongoing assessment of the quality and impacts of funded researchers and research groups, would provide a valuable input to decision-making on the future direction and targeting of support programmes.

To facilitate transparency and accountability within the context of maximisation of the value for money of public funds, we would also recommend that the overall findings (in aggregate form) from such bibliometric assessments be published.

MEASURES TO ENHANCE THE LIKELIHOOD OF TOP-RANKING RESEARCHERS REMAINING IN IRELAND SHOULD BE GIVEN A HIGH PRIORITY.

An issue within the context of value for money from public investment in research concerns the need to attract and retain high quality researchers in Ireland.

Our assessment and discussions with researchers has highlighted the degree of international mobility of high quality researchers. This has benefited the State as the assessment in this review has indicated that SFI has succeeded in attracting significant numbers of researchers from overseas in recent years while also retaining indigenous Irish researchers who might otherwise have moved abroad. It is generally accepted that international mobility constitutes a positive dynamic, where researchers benefit from exposure to approaches and ideas in different environments. However, this also highlights the increasingly global and competitive nature of high quality research activities and underscores the need to maintain the attractiveness of Ireland as a location for top quality researchers.

We believe that in attracting and retaining top-ranking research staff in Ireland going forward, increased focus should be given, both by SFI and education/research institutions, to the development and application of flexible approaches to recruitment and retention of staff.

ANNEXES

Annex 1 Glossary of Terms

Annual Publication Rate: A measure of research productivity. (For the purposes of the analysis in this report, the data is expressed as numbers of publications per researcher per annum. Integer counting is also used: a researcher is credited with a whole publication, not a fraction, in the case of a jointly-authored paper.)

Article-level Indicator: An indicator that is based on directly observable characteristics of individual research papers, for example, the number of times that a given paper was cited during 2005.

Bibliometrics: The study of publication patterns, often for the purposes of research evaluation. Bibliometrics typically deals with publishing and communication phenomena at high levels of aggregation (e.g. at the national level) and thus shares many common features with population studies.

Citation: A citation is a reference to a book, article, web page or other published item in sufficient detail to identify the source uniquely. Citations are used in scholarly work to give credit to or acknowledge the influence of others. In the context of this report, they are best understood as signposts to significant previous research findings, methodologies or concepts.

Citation Window: A citation window is the period of time that elapses between the publication of an item and the point at which citations to that item are counted. A three-year citation window is used in this report to calculate the early citation rate.

Conference Presentations: One of a range of possible publication formats used by researchers to disseminate the findings/outputs of their activities to different audiences. The extent to which this format is used varies between fields and conference papers are generated typically as a result of invitation. Unlike journal-based papers, no internationally agreed quality assessment measure is available to enable comparison of quality of conference papers/presentations. However, metrics such as extent of keynote presentations may provide an indication of the 'standing' of researchers.

Document Type: For the purposes of this report, document type is an umbrella term embracing journal articles, notes or letters, editorials, reviews and conference papers.

Early Citation Rate: The early citation rate is a standard measure of the rate at which articles are cited in their first few years of publication. For a 2003 early citation rate, the numerator is the number of citations accruing to 2003 publications using a three-year citation window divided by the number of source papers and then by three to give an annual rate.

Efficiency: The extent to which desired effects are achieved at reasonable cost.

Effectiveness: A measure of the extent to which an intervention achieves its objectives.

Impact: The longer-term effects or consequences of an intervention (see also *outcome*). One can distinguish between **specific** impacts (see *results*), and **global** impacts (see *outcomes)* and also **intermediate** impacts that lie between specific and global impacts.

Inputs: The human and financial resources involved in the implementation of an intervention.

Immediacy Index: A term used by Thomson Scientific (ISI). It is the ratio of papers cited to papers published within the same publication year. A high immediacy index suggests an unusually rapid take-up of ideas by other researchers. Such work might be described as particularly cutting edge (or controversial).

Impact: A generic term for some standard indicator that measures the rate of citation to a population of source documents. More specifically, two kinds of impact are measured in this report: early citation rate and journal impact factor.

Impact Factor: The impact factor is the ratio of the number of citations received by a journal in a given publication year divided by the number of articles, notes and reviews that generated those citations. In order to provide a standard measure, the citation count is restricted to recent papers only. So, for a 2006 journal impact factor the numerator is given by the number of citations received during 2006 restricted to those that come from 2004 and 2005 papers in the same journal. The denominator is the number of those 2004 and 2005 papers. The impact factor is thus a measure of the `average citedness' of an article in a particular journal.

Journal-level Indicator: An indicator that derives generically from the journal that published the papers in the project database rather than specifically from the papers themselves: for example, the rank of the publishing journal within its field.

Outputs: The goods and services produced by an intervention/support.

Publication year: The year formally attaching to a publication to aid its description and retrieval by researchers. Publication years and calendar years are not always in perfect synchronisation and a 2005 journal issue may actually appear, and possibly even be cited, in 2004.

Quality: Ultimately most researchers in bibliometrics agree that the absolute quality of a publication, at least in the every-day meaning of that term, is impossible to measure directly. Citations are often used as a proxy for quality in bibliometrics and `quality' in this specific context is probably best understood as fitness-for-purpose: work that scientists find especially useful will tend to be cited more often than work that is less relevant to their needs or that falls below an acceptable threshold of rigour.

Research Outputs: Publications, formal or informal, that arise during the course of research. Depending upon the field, these outputs might include journal articles, conference papers, websites, patents, software or datasets.

Scopus: A large-scale database of scientific papers produced by the Anglo-Dutch publisher Elsevier. Like Thomson Scientific, Scopus indexes the references as well as the papers themselves, thus making it possible to undertake citation analysis.

Subject Area: In this report, subject area should be understood as referring to the main subject of the journal, not necessarily the main subject of the paper. So, for example, a Biotechnology field paper on a drug used in the treatment of schizophrenia may be indexed under Neuroscience or Pharmacology (not both) depending on the nature of the source journal.

Thomson Scientific: A major US scientific database publishing company that produces standard bibliometric indicators such as journal impact factors as well as a large-scale citation databases.

Virtual Impact Factor: Virtual impact factors are used to describe the citation performance not of journals but of groups of researchers. The indicator is calculated using the same approach as that used to calculate the standard journal impact factor. By comparison with standard journal impact factors, the virtual impact factor is constructed at article level and therefore measures the real performance of SFI-funded researchers as opposed to the overall performance of the journals in which they publish.

Annex 2 Case Studies on CSETs

A1.1 Introduction

The following section outlines a number of case studies of the SFI funded CSET research groups. The analysis covers a number of aspects of the CSETs including staffing, management structure, funding, commercialisation and partnerships, and outreach programmes.

A1.2 DERI

A1.2.1 Introduction/Overview

DERI (Digital Enterprise Ireland Institute) was founded in June 2003 as a result of SFI CSET funding. The initiative originated within the National University of Ireland, Galway (NUIG) in association with Hewlett-Packard, which is active in software development in Galway.

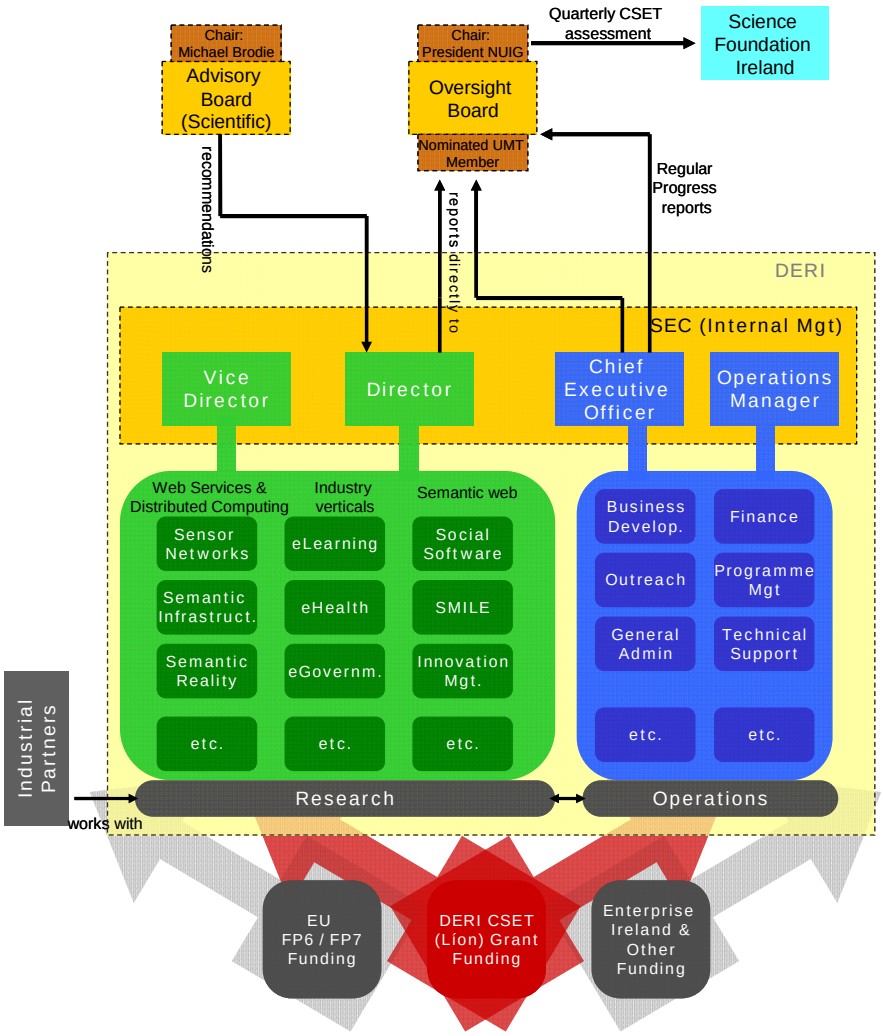
The SFI-funded DERI CSET succeeded in attracting two leading researchers from outside Ireland in the field of semantic web services. Semantic web is a specialised area of computer science aimed at structuring and organising different types of data within and across organisations whilst allowing different contributors to preserve their own languages ('ontologies') in a way that is intelligible to end-users, including members of the general public. As outlined below, semantic web has a wide range of potential applications, including health and government services. The immediate users of semantic web are other businesses but ultimately the end-users would be persons – for example, patients of medical practitioners. DERI is the only organisation of its kind in Ireland and has become a world leader in the development of semantic web since its foundation in 2003.

SFI has enabled the establishment of DERI (including the building and physical infrastructure), the coverage of overheads and the development of key prototype technologies. DERI has also leveraged further funding, primarily from the EU. In turn, the SFI and other funding sources have enabled DERI to develop potentially significant new applications of semantic web services in eLearning, eGovernment, eHealth, Sensor Networks, Telecommunications and eScience.

A1.2.2 Management

The management structure of DERI is illustrated in the figure below. The day-to-day management of DERI comprises two parts – a Research function (denoted in green in the chart) and an Operations function (denoted in blue).

Management Structure of DERI



Source: DERI.

The Director and Vice-Director, together with the Chief Executive Officer (CEO) and Operations Manager on the Operations side, make up the Strategic Executive Committee of DERI, which manages business developments and outreach as well as the various research activities. The Director and CEO report to the DERI Oversight Board (which is chaired by the President of NUIG) and the reporting include the provision of regular progress reports, which in turn are an input into the Oversight Board's quarterly CSET assessments to SFI. The Oversight Board provides governance, guidance and advice to DERI to ensure that its activities are consistent with its vision, goals and management plan. This responsibility includes all activities of DERI no matter what the funding source (e.g. SFI, EU, Enterprise Ireland, IDA & NUIG). Indecon understands that the Oversight Board initially held monthly meetings; however, the Board decided that it was sufficient to meet on a quarterly basis, and has been doing so for this reporting period. It is envisaged that the Board will continue with the policy of quarterly meetings.

In addition to the Oversight Board, there is also an Advisory Board (Scientific) that makes recommendations to the Director concerning the research function of DERI. Membership of the Advisory Board includes leading international research scientists, who are also involved in industry collaboration.

Indecon understands that the Advisory Board was reconstituted during 2006/07 to a more manageable size. The Advisory Board provides scientific guidance and advice to the centre and ensures that its activities are consistent with its scientific vision, goals and scientific strategic plan. The Advisory Board may also act as a resource to help identify PI candidates for recruitment to DERI.

In Indecon's consultation with DERI, it was learned that the Advisory Board has been helpful regarding identifying project leaders as well as being instrumental in suggesting projects and making the right connections. An example in this regard was the Advisory Board setting up contact between DERI and a post-doctoral researcher at MIT, for whom DERI submitted a Stokes proposal. Nevertheless, attracting senior personal is always a challenging ongoing task.

A1.2.3 Funding

The composition of the sources of funding to DERI (2003-2010) is shown in the table below. The major funding source of DERI to date has been SFI through its CSET mechanism, followed by the EU (including FP7, which becomes available beginning in 2008) and Enterprise Ireland.

Breakdown of Sources of Funding to DERI 2003-2010 - €'000

Funding Source	2003	2004	2005	2006	2007	2008	2009	2010	Total	%
SFI	531	2,614	3,552	3,003	2,245	1,241			**13,186**	***53.0***
Enterprise Ireland		18	24	977	977	953			**2,949**	***11.8***
European Union (includes FP7)		872	1,011	2,224	1,592	1,848	576	308	**8,431**	***33.9***
HEA - SIF					150	166			**316**	***1.3***
Industry - Direct Funding					15				**15**	***0.1***
Total	**531**	**3,504**	**4,587**	**6,204**	**4,979**	**4,208**	**576**	**308**	**24,897**	***100.0***
EU FP7 Funds						*453*	*453*	*308*		

Source: DERI, Indecon analysis.

One of the main issues concerning funding relates to the timing of the review process (by SFI) and the granting of continued SFI funding in May 2008 (when the first round of SFI funding is due to expire). While decisions on renewal of funding for this, as with any other research group, must be based on a rigorous assessment of performance and value for money, it is understood that uncertainty in continuation of funding may make it more difficult to hire and retain key research staff. Indecon understands that DERI has been in the process of assembling a proposal for a second round of funding for the group.

A1.2.4 Research and Research Performance

In assessing the research of DERI, papers accepted at major international conferences are a key performance metric in the area of semantic web – more so, Indecon understands, than papers accepted in journals. This reflects the rapidly changing nature of semantic web and the need to disseminate research as rapidly as possible (publication lags tend to be in months, rather than years).

Research publications between 2003 and 207 at DERI have totalled 288 and recent highlights include:

- World Wide Web Conference 2007 (acceptance rate of 15%);
    - 3 Conference Papers

- European Semantic Web Conference 2007 (acceptance rate of 17%)
  - Conference Papers (1st rank)
- International Semantic Web Conference 2007 (acceptance rate of 11%)
  - Conference Papers (shared 1st rank)
- Tutorials (e.g., WWW 2006, WWW 2007, JCDL 2006)
- Workshops (e.g., ISWC 2006, WWW 2007, FLOC),
- Conferences (ISWC, IEEE P2P, ESWC)

The importance of conference papers to the research performance of DERI is seen in the table below. Conference papers delivered since 2003 have accounted for almost 54% of all research papers at DERI.

Breakdown of Research Publications at DERI 2003-2007

	2003	2004	2005	2006	2007	Total	%
Number of Published Articles in Refereed Journals	7	5	11	4	9	**36**	***12.5***
Number of Notes or Letters in Refereed Journals						**0**	***0.0***
Number of Books or Monographs Published			1			**1**	***0.3***
Number of Review Articles Published						**0**	***0.0***
Number of Editorial Articles Published						**0**	***0.0***
Number of Workshop Papers	3	19	26	25	23	**96**	***33.3***
Number of Conference Papers Delivered	4	13	32	47	59	**155**	***53.8***
Total	**14**	**37**	**70**	**76**	**91**	**288**	***100.0***
%	***4.9***	***12.8***	***24.3***	***26.4***	***31.6***	***100.0***	

Source: DERI, Indecon analysis.

In assessing the research profile of DERI, Indecon also obtained information on the level of 'esteem' attributed to researchers *via* plenary sessions given at Irish and international conferences and editorial board membership. The figures shown in the table below reveal a significant level of research esteem in 2007, particularly in the international sphere.

Evidence of Research Esteem among DERI Researchers 2007

	2007
Number of Plenary/Keynote Speeches at Conferences held in Ireland	3
Number of Plenary/Keynote Speeches Delivered at Internationally-Held Conferences	9
Number of Members on Editorial Boards of Irish-Based Journals	0
Number of Members on Editorial Boards of Internationally-Based Journals	3
Number of Members on Irish Government Scientific Boards or Committees	1
Number of Members on International Scientific Boards or Committees	1
Number of Members on UK RAE Panels	0
Number of Members on Research Evaluation Panels Internationally (EU, US, Other)	2

Source: DERI, Indecon analysis.

Further evidence of the international profile of DERI takes the form of a number of off-shoots or international 'plantings' of the DERI Galway model, including:

- DERI Stanford (which currently has 10 people);
- DERI Korea (Seoul) (currently 60 people);
- DERI Innsbruck (currently 50 people).

We also understand that a new DERI off-shoot at EPFL in Switzerland is being planned. In each of these organisations, DERI (Galway) owns the Boards and operation is by way of a Memorandum of Understanding (MOU) between DERI and each off-shoot. There are exchange programmes among the DERIs, including between DERI (Galway) and the off-shoots. A key issue will be the outputs that emerge from these formal linkages.

A1.2.5 Commercialisation

Patenting and copyright is generally less important in the area of semantic web than in other areas of applied science because of the 'open source' nature of semantic web. The economic incentive of DERI is basically to attract more users to its services, which raise the profile of DERI and in turn allows DERI to attract more funding and interest from industry as its presence develops.

Our understanding is that SFI has enabled DERI to realise this dynamic: in particular, the SFI funding has underpinned the research core of DERI and the development of prototypes (e.g. Semantically Interlinked Online Communities or 'SIOC'), which business users are beginning to consider. The typical prototype of DERI would be a piece of software engineering (e.g. SIOC, licensing in progress), which would attract the attention of a user (i.e. a software firm), who would in turn develop the prototype along its own lines. In this way, a requirement for DERI, which provides the first link in the supply chain of semantic web, is to provide flexible prototypes in order to be of value to as many downstream software firms as possible.[12]

DERI is aiming at creating a set of companies around DERI technology in Galway – what it terms 'DERI Land'. This includes talks with the following foreign-owned companies, the first of which has a base in Galway:

- Cyntelix (US, Netherlands - established);
- Openlink (UK);
- Imola (Italy);
- Topquadrant (US).

In terms of SFI-funded industry partners, HP Galway is DERI's anchor client and that relationship has inputted into the DERI Lion project (aimed at a semantic desktop and web package). Other existing, or in development, partnership, include: Nortel; Cisco; IBM; Ericsson and Storm (see figure overleaf). In conjunction with the transfer technology office (TTO) at NUIG (where a Case Manager for ICT, Engineering and Software Development has been assigned to DERI), we understand that DERI is engaging with multinational corporations and SMEs to explore new opportunities.

[12] As well as SIOC, other DERI technologies/prototypes in which licensing is in progress are: WSMX; JeromeDL; Analyst Workbench (joint licensing with HP); and SWSE.

Storm Technologies as an Industry Partner with DERI

The supply chain or vertical relationship stemming from the activities of SFI-funded DERI may be seen to take the form:

DERI → Software Development Company → User Company

Storm Technologies Limited (founded in 1995 and based in the IDA Business Park in Lower Dangan Road, Galway (close to DERI)) is an example of a software development company in the middle of the illustrative supply chain. The existence of DERI enables what Indecon considers to be a more efficient use of resources regarding key technology development – in this case, Storm was able to approach DERI with a view to helping it to look into how Microsoft's web search engine might be developed/augmented, which in turn would enable Storm to provide services based on the augmented offering to downstream users (client businesses of Storm, which operate in a number of data-intensive industries). Storm is a Gold Certified Partner of Microsoft. Without SFI funding, and therefore in the absence of DERI, this assistance to Storm would not have been possible. The relationship between DERI and Storm has enabled Storm to concentrate on its core areas and DERI to focus on the basic science of the particular software development in this case.

The project with Storm is due to end in May 2008 (after 1 year). It is based on DERI's core research – optimising search within companies. The output of the collaboration between DERI and Storm is envisaged to be a technology component that would be integrated into Storm client companies' data management systems (having Microsoft Office Sharepoint Office technology).

According to Storm, the relationship with DERI has been very positive (and has involved exchange of personnel between the two organisations). The main issues arising from the project are:

- Time for the upstream provider (DERI) to find the right people to help Storm (highlights the highly specific nature of semantic web applications in practice);
- Possibility of PhD/Post-Doc personnel moving from CSET to client company;
- Flexibility and understanding from SFI during the relationship.

Source: Storm, DERI and Indecon.

A key issue discussed with DERI at Indecon's site visit in Galway is an apparent 'gap' between the research and development stages of the innovation process, in particular a gap between the research leading to a prototype and industry/commercial exploitation of that prototype. In DERI's experience, the TTO at NUIG has performed very well in terms of drawing industry attention to DERI's activities and emerging prototypes, and the Operations function of DERI is also active in this regard. However, it is felt by DERI that there is need for continued agency involvement to bridge the apparent gap between SFI-funded research and commercial development of new technologies. Indecon believes that this is a fundamentally important

issue and one that requires international as well as domestic reach, implying a more direct role for Enterprise Ireland and the IDA, in conjunction with SFI and the HEA.

A1.2.6 Outreach

DERI is also involved in outreach projects, courses and guides, which aim at showing how the new developing web technologies and the research of DERI can improve the quality of life of schools, communities & of society generally. The group is also involved in promoting the development of an 'Online Galway Accessible to All', with project partners including the Health Services Executive (HSE), Galway County Council, Galway City Council, Galway Education Centre, the Department of Defence and NUIG Departments.

A1.2.7 DERI's Future

DERI's future objectives centre on two broad goals –

- To extend the success of Web 2.0 and Semantic Web convergence– Web Science (including building more Web standards (like SIOC) and attracting and being involved in the setting-up of more companies);
- To develop 'Semantic Reality', including the setting-up of a national experiment in Ireland relating to electronic connectivity.

A1.2.8 Summary

DERI is an international research centre focusing on semantic web technology-related research. Its research activities are led by two scientists who were attracted to Galway on the basis that this area of applied science would be funded by SFI (both were non-Irish). The SFI funding has enabled DERI to develop new industrially relevant semantic web technologies and allowed DERI to leverage further funding, most of which have come from the EU.

A1.3 REMEDI

A1.3.1 Introduction

REMEDI was established at NUIG in 2004 through a €15 million CSET grant from SFI and an industry contribution of €4m. At this time, the group was engaged in the subject areas of Genetics, Toxicology and Molecular Biology and the initial focus of the centre was on adult stem cell and vector based research. In 2005, it branched out to include Immunology and has retained this scope in the intervening period. Within these broad subject areas, the three main programmes that are covered at the institute are stem cell research, gene therapy research and more recently cardiovascular research.

REMEDI's strategic vision is:

"to develop a new and realisable paradigm for medicine in the future utilising minimally invasive therapeutic approaches to promote organ repair and regeneration rather than replacement".

To realise this vision, there are a number of definitive goals that Indecon understands the institute is working towards. These include:

- To combine cell and gene therapy approaches for tissue regeneration purposes;
- To bring together clusters of researchers from academia and industry;
- To understand the biology of stem cells and to utilise this knowledge to genetically modify these cells for therapeutic purposes;
- To commercialise the intellectual property arising from REMEDI research programmes in partnership with industry; and
- To develop a robust education and outreach programme by engaging with the public, schools, and policy makers.

More recently, we understand that the range of REMEDI's research activities has been strengthened to include a specific focus on plans to develop liposomal and site specifically integrated lentiviral vectors for gene delivery to stem cells.

The table below describes staffing levels at REMEDI over the period 2004-2007. The institute had a total of approximately 73 staff in 2007, up from 53 in 2004. This includes 3 professorial staff, 5 lecturers, 23 post-docs, 24 PhD students and 18 support staff. Staff members at the institute have come to Ireland from the US, UK, Italy, Canada, Germany. More recently, we understand that a senior US researcher in cardiovascular sciences has been recruited.

Number of Persons Employed in SFI Funded REMEDI CSET – 2004 - 2007

Staff Position	2004	2005	2006	2007*
Number of Full Professors in SFI Unit	2	2	2	3
Number of Other Professors (Assistant or Associate) in SFI Unit	0	0	0	0
Lecturers	0	3	4	5
Number of Post-Docs in SFI Unit*	18	30	27	23
Number of PhD Students in SFI Unit	15	22	23	24
Number of Support Staff in SFI Unit	15	19	19	18
Other Staff in SFI Unit (research assistants)	3	0	0	0
Total Staff	**53**	**76**	**75**	**73**

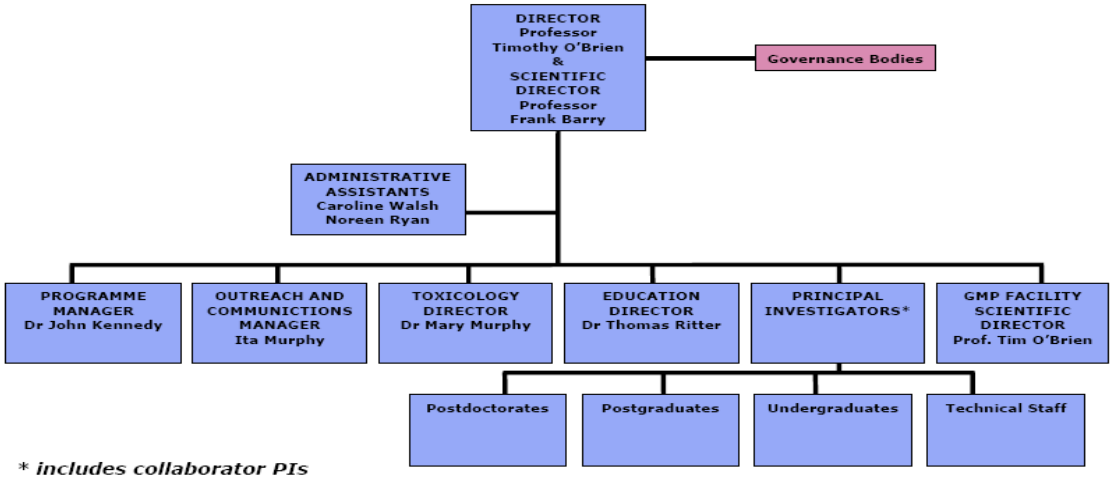
Source: REMEDI Data
** denotes partial Data.*

We understand that the physical infrastructure of the Institute is now in place and the development of laboratory space in Dangan in Galway will help alleviate space shortages. Some of this expansion will be covered by SFI under the overheads programme. The total space occupied by REMEDI is approximately 2,600m² including the NCBES Building, the Dangan IDA Park and the Clinical Sciences Institute at Galway.

A1.3.2 Governance and Management Structures

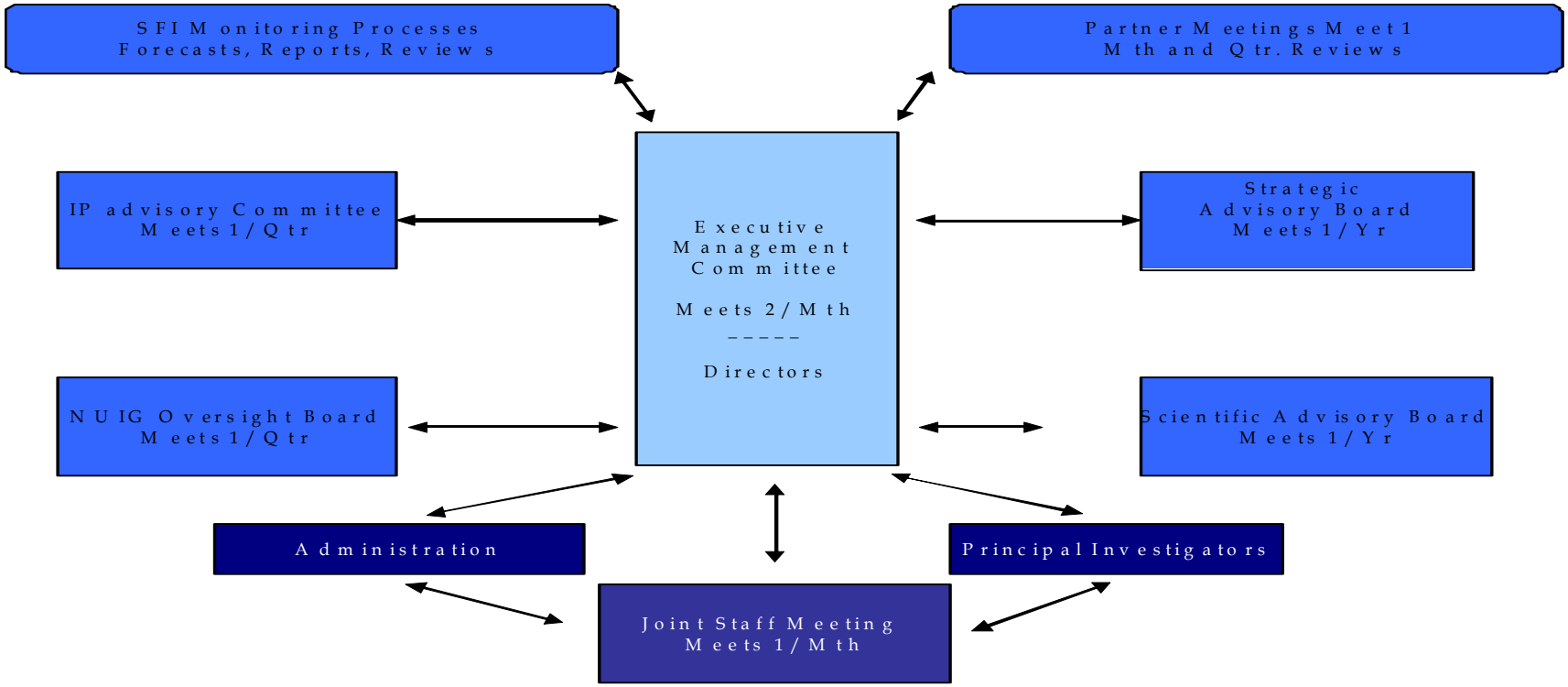
The governance and management structures at REMEDI are based on a flat hierarchy which the institute believes is essential to the development of an open, innovative culture and to promote participative behaviour within the CSET. The schematic overleaf maps the governance structure that is currently in place at the institute. The management structure is profiled in the subsequent schematic.

Governance Structure in Remedi CSET



Source: REMEDI Annual Report 2006

Organisational Management Structure of REMEDI CSET



Source: REMEDI Annual Report 2006

A1.3.3 Funding

The following table outlines the funding received by the institute since inception in 2004.

Sources and Levels of Funding for REMEDI – 2004 – 2008 (Committed)

Funding Source	2004	%	2005	%	2006	%	2007 (YTD)	%	2008 Committed	%
SFI	4,034,449	78	3,584,346	63	3,384,378	55	4,770,718	13	3,000,000	62
Internal NUIG Funding	450,000	9	921,000	19	1,033,500	17	1,537,000	4	1,450,650	30
Health Research Board	402619	8	530519		424779	7	11386244	31	-	
HEA	-		-		-		600000	2	-	
HSE	-		-		-		10500000	29	-	
Enterprise Ireland	-		104000	2	519685	8	655993	2	-	
IDA (Co-Funding + Smith & Nephew)	-		-		-		5050000	14	-	
Forfás	-		-		1000		20000		-	
IRCSET	304150	6	127360		72009	1	72009		-	
Foundations / Donations	-		66837	1	5000		500		-	
EU	-		-		160000	3	-		-	
Industry Contributions	-	-	380,000	7	551,500	9	1,617,000	4	375,000	8
Total Funding	5,191,218	100	5,714,062	100	6,151,851	100	36,209,464	100	4,825,650	100

Source : REMEDI data

SFI funding has been allocated through a number of programmes. The CSET programme was the largest allocation of funds but REMEDI has also benefited from the basic research grant programme, the equipment calls, the STAR supplement and acted as a UREKA site for 4 student placements. We understand that a leading clinical neuroscientist also spent a year at REMEDI from the Mayo Clinic financed by the ETS Walton programme.

A1.3.4 Research and Research Performance

The table overleaf outlines REMEDI's research outputs over the period 2004-2007.

Research Outputs by REMEDI Staff Members – 2004 - 2007

	2004	2005	2006	2007 (YTD)
Number of Published Articles in Refereed Journals	17	24	22	14
Number of Notes or Letters in Refereed Journals	0	0	0	-
Number of Books or Monographs Published	0	9	1	1
Number of Review Articles Published	0	2	9	2
Number of Editorial Articles Published	18	11	-	-
Number of Working/Discussion Papers	19	-	16	3
Number of Conference Papers Delivered	22	35	58	56

Source: REMEDI Data

Overall, there have been 36 peer review articles, 10 review articles and book chapters, and 88 conference presentations produced by REMEDI researchers since inception.

Indecon also obtained information on the level of esteem attributed to researchers via plenary sessions given at Irish and international conferences and editorial board membership. The table overleaf outlines number of the different measures of esteem that REMEDI achieved over the period 2004-2006, indicating that researchers at the institute have delivered at significant numbers of plenary and other sessions since the institute's establishment.

Measures of 'Esteem' for REMEDI Researchers and Scientists (2004 - 2006)

Measure of Esteem	2004	2005	2006	2007
Plenary/Key-Note Speeches Delivered by Members Unit at Conferences held in Ireland	21	26	22	16
Plenary/Key-Note Speeches Delivered by Members at Internationally-Held Conferences	20	10	17	21
Members Unit on Editorial Boards of Irish-Based Journals	0	0	0	-
Members Unit on Editorial Boards of Internationally-Based Journals	6	6	8	0
Members on Irish Government Scientific Boards or Committees	5	8	12	3
Members on International Scientific Boards or Committees	7	6	4	-
Members on UK RAE Panels	1	2	2	4
Members on Research Evaluation Panels Internationally (EU, US, Other)	1	1	4	4
Total	**61**	**59**	**69**	**48**

Source: REMEDI Data

A1.3.5 Commercialisation and Partnerships

Of importance is the extent to which REMEDI can generate revenue streams through commercial research, spin-outs, and licensing and royalties on IP, with the objective of sustaining the institute in the future.

Commercialisation and Intellectual Property

The table outlines technology transfer statistics compiled as part of the Indecon report. In 2004 and 2005, industrial partnerships were formed with Medtronic and Charles River Laboratories. In 2006, this was widened to include Wyeth Pharmaceuticals, Astra Zenica, Sanofi Aventis and Boehringer Ingelheim. In addition to the 6 established partnerships, new agreements were struck with Smith and Nephew and Stem Cell Sciences in 2007. The spin-outs established were Pro-Cure Laboratories Ltd in 2006 and Lucina Biotechnology in 2007. A key issue going forward will be the outcomes from these partnerships in terms of research and commercialisation outcomes.

REMEDI Technology Transfer Statistics

Technology Transfer	2004	2005	2006	2007 (YTD)
Number of Research Scientists at Unit with Links in any Way with Commercial Companies	9	14	18	16
Number of Patents Filed	0	0	0	3
Number of Commercial Products from Patents	0	0	0	0
Spin-Outs	0	0	1	1
No. of Industrial Partnerships	2	2	6	8
No. of Innovation Disclosures to NUIG Tech. Trans Office	0	2	4	3

Source: Indecon analysis of REMEDI data

Patents

REMEDI has generated IP in the form of know-how, materials and tools, and patentable inventions. To-date 3 patents have been filed by REMEDI, all in 2007. Two of these patents came through the CSET itself and one came from complementary research. A further 9 disclosures are under review with NUI Galway Technology Transfer Office. Altogether, 5 patent filings are expected in 2007, and 10 are expected by the end of the 1st quarter of 2008.

Trademarks

REMEDI have registered 3 trademarks in 2007:

1. Ready-Set-Bio which is a schools outreach programme world trademark;
2. REMEDI design logo; and
3. REMEDI word trademark.

Collaborative Partnerships

The following table outlines the various collaborative partnerships and the grant agency stakeholders with which REMEDI has engaged with to date. The total current number of partner organisations is 26.

Counterparties of REMEDI Collaborative Partnerships by Area

Academic Partnerships	Industrial Partners	Public Agencies and Foundations
UCD	Medtronic	Health Research Board
NUIM	Charles River Laboratories	HEA
DCU	Stem Cell Sciences	SFI
Georgia Tech, US	Smith and Nephew	Enterprise Ireland
	Wyeth Pharmaceuticals	IDA
	Astra Zenica	Forfas
	Sanofi Aventis	EU
	Boehringer Ingelheim	Foundations/Donations
		NUIG
		Fulbright
		IRCSET

Source: REMEDI data

We understand that the partnerships with Medtronic and Charles River Laboratories are of key importance to the institute. The partnership with Medtronic covers the broad area of stem cell and gene therapy applications in cardiovascular disease and diabetes mellitus. The overall aim of this work is to develop new strategies for the optimised delivery of cells and genes for myocardial repair and for enhanced re-endothelialisation of vessels following stent placement. The REMEDI/Medtronic partnership is also of significant importance to both parties. There are regular biweekly, monthly and quarterly meetings to manage the partnership. The partnership with Charles River Laboratories is in the general area of animal model development, and pre-clinical toxicology and effectiveness studies. The purpose of this work is to generate a database of pre-clinical toxicology prior to initiation of human clinical trials.

A1.3.6 Outreach

The REMEDI outreach programme aims to increase awareness and interest in science among young people and to encourage them to consider further education or a career in this field. The programmes that are currently in operation by REMEDI target students at 1st or 2nd level, teachers, parents, career guidance advisors and the wider school community.

The primary aim is to increase public awareness of research carried out at REMEDI and engage the public in discussions of future applications and ethical considerations of contemporary scientific research. The institute runs a number of programmes including Ready Set Bio aimed at elementary school, and the Galway Region Outreach (GRO) which targets secondary schools and which aims to engage young people in science, engineering and technology, and to encourage them to consider a career in these fields. The GRO has three main programmes. Firstly, GRO Interactive attempts to stimulate interest in science through the delivery of interactive projects and lectures in schools. Secondly, GRO Dialogue facilitates discussion among upper second level school students on the ethical and societal implications of advances in biomedical research. Finally, GRO Careers highlights the cutting edge researching ongoing at REMEDI and encourages students to consider careers in science and engineering.

The institute also run a total of 9 public information nights in Dublin, Cork, and Galway on stem cell research.

A1.3.7 Future

As well as developing the commercial potential of the institute, future developments are planned in cell and gene therapy including cells to deliver genes and genes to modify the functional characteristics of stem cells. A number of diversification targets are also in place into areas such as pulmonary disease, the spinal cord repair, and Osteoarthritis. New Industry partners are being sought by REMEDI in these areas.

A1.3.8 Summary

REMEDI is continuing to develop its potential as an international research institute in its field. The institute is building critical mass in staffing and has also attracted a number of leading researchers from overseas. Commercialisation activities are on an upward trend and the number of industrial partners is developing. Interaction with major industry partners such as Medtronic and Charles River Laboratories has been extremely successful to date. Notwithstanding these positive developments, of key importance, however, will be the outcomes that emerge going forward in terms of research performance and particularly commercialisation outcomes. Decisions on renewal of funding must therefore pay close attention to demonstrated emerging impacts in these areas.

A1.4 CRANN

A1.4.1 Introduction

The Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN) is an SFI funded CSET comprising academic partners Trinity College, University College Dublin and UCC. The centre also has a number of industry partners including Intel, Hewlett Packard and a number of other Irish high tech companies.

CRANN carries out fundamental research by academic and industry experts which is leveraged to address issues in ICT and Biotechnology. Research focuses on three key areas of Nanoscience: Magnetic Structures and Devices; Bottom-Up Fabrication and Testing of Nanoscale Integrated Devices; and Nano-Biology of Cell Surface Interactions. CRANN researchers are each involved in one or more of these thematic areas through a range of collaborative, interdisciplinary research projects supported by the Centre and Science Foundation Ireland as well as other national and international funding agencies.

Staffing

The table below outlines the number of staff supported at the CRANN CSET over the period 2003 – 2007 (including staff supported by the CSET mechanism and the Hewlett Packard supplemental grant in each year). The number of full time professors has increased from 7 in 2004 to 16 in 2007, while there were also 8 associate/assistant professors in 2007. The number of post docs and PhD students has also increased rapidly in this period, to 16 in 2007 in each case. Including support staff, CRANN had a total staff complement of 66 persons in 2007.

Number of Staff Supported by CRANN – 2004 – 2007*

Staff Inputs	2004	2005	2006	2007
Number of Full Professors in SFI Unit	7	9	10	16
Number of Other Professors (Assistant or Associate) in SFI Unit	-	-	9	8
Number of Post-Docs in SFI Unit	5	11	16	16
Number of PhD Students in SFI Unit	5	13	16	16
Number of Support Staff in SFI Unit	2	5	9	11
Total Staff	**19**	**38**	**60**	**66**

Source: CRANN data
* Note: The numbers record personnel who were supported by the CSET grant and the HP supplemental grant in any given year. Not all people were supported for the full year in each case.

A1.4.2 Management

The CRANN management team comprises a director, deputy director, and executive director. The Director has full responsibility for ensuring the successful operation of the centre. He/She must report to the Institute Board and funding agencies. The Director also has to ensure that the strategic plan for CRANN is implemented and has responsibility for the allocation of space within the institute and overall budgeting. In addition the Director manages the Scientific Advisory Board.

The Executive Director has all operational responsibilities, including personnel, health and safety, financial management, CRANN operational issues, intellectual property, and managing relationships with funding agencies, industrial partners and internally within the university. In addition the Executive Director oversees the development of the CRANN building.

A1.4.3 Funding

The table below outlines the funding received by CRANN over the period 2004 to 2007. To-date, the group has generated funding to the tune of €37.8 million, of which SFI funding has accounted for over three-quarters. It is notable that a relatively small proportion of funding has to-date emerged from industry sources and this is an area that we believe must be given increased priority going forward.

Sources of Funding Received by CRANN - 2004 -2007 (€)

Source of Funding	2004	2005	2006	2007
CSET	281,014	2,153,960	1,393,868	2,400,000
Other SFI	6,702,502	6,320,968	4,561,607	5,000,000
Amount of Funding of Other Irish-Based Research Award	358,621	520,001	864,822	6,200,000
Non-Irish Research Funding	111,465	213,401	183,579	
Internal/Own-University Research Funding	2,484	47,387	161,844	240,000
Industry Funding	19,592	27,544	13,428	
Total Funding Received	**7,475,678**	**9,283,261**	**7,179,148**	**13,840,000**

Source: CRANN data

A1.4.4 Research and Research Performance

While only partial data was available in relation to research outputs from the CRANN centre, the table below indicates that the total number of published articles in refereed journals increased from 18 in 2005 to 42 publications in 2007. Notwithstanding the increased numbers of publications, of importance is the quality of these outputs. While a detailed bibliometric assessment of research output quality at the level of individual research centres was beyond the scope of this review, this would be an important aspect meriting closer inspection going forward to ensure that all research groups supported deliver value for money in terms of research quality.

Selected Data on Research Outputs from CRANN CSET – 2005 – 2007

Research Outputs	2005	2006	2007
Number of Published Articles in Refereed Journals	18	13	42

Source: CRANN data

A1.4.5 Commercialisation

Partnerships

Industrial Partnerships

As well as partnerships with Intel and Hewlett Packard, CRANN works with a number of other Irish technology companies in the small to medium size range. At present CRANN has four SME partners: Deerac Fluidics, Commergy, Eblana Photonics, and Magnetic Solutions. These are a number of university spin off companies that work across a number of sectors including biotechnology, semiconductor and optical communications. CRANN is also currently working with Enterprise Ireland to encourage the industrial community to become aware of the importance of research.

Academic Partnerships

As mentioned previously, CRANN is involved with the the following universities: University College Dublin, Trinity College Dublin and University College Cork.

Commercialisation

The table below outlines the commercialisation indicators relating to CRANN over the period 2005 – 2007. The number of research scientists at CRANN that had links with commercial companies remained constant in 2005 and 2006 but increased to 10 in 2007. The number of patents filed totaled 5 over the 2005-2007 period, which is at a low level comparatively and it would be important to achieve further progress in this important area if significant commercialisation outcomes are to be developed.

Partial Data on Commercial Activities in CRANN CSET – 2005 - 2007

Research Outputs	2005	2006	2007
Number of Research Scientists at Unit with Links in any Way with Commercial Companies	6	6	10
Number of Patents Filed	2	2	1

Source: CRANN data

A1.4.6 Outreach

There are four stands to CRANN's approach to increasing awareness and understanding of its activities with academia and society at large. These are:

- Educational Initiatives: CRANN provide professional laboratory training to post-graduate students, summer placements to undergraduate and final-year students and make a significant contribution to university teaching. They also extend educational initiatives to second and primary levels including a road show called "Nano-Experience" and Transition Year training programmes.

- Wider Public: CRANN has made a major contribution to the development of the concept and fundraising for the Science Gallery. This flagship forum for science communication in Ireland will open alongside CRANN in early 2008, occupying the ground and first floors of the Naughton Institute.
- CRANN are also closely involved with Discover Science and Engineering, W5 in Belfast, the Third-level Research Education and Outreach network (TREO), the Science Museum (London), the British Association for the Advancement of Science as well as developing relationships with interested groups and individuals.

A1.4.7 Summary

CRANN is one the largest groups supported by SFI and has linkages with a number of other SFI-funded CSETs and research grouops. The group focuses on research in Nanoscience and has developed interactions with commercial entities across a range of areas while the number of staff at the centre linked to companies has increased in recent years. The Centre has secured some €28.8 million in funding through SFI programmes. However, it the proportion of its funding generated from industry sources has been low in relative terms and this is an area where further progress would be required going forward. In terms of commercialisation, while there are positive outcomes evident in relation to the number of research scientists at CRANN that had links with commercial companies, activity levels in relation to patent filings appears low in comparative terms and it would be important to achieve further progress in this important area if significant commercialisation outcomes are to be developed.

A1.5 LERO

A1.5.1 Introduction

LERO, the software engineering research centre, is active in computer science and other ICT-related activities. It was established in November 2005 following the awarding of €11.5m funding under the SFI CSET programme. The centre is based at the University of Limerick (UL) and the academic partners involved with the CSET are UL, DCU, TCD and UCD.

Lero's Vision is of Ireland as a leading location for designing and managing innovative software solutions. Lero's mission is to establish a sustainable, national Software Engineering research centre of international standing which focuses on strategic industrial domains. Based on this mission Lero's derived goals are to:

1. Establish the Lero brand in Ireland and abroad
2. Operate the centre efficiently, effectively and transparently
3. Develop and implement a long-term business plan for the centre
4. Build-up and maintain strong national university-industry research links
5. Impact on national software engineering education and training
6. Produce internationally recognised research outputs
7. Establish close links with international research institutions
8. Tackle research problems of industrial relevance
9. Validate and improve research results with industry
10. Help to make Ireland attractive for software engineering R&D

The centre currently takes a domain-specific approach and focuses on the automotive software sector. The main areas of research that the centre covers are Autonomic Software Systems, Global Software Development, Mathematics Applied to Software Engineering, Service and Aspect-based Component Architectures and Software Product Line Engineering.

Staffing

Summary details in relation to staffing at Lero are shown in the table below. In 2007, the centre had a total of 44 staff in its SFI unit, comprising 2 full professors, 5 other professors, 12 post-docs, 18 PhD students and 7 support-related and other staff. The centre has had a number of successes in attracting top research staff from abroad including post-docs from USA, Germany and Switzerland.

Number of Staff Supported in LERO CSET - 2006 - 2007

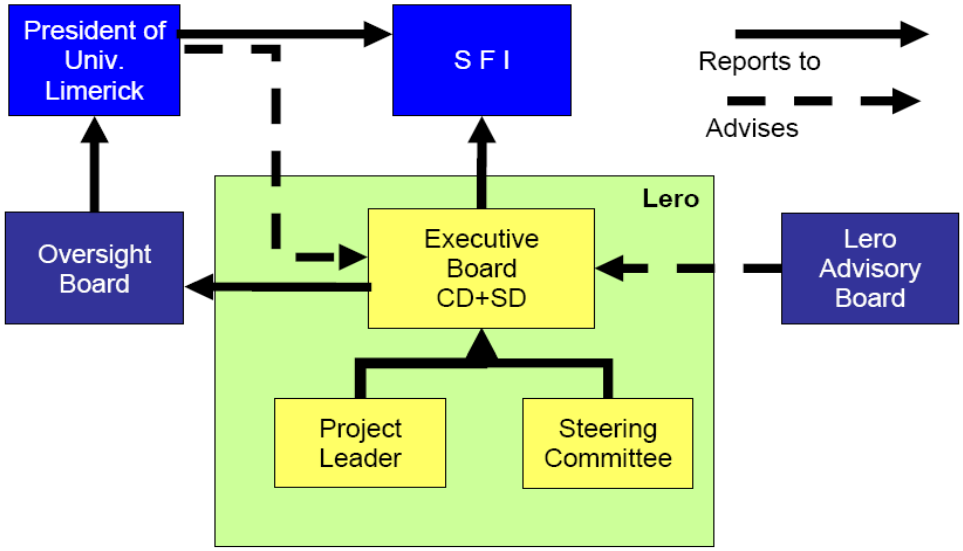
Staff Inputs	2006	2007
Number of Full Professors in SFI Unit	2	2
Number of Other Professors (Assistant or Associate) in SFI Unit	5	5
Number of Post-Docs in SFI Unit	10	12
Number of PhD Students in SFI Unit	15	18
Number of Support Staff in SFI Unit (includes Tech support)	3	5
Other Staff in SFI Unit	0	2
Total Staff	**35**	**44**

Source: Lero data

A1.5.2 Management

The schematic overleaf describes the management structure in place in the Lero CSET. We understand that standard, best practice governance approaches are applied in the centre.

Management Structure of LERO CSET



Source: Lero data

A1.5.3 Funding

The table overleaf outlines the sources of funding received by Lero in 2006 and 2007. The centre received a total of circa €2m in 2006 and €0.9m in 2007. Most recently, in 2007, the centre was successfully awarded funding under PRTLI Cycle 4, which amounts to €7.3 million and this will provide a substantial addition to overall funding going forward. In addition to SFI funding, the centre has also received funds from other sources including other, non-SFI Irish public funding, internal UL funding and also industrial and EU contributions. It is notable that in 2006-2007, industry funding accounted for some 14% of overall funding over this period.

Sources of Funding for Lero CSET – 2006 - 2007

Source of Funding	2006	2007
SFI Conference Grant	5000	5000
STARS	20,000	20000
SFI Gender Audit Grant	100000	
IRCSET	43000	
Industry Funding	394900	
Direct and Indirect Industry Funding	485,100	649,834
EI Innovation Partnerships		6780
EU OPAALS (FP6 Network of Excellence)	367000	
FLOSS EU Tender Grant	40,000	
Internal Funding - UL Professorship	150000	150,000
Internal Funding - UL: Space Rental (part)	90,000	90,000
Internal Funding - Refurbishment	200,000	
Total Funding	**1,895,000**	**921,614**

Source: Lero data

A1.5.4 Research Performance

The main research objectives of the centre are outlined above. The main focus is on two domains; automotive systems and telecommunications services. Four of the main specific areas targeted are:

1. Mathematics Applied to Software Engineering – focusing on the application of existing mathematical techniques to increasing the quality of software via proofs and testing.

2. Service and Aspect-based Component Architectures – focusing on using the emerging aspect oriented and autonomic approaches in the derivation, definition and delivery of software services.

3. Globally Distributed Software Development – adding to the study of the Open Source paradigm as a model for distributed development and the study of Requirements Engineering in a global context to the existing three areas being covered by the SFI supported Cluster

4. Software Product Lines – focusing on the product phase of SPL engineering, with a particular emphasis on Visualisation, Verification and study of SPL in practice.

In relation to outputs from research activity, the table below provides a summary analysis for the period 2006 to 2007. The number of published articles in refereed journals totalled 33 during 2006 and 26 during 2007. The number of books or monographs increased from one in 2006 to 3 in 2007 and the number of conference/working papers produced increased from 66 to 68 year on year. Notably, the total number of outputs declined from 100 in 2006 to 97 in 2007.

Research Outputs from Lero CSET - 2006 - 2007

Research Outputs	**2006**	**2007**
Number of Published Articles in Refereed Journals	33	26
Number of Books or Monographs Published	1	3
Number of Conference Papers Delivered (including Working Papers/Discussion Papers)	66	68
Total Number of Research Outputs	**100**	**97**

Source: Lero data

The table below outlines a number of measures of esteem for the Lero centre. Lero researchers have attracted some of the leading conferences in their specialist areas including The 10th European Conference on Computer Supported Co-operative Work 2007, 3rd International Conference on Open Source Systems 2007, 12th International Software Product Line Conference 2008, eXtreme Programming 2008, International Conference on Global Software Engineering 2009 and ACM SIGMIS on Computer Personnel Research Conference 2009. Notwithstanding these developments, of importance going forward will be the outcomes in terms of research publications and commercialisation impacts.

Measures of Research 'Esteem' at Lero CSET - 2006- 2007

Measure of Esteem	2006	2007
Email Alerts to Interested Parties re Papers, Activities etc.?	Yes	Yes
Number of Plenary/Key-Note Speeches Delivered by Members of LERO at Conferences held in Ireland	1	0
Number of Plenary/Key-Note Speeches Delivered by Members of LERO at Internationally-Held Conferences	2	2
Number of Members of LERO on Editorial Boards of Irish-Based Journals	1	1
Number of Members of LERO on Editorial Boards of Internationally-Based Journals	4	3
Number of Members of LERO on Irish Government Scientific Boards or Committees	0	0
Number of Members of LERO on International Scientific Boards or Committees	4	4
Number of Members of LERO on UK RAE Panels	1	1
Number of Members of LERO on Research Evaluation Panels Internationally	3	2

Source: Lero Data

A1.5.5 Commercialisation and Partnerships

Partnerships

Academic Partnerships

The Lero centre has also been involved in a number of Irish academic collaborative activities. The centre is involved in a cluster project with DCU, Dundalk IT, NUIG and UCC. The development of the CSET itself took place with DCU, TCD and UCD and there has been publication activity with UCC, NUIG, DCU and Dundalk IT.

Industry Partnerships

Lero has received a number of different forms of support from industry. In particular, the centre has received direct funding, human resources investment, scholarships (such as industrially funded stipends), and sponsorships (Industrial grants to support dedicated research activities in Lero). The centre has masters and PhD students supported by the following companies: Analog, Motorola, Intel, Logica, KMC, Vitalograph, and Lehman Bros. There have also been joint projects, papers and conferences with Intel, IBM, Siemens, Bosch, and Rovsing. In 2004, Lero made contact at ICSE with Siemens Corporate Research, USA. Since then, members of the Lero staff collaborated on Global Software Studio projects co-ordinated by SCR.

The companies with the strongest funding links with Lero are Fidelity, BT, IBM, Bosch, Rovsing, and Hewlett-Packard. In total, Lero had linkages with 25 companies in 2006 and 35 companies in 2007.

As in the case of other partnerships, a key issue concerns what emerges from industry links in the form of research and commercialisation outcomes and this is an area that we believe should be monitored closely going forward.

A1.5.6 Outreach

Lero has undertaken a number of outreach programmes and activities. They conducted an undergraduate computer programming competition with in the Computer Science and Information Systems department in UL. The event was sponsored by Dell. The Software Development and Visualisation Workshop taught skills in the Linux operating system, Python programming and Macromedia Flash Animation to second level students. In total, 110 students participated in five courses which ran from February to August 2006. A Lero Poster and Essay competition was also conducted for secondary schools in Limerick. Other events that were conducted include a speaking programme and a number of industry talks.

A1.5.7 Future

Lero has a strong position vis-à-vis funding into the future. The SFI CSET grant runs until 2010 and the centre is well place to receive future funding for FP7 and to receive more SFI PI rewards. The centre's capacity will also benefit through its successful access of PRTLI Cycle 4 funding. Notwithstanding these successes, we would emphasise the importance, however, of maximising the leverage from SFI and PRTLI funding, particularly through EU and industry sources.

A1.6 BDI

A1.6.1 Introduction

The Biomedical Diagnostics Institute (BDI) is an Industry-Academic partnership which carries out research on the development of biomedical diagnostic devices. It was established in 2005, through a CSET award from Science Foundation Ireland with DCU as the lead institution. The devices designed in the Institute measure and indicate the development of a disease and are being developed for use in the home or at the point of care. These devices enable the detection of life-threatening diseases before a critical stage is reached. The development of these indicators uses complex biological samples but also incorporates advanced communications technology.

The development of diagnostics devices at BDI occurs through the integration of fundamental and applied research into working demonstrations. This involves bringing together researchers from academia, companies and the clinical environment to form a team of over 70 scientists.

The Institute is active in both the BIO and ICT sectors covering the following subject areas: Agricultural and Biological Sciences, Biochemistry, Genetics, Molecular Biology, Immunology and Microbiology. They are also involved with Materials Science and Physics.

Staffing

The table overleaf outlines the number of staff supported by the BDI over the period 2005 to 2007.

Staff Levels Supported by BDI CSET - 2005 - 2007

Staff Supported	2005	2006	2007
Number of Full Professors in SFI Unit	5	5	5
Number of Other Professors (Assistant or Associate) in SFI Unit	0	0	0
Number of Post-Docs in SFI Unit	12	26	28
Number of PhD Students in SFI Unit	8	17	18
Number of Support Staff in SFI Unit	5	5	7
Other Staff in SFI Unit	6	14	14
Total Staff	**36**	**67**	**72**

Source: BDI data

Total staff numbers have risen significantly since 2005 and in 2007 there were 72 staff in total. The number of full time professors has remained constant over the period but the number of Post-Docs and PhD students has increased to 28 and 18 respectively in 2007. There are 10 research staff members in the institute that are supported by industry partners.

A1.6.2 Funding

The table overleaf outlines the sources of funding received by BDI over the period 2005-2007. In total, funding to the tune of €32.2 million was generated by the institute over this period, of which €7.3 million or 22.8% derived from CSET and other SFI programmes/supports (including via the Research Professorship, Equipment Supplement, ETS Walton Visitor award and UREKA Site supports). Apart from SFI funding, the largest component of income will derive through the award to DCU under PRTLI Cycle 4, amounting to €19.5 million in 2007. BDI has also benefited from funding via EU-based FP and Marie Currie supports, EPA, HRB and IRCSET funding. Notably during this period, apart from via the CSET, no significant additional industry-based funding is evident.

Sources of Funding for BDI CSET – 2005 - 2007

Source of Funding	2005	2006	2007
Total Annual Funding Received from SFI (€000) - CSET Programme	402,940	2,741,590	2,878,400
SFI Research Professorship	282,500	277,250	229,750
SFI Equipment Supplement		292,406	
SFI ETS Walton Visitor			73,100
SFI UREKA Site		69,000	91,000
EPA Research Fellowship			183,877
RDS Science Live Bursaries		2,000	1,000
HRB PhD Scholars Programme*			5,000,000
PRTLI IV**			19,500,000
IRCSET Postgraduate Studentship		24,003	48,006
Non- Irish 6th Framework Programme and Marie Curie		23,754	47,508
Own University Funding - Equipment Maintenance Fund DCU/OVPR			18,668
Total Funding Received	**685,440**	**3,430,003**	**28,071,309**

Source: Indecon Analysis of BDI Data
**Award made to a group of partners*
***Award made to DCU*

A1.6.3 Research and Research Performance

The main activities of the BDI institute lie primarily in creating miniaturised systems in which the presence of low concentrations of target markers can be detected in small volumes of biological samples. A range of scientific and engineering disciplines is required for the development of these devices.

Fundamental research is carried out in the following areas: Biomolecular Recognition, Functional Diagnostics in Platelet Biology, Signal Transduction Science, Signal Amplification Science and Microfluidic Platforms.

Application-focused research is also conducted mainly through guidance from Industry partners addressing unmet or emerging market needs. These 'integration projects' work the outcomes of core programmes into prototype devices. One example of such a device is a miniaturised coagulation device to be used in the monitoring and management of anti-coagulation therapy.

The table below describes the research outputs of supported BDI researchers for 2007. In that year, 16 articles were published in refereed journals, 18 working or discussion papers were produced and 24 conference papers were delivered.

Research Outputs by BDI Supported Researchers - 2007

Research Outputs	2007
Number of Published Articles in Refereed Journals	16
Number of Notes or Letters in Refereed Journals	0
Number of Books or Monographs Published	0
Number of Review Articles Published	0
Number of Editorial Articles Published	0
Number of Working/Discussion Papers (Non-Published)	18
Number of Conference Papers Delivered	24
Total	**58**

Source: BDI data

The table below outlines measures of "esteem" related to the Institutes' activities.

Summary of Measures of Esteem for BDI CSET - 2005

Indicator of Esteem	2005
Does your Unit produced Non-Technical Summaries of Papers	No
Does you Unit have Email Alerts to Interested Parties re Papers, Activities etc.	Yes
Number of Plenary/Key-Note Speeches Delivered by Members of your SFI Unit at Conferences held in Ireland	2
Number of Plenary/Key-Note Speeches Delivered by Members of your SFI Unit at Internationally-Held Conferences	11

Source: BDI data

A1.6.4 Commercialisation and Partnerships

BDI has a number of fundamental partnerships in place with a range of academic and industry sources.

Academic Partners

The main academic partnership that BDI is involved in is with its host institution, DCU, and the associated National Centre for Sensor Research. The institute has also strong academic partnerships with the National Centre for Biomedical Engineering Science at the National University of Ireland, Galway, the Royal College of Surgeons in Ireland (including the Clinical Research Centre at Beaumont Hospital, Dublin) and the Tyndall National Institute at University College, Cork.

Industry Partners

Industry partnerships are in place with the following companies: Becton Dickenson and Co., Analog Devices, Hospira Inc, Inverness Medical Innovations Inc, Enfer Technologies, and Amic AB. Associate members of the institute are Biotrin, SensL, Tridelta, Nanoemboss, Genzyme Diagnostics, Adhesives Research, NASA, ESI Group, Biodot and Enplas.

The table below outlines some indicators of technology transfer and commercialisation relating to activities at the BDI during 2007. As this data relates only to a single year of activity, further evidence would be required to enable a more definitive judgment on emerging commercialisation outcomes from the institute.

Summary of Metrics of Technology Transfer and Commercialisation Indicators from BDI CSET - 2007

Technology Transfer and Commercialisation Indicators	2007
Number of Research Scientists at Your Unit with links in any way with Commercial Companies	All
Number of Patents Filed	1
Number of Commercial Products from Patents	0
Invention Disclosures	6

Source: BDI Data

A1.6.5 Outreach

The institute runs a comprehensive programme of education and outreach activities. The initiatives are targeted from primary school to fourth level in addition to outreach programmes for the general public.

The main programmes that have been initiated are the introduction of an MSc in Biomedical Diagnostics, the introduction of the primary school programme "Me & My Body" (MAMBO) to over 200 children and the hosting of Irish and international undergraduate students as part of the SFI UREKA programme. There have been 25 students so far involved in the UREKA programme with a further 14 placements on offer for 2008.

BDI also offer a second level science teacher programme where teachers participate in an eight week research programme with BDI. There is also a nursing outreach programme which represents outreach and research in the ethics and psychosocial aspects of diagnostic technology. This has led to the development of the Future Health Seminar Series.

A1.6.6 Summary

BDI has increased staffing numbers and has had success in attracting industry partners as well as the successful collaborations with academic institutions. However, while the institute has benefited from funding via EU-based FP and Marie Currie supports, EPA, HRB and IRCSET funding, notably, apart from via the CSET, no significant additional industry-based funding is evident to-date and this is an area where further progress would be desirable going forward if the institute is to successfully leverage SFI and other funding sources. In relation to research performance and particularly commercialisation activities, while there are some signs of positive developments emerging, further evidence is required in these areas in relation to progress and impacts.

A1.7 Synopsis of Findings from Case Studies

Among the key findings that emerge from the case study reviews include the following:

- SFI funding has helped to create research centres of international research excellence, which in the absence of SFI funding would be unlikely to be present in Ireland;
- The CSETs have been in the process of building strong research teams, including through the attraction of leading researchers from overseas. Achieving and maintaining critical mass will remain a strong imperative in this respect;
- A steady increase in the volume of CSET research outputs is evident since their establishment although further evidence on research performance, including bibliometric assessment of research quality, would be required before more definitive conclusions could be delivered in this important area;
- The CSETs have forged partnership and networking arrangements with a wide range of industrial and academic partners. However, of key importance are the outcomes that emerge from these collaborative linkages in terms of research and commercialisation activities, and wider economic impacts;
- While a number of the CSETs have been successful in securing funding from non-SFI sources, in some cases further progress is required to maximise the leverage from SFI and PRTLI funding, particularly in relation to non-State, EU and other international sources, and industry funding; and
- The CSETs are involved in a range of outreach activities, including educational programmes, development of links with students at first and second level and wider public awareness-raising actions. Of importance, however, is the extent to which the research groups achieve wider dissemination of research among the public at large and particularly industry.

Annex 3 Additional Supporting SFI Data

Number of BIO Directorate Research Staff, by Seniority

Researcher, Type	2001	2002	2003	2004	2005	2006
Number Research/Group Leaders	3	26	35	24	24	44
Number Post-Docs	0	15	48	191	217	266
Number PhD Students	0	0	6	62	209	242

Source: Indecon Analysis of SFI data

Number of ICT Directorate Research Staff by Seniority

	2001	2002	2003	2004	2005	2006
Number Research/Group Leaders	8	38	35	24	15	31
Number Post-Docs	0	26	69	150	217	224
Number PhD Students	0	24	114	239	297	288

Source: Indecon Analysis of SFI data

Number of SFI-funded FES Directorate Research Staff by Seniority

	2005	2006
Number Research/Group Leaders*	230	388
Number Post-Docs	53	141
Number PhD Students	104	328

Source: Indecon Analysis of SFI data
Note: 'Other' category refers to Interns, general Admin Staff & Masters Students involved across particular projects

Annual Number of SFI-funded Awards made to Irish and Overseas-origin Research/Group Leaders in the BIO Sector

	2001	2002	2003	2004	2005	2006
Overseas Irish National	0	3	6	0	3	3
Overseas Non-Irish National	0	2	1	7	2	6
Total Overseas-origin Researchers	**0**	**5**	**7**	**7**	**5**	**9**
Total Irish-based Researchers	**3**	**21**	**28**	**17**	**19**	**35**
Annual Total No. of New Group Leader Awards	**3**	**26**	**35**	**24**	**24**	**44**
Overseas-origin as % Total	*0%*	*19.2%*	*20%*	*29.2%*	*20.8%*	*20.5%*

Source: Indecon analysis of SFI data

Annual Number of SFI-funded Awards made to Irish and Overseas-origin Research/Group Leaders in the ICT Sector

	2001	2002	2003	2004	2005	2006
Overseas Irish National	2	0	0	1	0	0
Overseas Non-Irish National	3	5	5	2	4	2
Total Overseas-origin Researchers	**5**	**5**	**5**	**3**	**4**	**2**
Total Irish-based Researchers	**3**	**25**	**23**	**16**	**7**	**22**
Annual Total No. of New Group Leader Awards	**8**	**30**	**28**	**19**	**11**	**24**
Overseas-origin as % Total	*62%*	*16.7%*	*17.9%*	*15.8%*	*36.4%*	*8.3%*

Source: Indecon analysis of SFI data

Overview of ICT Sector Collaboration related Activity – Academic Collaborations

	2001	2002	2003	2004	2005	2006*
Number of Irish ICT Academic Institution Collaborations	n/a	2	17	58	76	87
Number of International ICT Academic Institution Collaborations	n/a	12	67	171	193	237

Source: Indecon analysis of SFI data

Overview of BIO Sector Collaboration Related Activity – Academic Collaborations

	2001	2002	2003	2004	2005	2006
Number of Irish BIO Academic Institution Collaborations	n/a	7	23	106	101	109
Number of International BIO Academic Institution Collaborations	n/a	9	58	191	256	230

Source: Indecon analysis of SFI data

Research Outputs by Format and Directorate

Year	2002	2003	2004	2005	2006
Number of ICT International Presentations Conducted	46	263	562	682	997
Number of ICT research articles published in refereed national/international journals	118	357	769	728	816
Number of BIO International Presentations Conducted	33	144	758	872	723
Number of BIO research articles published in refereed national/international journals	17	96	539	524	502

Source: Indecon analysis of SFI data

FES Directorate Data

Year	2005	2006
Annual Total Number of New FES International presentations conducted	33	430
Annual Total No. of New FES research articles published in refereed national/international journals	118	501
Annual Total Number of New FES Patents granted	1	1
Annual Total Number of New FES Copyrights awarded	0	0
Annual No. of New Irish FES Academic Institution Collaborations established	4	17
Annual Number of New International FES Academic Institution Collaborations established	8	11
Annual Number of New Irish FES Industry Collaborations established	0	2
Annual Number of New International FES Industry Collaborations established	2	5

Source: Indecon analysis of SFI data

Annex 4 Additional Bibliometric Outputs

Comparison of SFI Funded Outputs to International Standards

International benchmarking by destination journal quality

The table below outlines the mean percentile ranking of papers by a cohort of 57 SFI funded Irish BIO researchers. The results show a consistent and high level of performance as the researchers publish in the top quartile of world journals. As Thompson ISI only ranks the top 40% of peer reviewed science journals, this further corroborates the achievement displayed by these researchers.

Trends in Destination Journal Quality for BIO Researchers – Percentile Rankings (n = 1,823 journal articles)

Year	Mean	Median	Standard Deviation
1998	24.5	17.1	22.9
1999	26.2	17.6	24.1
2000	24.5	16.5	22.5
2001	22.0	15.7	18.7
2002	23.3	16.3	19.3
2003	22.6	15.7	19.7
2004	24.1	15.9	22.2
2005	23.8	16.1	20.8
2006	24.7	15.9	21.6
2007	23.5	16.3	20.2
Total	**24.0**	**16.0**	**20.2**

Source: Bibliometric Analysis of SFI Research Outputs

The table below indicates the mean percentile ranking of papers by a cohort of SFI funded Irish ICT researchers. These statistics display a significant and consistent increase in performance over time. Over the period 1998 to 2006, the average performance of the ICT cohort has improved by 13 percentage points.

Trends in Destination Journal Quality for ICT Researchers – Percentile Rankings (n = 728 journal articles)

Year	Mean	Median	Standard Deviation
1998	34.8	31.3	24.9
1999	33.5	27.9	23.0
2000	31.7	25.2	23.1
2001	28.0	18.8	23.7
2002	27.9	22.8	22.4
2003	27.8	24.3	21.6
2004	24.7	18.6	20.3
2005	24.4	15.1	21.3
2006	21.4	19.4	16.7
2007	25.5	19.5	21.6
Total	27.4	21.4	21.9

Source: Bibliometric Assessment of SFI Research Outputs

Trends in research quality before/after SFI funding

In assessing impacts of SFI funding, it is also instructive to consider the movements before and after SFI funding in relation to the average quality of journals in which researchers publish their outputs.

The table below compares the destination journal impact factors before and after award of SFI funding for researchers and research subject areas in the ICT sector.

Comparison of Destination Journal Impact Factors by Broad Subject Area Before and After award of SFI funding – ICT Sector Researchers*

Scopus broad subject	Before/ After SFI Funding	Thompson/ISI Impact Factors		
		Mean	Median	S.D.
Computer Science	Before	1.08	0.86	0.74
	After	1.49	1.36	1.16
Electrical Engineering*	Before	1.57	1.48	1.03
	After	1.90	2.27	0.66
Materials Science*	Before	2.70	2.32	2.59
	After	4.46	4.29	2.84
Physics and Optics	Before	2.39	2.05	1.23
	After	2.58	2.08	1.41
All ICT	Before	2.48	1.67	3.56
	After	2.79	2.33	2.00

Source: Bibliometric Assessment of SFI Research Outputs

*Note: *Difference before and after significant at the 5% level. N= 728 journal articles*

The above analysis indicates that mean and median impact factors have increased significantly after award of SFI funding for research in the electrical engineering and materials science in particular, although upward movements in average impact factors across the ICT sector as a whole has not been as strong.

Considering the BIO sector, there is no discernable difference in impact factors before and after SFI funding (see table below). There are, however, significant increases in average impact of destination journal for researchers in the immunology and microbiology areas post SFI funding.

Comparison of Destination Journal Impact Factors by Broad Subject Area Before and After Award of SFI funding – BIO Sector Researchers

ISI Subject Area	Before/ After SFI Funding	Mean	Median	S.D.
Immunology**	Before	3.52	3.97	1.32
	After	4.79	3.97	4.84
Microbiology*	Before	3.11	3.48	3.08
	After	3.53	3.66	2.73
Molecular and cell biology	Before	5.50	4.89	4.32
	After	5.71	4.56	4.45
Neuroscience	Before	4.39	3.86	2.60
	After	4.12	3.92	1.98
Pharma	Before	3.99	3.20	2.03
	After	3.88	3.63	1.68
All BIO	Before	4.59	3.71	4.05
	After	4.67	3.77	4.02

Source: Bibliometric Assessment of SFI Research Outputs
*Note: *Difference before and after significant at 1% level*
***Difference before and after significant at 5% level. n= 1,823 journal articles*

Trends in Early Citation Rates

The key objective in this section is to determine whether SFI support is associated with higher quality outputs, using cohorts of BIO and ICT researchers before and after such an award as a control. The indicator used in this analysis is the early citation rate which refers to the rate at which an article is cited in the first few years of publication.

The table below describes the annual movements in mean and median early citation rates for SFI-funded BIO researchers. It shows a general increasing trend in the rate over the period outlined.

Trends in Early Citation Rates, BIO Researchers (n = 2,819 documents)

Year	Mean	Median	S.D.
1998	2.64	1.67	3.38
1999	2.64	1.67	3.90
2000	3.25	2.00	4.20
2001	3.08	1.67	5.50
2002	3.32	2.00	4.57
2003	2.66	1.33	4.44
2004	4.31	2.17	8.50

Source: Bibliometric Assessment of SFI Research Outputs

To isolate the specific effects of SFI funding, the early citation rates are calculated for the specific subject areas supported by SFI in the period before and after the introduction of funding. There has been a statistically significant increase in the rate for the whole BIO sector before and after funding. As the citation rate has increased after funding, this indicates an improvement in citation performance after SFI funding was introduced (see table overleaf).

Early Citation Rates, Before and After SFI Funding by Subject, BIO Researchers (n = 2,819 papers of all document types)

ISI Subject Area	Before/ After SFI Funding	Mean	Median	S.D.
Immunology***	Before	2.29	1.67	2.30
	After	5.56	3.67	5.10
Microbiology	Before	3.24	2.67	3.27
	After	2.65	2.00	2.01
Molecular and cell biology	Before	3.67	2.00	5.92
	After	3.99	2.67	4.67
Neuroscience***	Before	2.67	2.00	2.54
	After	4.18	3.00	4.68
Pharma	Before	2.76	1.67	4.73
	After	2.13	1.67	2.50
All BIO**	Before	3.02	1.67	5.03
	After	4.18	2.33	6.42

Source: Bibliometric Assessment of SFI Research Outputs
*Note : ***Difference before and after significant at 10% level*
***Difference before and after significant at 5% level*

In relation to the ICT sector, the table overleaf indicates a sharper and sustained improvement in early citation rates among SFI-funded researchers over the past decade.

Trends in Early Citation Rates, ICT Researchers (n = 1,713 papers of all document types)

Year	Mean	Median	S.D.
1998	0.93	0.00	2.89
1999	0.97	0.33	1.36
2000	1.36	0.33	4.56
2001	1.20	0.33	2.74
2002	1.20	0.33	1.66
2003	0.93	0.00	2.89
2004	0.97	0.33	1.36

Source: Bibliometric Assessment of SFI Research Outputs

The table below outlines the early citation rates by subject for ICT sector researchers. The results do not as a whole indicate an SFI specific effect on citation rates. There are subject specific effects in Electrical Engineering and Materials Science, where there is a statistically significant difference between citation rates before and after SFI funding and where citation rates have improved post-funding.

Early Citation Rates by Subject, ICT Researchers (n = 1,713 documents)

Scopus broad subject	Before/ After SFI Funding	Mean	Median	S.D.
Computer Science	Before	1.53	0.33	2.98
	After	2.50	2.83	0.79
Electrical Engineering*	Before	0.99	0.33	1.20
	After	3.20	2.67	2.10
Materials Science*	Before	1.33	0.67	1.70
	After	3.83	4.33	2.51
Physics	Before	1.85	1.00	3.88
	After	1.60	2.00	1.59
All ICT	Before	1.26	0.33	3.22
	After	1.29	0.33	1.82

Source: Bibliometric Assessment of SFI Research Outputs
*Note: *Difference before and after significant at the 1% level*

BIO specific Tables

BIO Research outputs by document type

Year	Article	Conference	Review	Editorial	Note or Other	Total
1998	187	14	25	4	8	229
1999	186	13	18	1	8	226
2000	222	8	12	4	5	251
2001	181	12	18	1	4	216
2002	176	34	19	0	3	232
2003	185	23	35	2	1	246
2004	223	22	35	2	4	286
2005	228	26	32	3	4	293
2006	263	11	28	1	8	311
2007	124	11	14	4	2	155
Total	**1,966**	**174**	**236**	**22**	**22**	**2,445**

Source: Bibliometric Analysis of SFI Research Outputs

BIO Destination journal quality, before and after SFI funding

Destination journal: vigicile	All articles	Before SFI funding	After SFI funding
5	10.8	10.6	10.7
10	27.8	27.9	25.7
15	42.6	41.6	41.8
20	59.7	59.6	58.0
25	68.9	69.1	68.2
30	73.3	73.5	72.8
35	78.1	77.6	78.2
40	81.1	80.4	81.5
45	84.8	84.0	85.5
50	87.1	86.4	87.9
55	90.1	89.2	91.2
60	92.4	92.2	92.7
65	93.2	92.8	93.7
70	94.8	94.2	95.2
75	95.2	95.0	95.4
80	96.2	96.1	96.3
85	96.5	96.4	96.4
90	98.7	98.5	99.1
95	99.7	99.9	99.9
100	100.0	100.0	100.0

Source: Bibliometric Analysis of SFI Research Outputs

Average BIO immediacy by funding programme using Ave Immediacy Index

Award	Mean	Median	Standard Deviation
CSET	0.90	0.68	0.79
PI	0.91	0.64	1.81
PIYRA	1.06	0.61	1.44
RP	0.84	0.72	0.76

Source: Bibliometric Assessment of SFI Research Outputs

BIO Early citation rate by funding programme (n = 1,713)using Ave Immediacy Index

Award	Mean	Median	Standard Deviation
CSET	2.60	1.33	4.55
PI	3.26	2.00	5.55
PIYRA	3.86	2.17	4.82
RP	3.10	1.67	5.07

Source: Bibliometric Assessment of SFI Research Outputs

Citations to BIO papers by year of their publication13

Year	1998 cites	1999 cites	2000 cites	2001 cites	2002 cites	2003 cites	2004 cites	2005 cites	2006 cites
1998	117	662	1,037	997	936	829	862	789	730
1999	-	117	704	972	1,009	901	923	874	837
2000	-	-	295	1,206	1,508	1,440	1,436	1,464	1,443
2001	-	-	-	952	2,113	2,129	2,061	1,903	1,707
2002	-	-	-	-	190	922	1,198	1,192	1,110
2003	-	-	-	-	-	272	1,116	1,419	1,416
2004	-	-	-	-	-	-	340	1,409	1,946

Source: Bibliometric Assessment of SFI Research Outputs

13This table includes two papers (in Nature) that have attracted 6,242 and 1,798 citations to date: this pair of represents almost 5% of all BIO citations but only 0.0004% of BIO papers. The two papers were removed from the subsequent analysis to offer a truer picture of the underlying trends.

ICT Specific Tables

ICT Research outputs by document type

Year	Article	Conference	Review	Editorial	Note or Other	Total
1998	187	14	25	4	8	229
1999	186	13	18	1	8	226
2000	222	8	12	4	5	251
2001	181	12	18	1	4	216
2002	176	34	19	0	3	232
2003	185	23	35	2	1	246
2004	223	22	35	2	4	286
2005	228	26	32	3	4	293
2006	263	11	28	1	8	311
2007	124	11	14	4	2	155
Total	**1,966**	**174**	**236**	**22**	**22**	**2,445**

Source: Bibliometric Analysis of SFI Research Outputs

ICT Destination journal quality, before and after SFI funding

Destination journal: vigicile	All articles	Before SFI funding	After SFI funding
5	9.6	6.9	13.3
10	22.8	17.4	31.1
15	39.1	32.0	50.0
20	48.2	41.9	58.3
25	55.8	49.9	64.8
30	65.5	59.6	75.0
35	68.5	63.9	76.1
40	76.5	70.8	85.2
45	80.9	75.7	89.4
50	87.0	83.9	91.7
55	88.9	85.9	93.6
60	90.9	88.0	95.8
65	93.0	90.8	96.6
70	94.6	92.3	98.9
75	95.5	93.9	98.9
80	95.9	94.6	98.9
85	97.1	96.2	99.6
90	97.4	96.7	99.6
95	99.0	98.5	100.0
100	100.0	100.0	100.0

Source: Bibliometric Analysis of SFI Research Outputs

Average BIO immediacy by funding programme -Ave Immediacy Index

Award	Mean	Median	Standard Deviation
CSET	0.75	0.68	0.76
PI	0.43	0.31	0.70
PICA	0.67	0.69	0.39
PIYRA	0.55	0.68	0.20
RP	0.43	0.31	0.37
Walton	0.53	0.35	0.85

Source: Bibliometric Assessment of SFI Research Outputs

Average ICT immediacy, before and after SFI funding by subject

Ave. ISI Immediacy Index	Before/ After SFI funding	Mean	Median	Standard Deviation
Computer Science	Before	0.22	0.12	0.25
	After	0.17	0.09	0.15
Electrical Engineering*	Before	0.24	0.16	0.18
	After	0.33	0.39	0.18
Materials Science*	Before	0.40	0.25	0.45
	After	0.76	0.69	0.53
Physics	Before	0.46	0.38	0.28
	After	0.50	0.48	0.32

Source: Bibliometric Assessment of SFI Research Outputs
***Indicates that the difference before and after is statistically significant at the 1% level.*

Citations to ICT papers by year of their publication14

Year	1998 cites	1999 cites	2000 cites	2001 cites	2002 cites	2003 cites	2004 cites	2005 cites	2006 cites
1998	33	128	218	237	210	261	269	275	345
1999	-	27	98	201	186	199	201	201	275
2000	-	-	39	175	275	387	402	415	418
2001	-	-	-	46	178	262	326	336	287
2002	-	-	-	-	74	221	253	284	343
2003	-	-	-	-	-	40	236	399	357
2004	-	-	-	-	-	-	110	429	595

Source: Bibliometric Assessment of SFI Research Outputs

14This table includes two papers (in Nature) that have attracted 6,242 and 1,798 citations to date: this pair of represents almost 5% of all BIO citations but only 0.0004% of BIO papers. The two papers were removed from the subsequent analysis to offer a truer picture of the underlying trends.

Early citation rate by funding programme, ICT researchers (n = 1,713)

Award	Mean	Median	Standard Deviation
CSET	3.11	0.67	5.58
PI	1.12	0.33	2.86
PICA	2.17	1.00	3.00
PIYRA	1.63	1.00	2.25
RP	0.52	0.33	0.73
Watlon	1.47	0.67	3.71

Source: Bibliometric Assessment of SFI Research Outputs

Annex 5 Additional Survey Research Outputs

Indecon Survey of SFI Funded Researchers

Survey of SFI Funded Researchers – Funded Research Group Member by Type

Type	*% of Total Responses*
Principal Investigator	97%
Research Scientist/Research Fellow	0%
Post-doctoral Researcher	0%
Postgraduate Student	0%
Intern	0%
Support Staff	0%
Other	3%
Total Responses	100%

Source: Indecon Survey of SFI Funded Researchers

The table below outlines the number of years that the researcher is with their current research group. The average time spend is 9.6 years with a standard deviation of 7 years. The longest that a researcher was involved with their current group is 31 years and the shortest was half a year.

Survey of SFI Funded Researchers - Number of Years Funded Researcher Based with Current Research Group

Statistic	Value
Mean	9.6
Median	8.0
Mode	15.0
Standard Deviation	7.0
Minimum	0.5
Maximum	31.0

Source: Indecon Survey of SFI Funded Researchers

The Table below profiles the sectoral breakdown of respondents. 44% of respondents were involved in the ICT sector, 47% were involved in the BIO sector and 10% were in other sectors most notably the FES sector.

Survey of SFI Funded Researchers - Sector in which Funded Researcher is Involved

Sector	*% of Total Responses*
ICT	44%
Biotech	47%
Other	10%
Total Responses	100%

Source: Indecon Survey of SFI Funded Researchers

Survey of SFI Funded Researchers - Funded Researchers' Awareness of SFI Awards

Award	% Yes	% No
Investigator Programme Grants (including Fellow Awards)	97.7%	2.3%
Research Professorships	98.8%	1.2%
CSETs	97.7%	2.3%
PIYRAs	97.6%	2.4%
ETS Walton Visitor Awards	98.8%	1.2%
Research Frontiers Programme	95.3%	4.7%

Source: Indecon Survey of SFI Funded Researchers

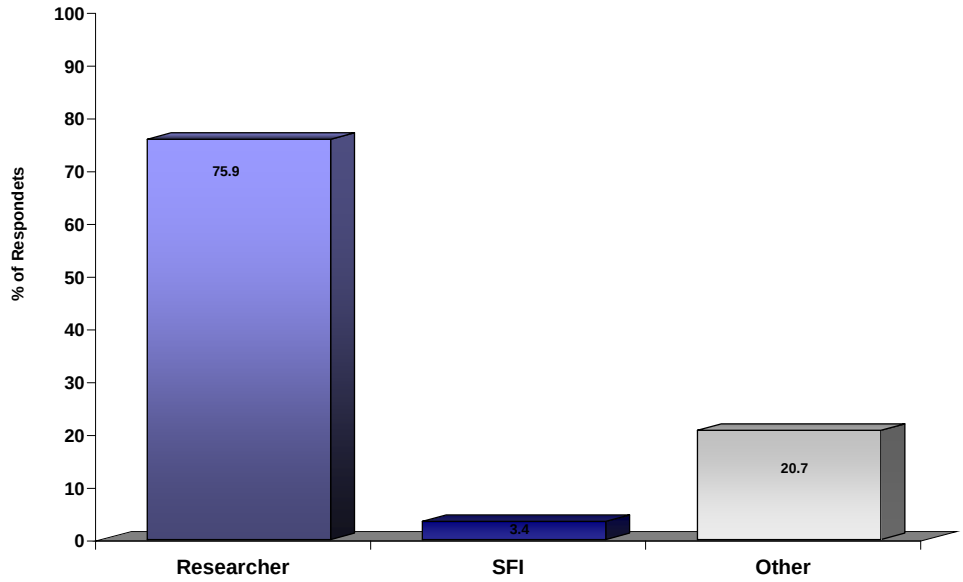
Survey of SFI Funded Researchers – Whether researcher was Aware of SFI Objectives?

Objective	**% Yes**	**% No**	**Total %**
Develop Human Capital	90%	10%	100
Support Strong Ideas	92%	8%	100
Promote Partnerships	85%	15%	100

Source: Indecon Survey of Funded Researchers

The Figure below outlines the responses to the question of who initiated contact. In a majority of cases, 75.9%, it was the funded researcher themselves that initiated contact with SFI. SFI initiated contact in only 3.5% of the cases and the remaining 20.7% of researchers were put in contact with SFI through a third party.

Survey of SFI Funded Researchers - Who Initiated Contact with SFI? (%)



Source: Indecon Survey of SFI Funded Researchers

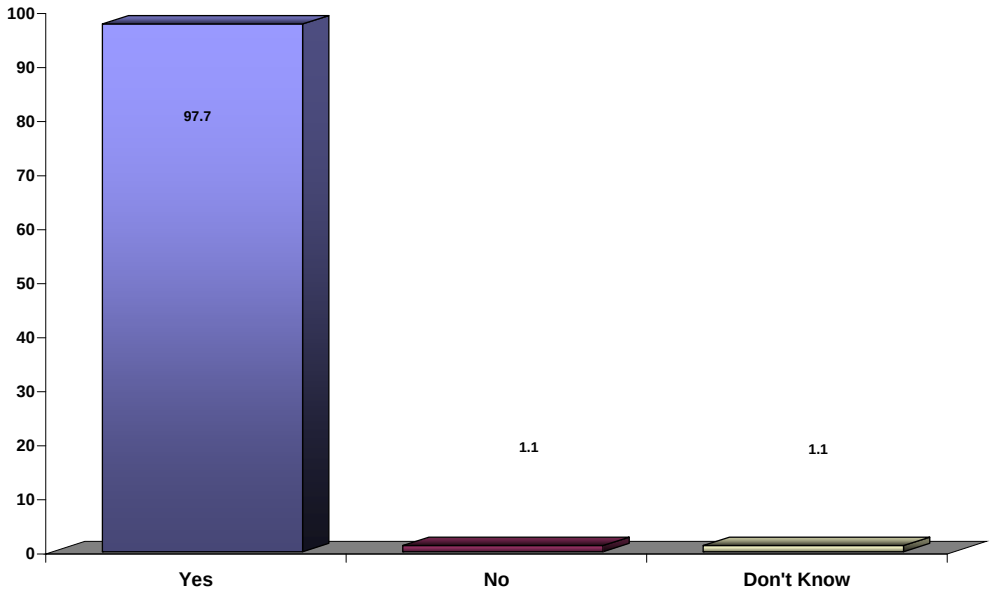
The Table below shows that funded researchers overwhelmingly believe that contact they have had with SFI has been productive; 98.8% of respondents believe that contact has been productive whereas only 1.2% believe that contact has been unproductive.

Survey of SFI Funded Researchers - Whether Contact with SFI has been Productive?

Response	***% of Total Responses***
Yes	*98.8*
No	*1.2*
Total Responses	***100.0***

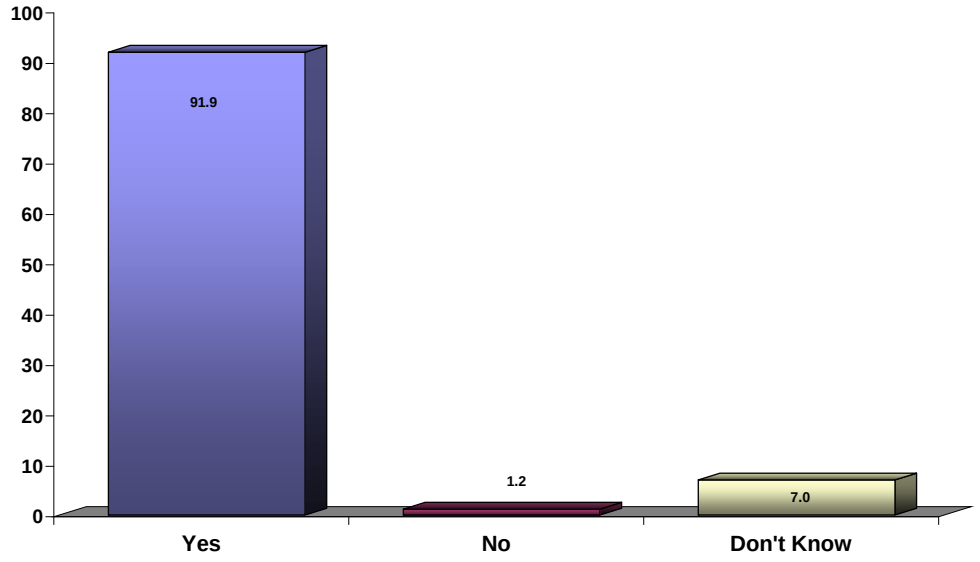
Source: Indecon Survey of SFI Funded Researchers

Views of SFI-funded Researchers on Whether there has been Substantive Improvements in the Volume and/or Quality of Relevant Research being Performed in *Respondents Research Group* as a Result of SFI Funding or Influence - % of Respondents



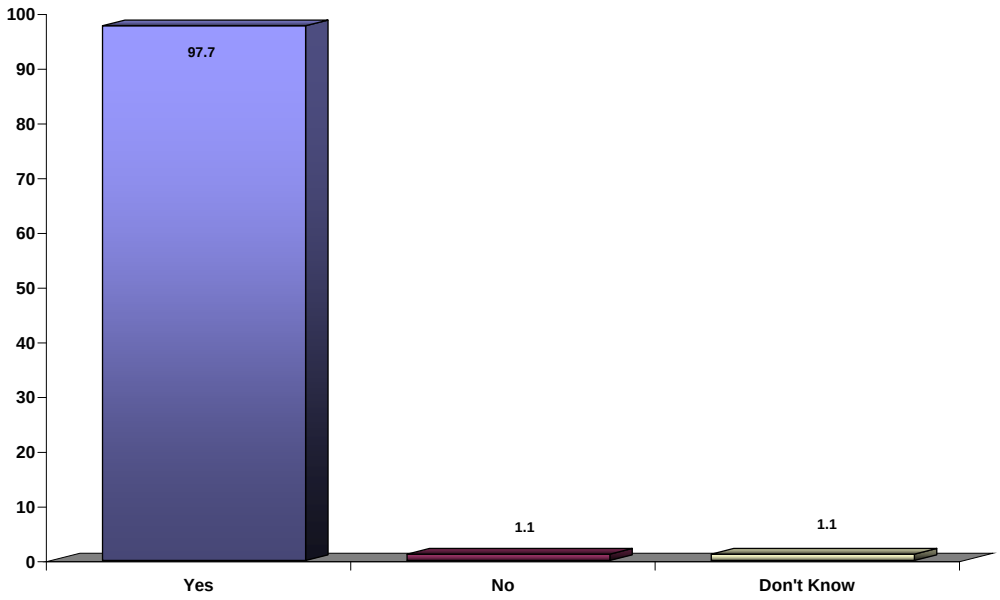
Source: Indecon Survey of SFI Funded Researchers

Whether there has been Substantive Improvements in the Volume and/or Quality of Relevant Research being Performed in *Other* Research Group as a Result of SFI Funding or Influence? (% of Respondents)



Source: Indecon Survey of SFI Funded Researchers

Survey of SFI Funded Researchers – Whether respondent believes SFI has had a Positive Influence on Research Group/Institution?



Source: Indecon Survey of SFI Funded Researchers

Survey of SFI Funded Researchers - Whether SFI Funding has Influenced the Manner in which Research has been Conducted?

Response	*% of Total Responses*
Yes	*69.5*
No	*30.5*

Source: Indecon Survey of SFI Funded Researchers

Indecon Survey of Unsuccessful Applicants for SFI Funding

Survey of Unsuccessful Applicants -Research Group Member, by Type

Type	% of Total Responses
Group Leader	79.4
Research Scientist/ Research Fellow	13.2
Post-doctoral Researcher	1.5
Postgraduate Student	0.0
Intern	0.0
Support Staff	0.0
Other	5.9
Total Responses	100.0

Source: Indecon Survey of Unsuccessful Applicants for SFI funding

Survey of Unsuccessful Applicants -Number of Years Based with Current Research Group

Statistic	Value
Mean	9.8
Median	8.0
Mode	10.0
Standard Deviation	6.5
Minimum	0.0
Maximum	30.0

Source: Indecon Survey of Unsuccessful Applicants for SFI funding

Survey of Unsuccessful Applicants -Sector in which Unsuccessful Applicants were involved

Sector	% of Total Responses
ICT	34.3
Biotech	34.3
Other	31.4
Total Responses	100.0

Source: Indecon Survey of Unsuccessful Applicants for SFI funding

Survey of Unsuccessful Applicants –Applicants Awareness of SFI awards

Award	*Yes Responses as % of Total Responses*	*No Responses as % of Total Responses*
Investigator Programme Grants (including Fellow Awards)	*18.0*	*6.5*
Research Professorships	*16.6*	*17.4*
CSETs	*16.9*	*15.2*
PIYRAs	*15.4*	*26.1*
ETS Walton Visitor Awards	*16.9*	*15.2*
Research Frontiers Programme	*16.3*	*19.6*
Total Responses	*100.0*	*100.0*

Source: Indecon Survey of Unsuccessful Applicants for SFI funding

Survey of Unsuccessful Applicants –Whether Applicant had previously Received SFI Funding

Response	*% of Total Responses*
Yes	*56.7*
No	*43.3*
Total Responses	***100.0***

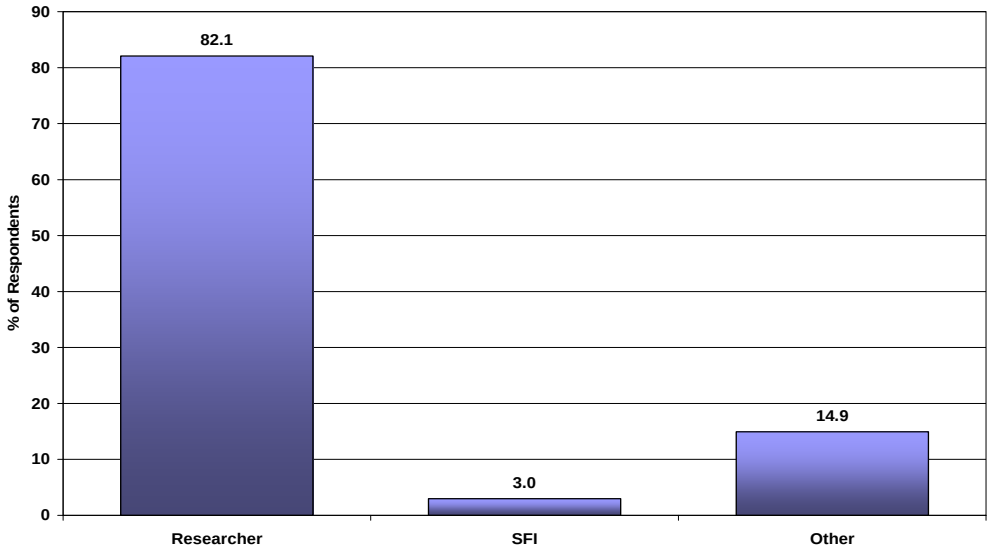
Source: Indecon Survey of Unsuccessful Applicants for SFI funding

Survey of Unsuccessful Applicants -Number of Applications Submitted for SFI Programmes

SFI Programme	*% of Total Responses*
Investigator Programme Grants (including Fellow Awards)	*34*
Research Professorships	*5*
CSETs	*3*
PIYRAs	*8*
ETS Walton Visitor Awards	*3*
Research Frontiers Programme	*47*
Total	*100*

Source: Indecon Survey of Unsuccessful Applicants for SFI funding

Survey of Unsuccessful Applicants -Who Initiated Original Contact with SFI



Source: Indecon Survey of Unsuccessful Applicants for SFI funding

Survey of Unsuccessful Applicants –Whether applicant has previously been Aware of SFI Objectives

Objective	Yes as % of Total	No as % of Total
Develop Human Capital	78	22
Support Strong Ideas	81	19
Promote Partnerships	72	28

Source: Indecon Survey of Unsuccessful Applicants for SFI funding

Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Number of Years Company has been Operating in Ireland

Statistic	Value
Mean	22.2
Median	17.5
Mode	15.0
Standard Deviation	17.5
Minimum	1.5
Maximum	71.0

Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Current Number of Full-time equivalent Irish Employees in Company

Statistic	Value
Mean	411
Median	100
Mode	100
Standard Deviation	789
Minimum	0
Maximum	3,000

Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Current Number of Full-time equivalent Employees in company Worldwide

Statistic	Value
Mean	25,373
Median	3,200
Mode	0
Standard Deviation	73,171
Minimum	0
Maximum	320,000

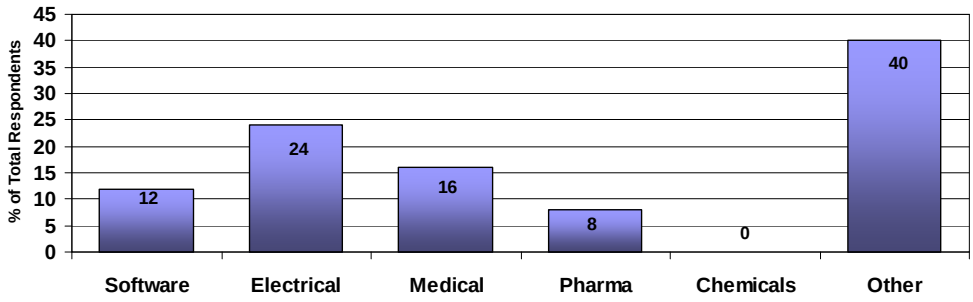
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Company's Approximate annual Expenditure on R&D in Ireland

Statistic	Value
Mean	7,004,706
Median	450,000
Mode	600,000
Standard Deviation	16,958,833
Minimum	0
Maximum	65,000,000

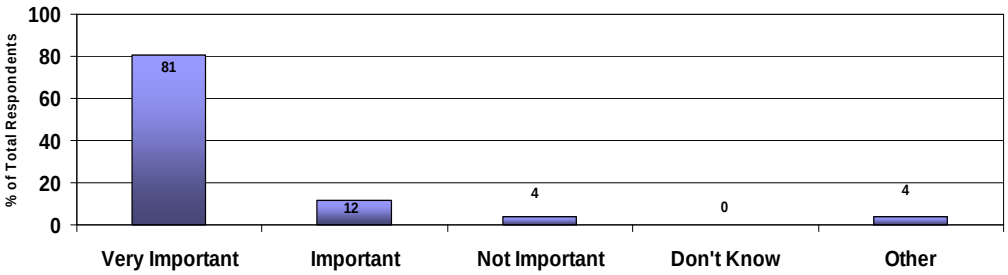
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Sector in which Company is principally Involved



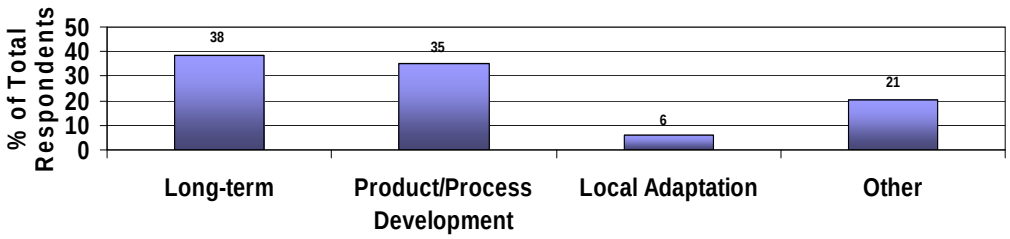
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry- Importance of R&D Activities within Company



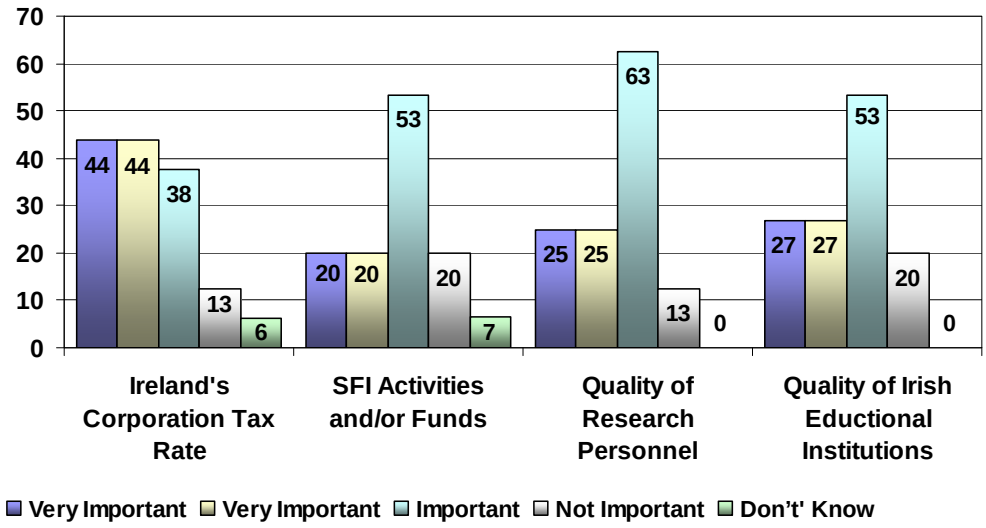
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry- Type of R&D Activities which Company conducts



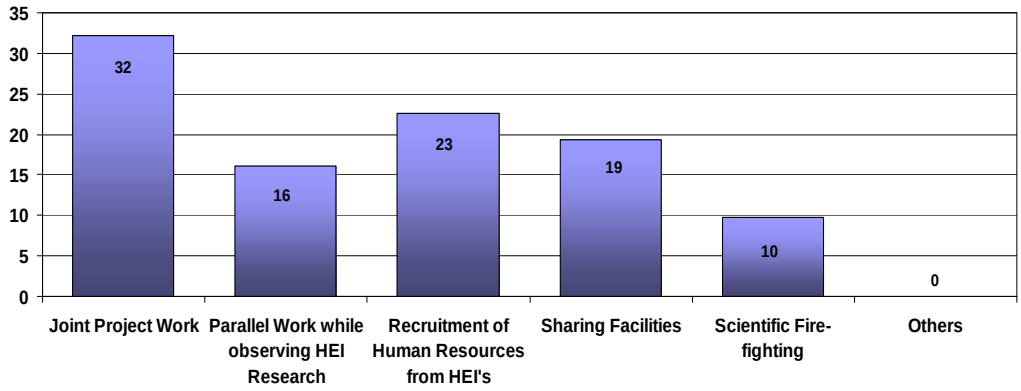
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Importance of Factors influencing choice of location of company in Ireland, (%)



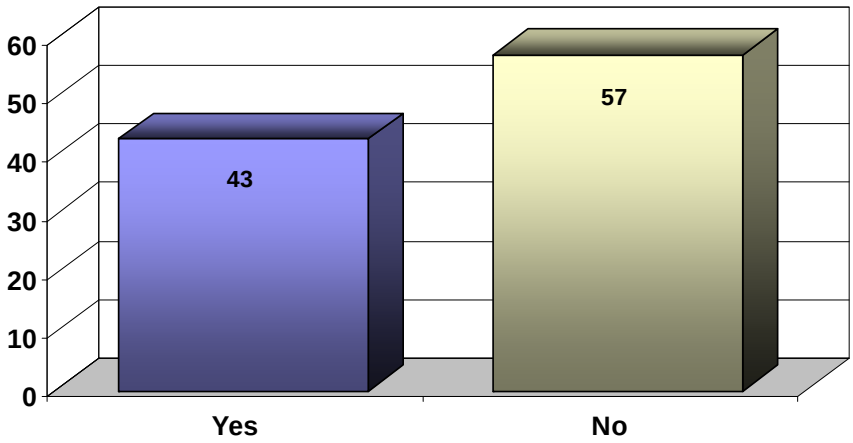
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Type of Work Undertaken with Academic Partners (%)



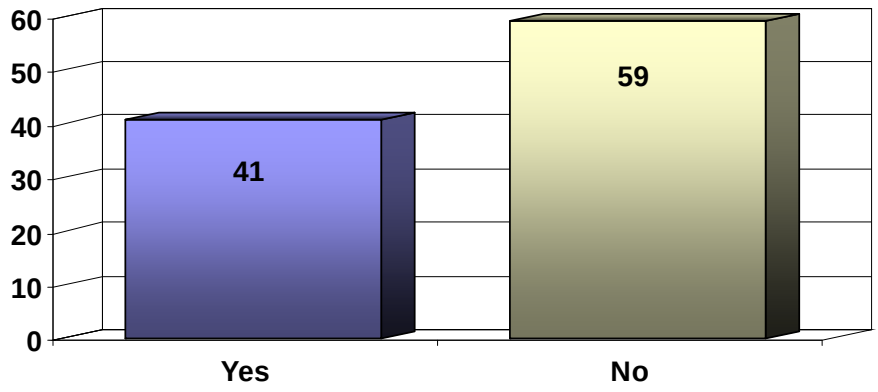
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry -Whether the nature of the Company's relationship with HEI is changing (%)



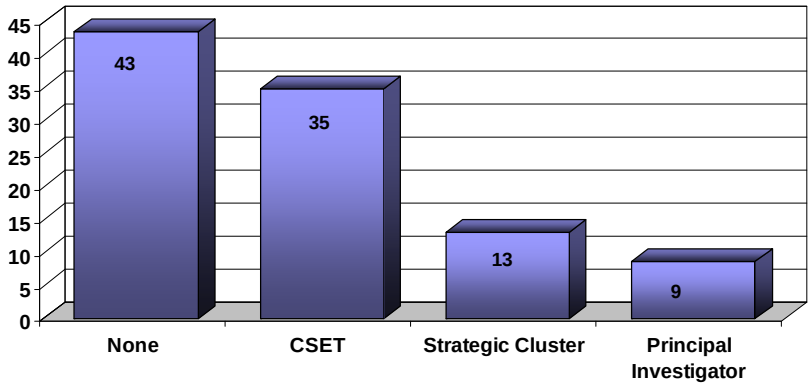
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Whether Company has had direct contact with SFI (%)



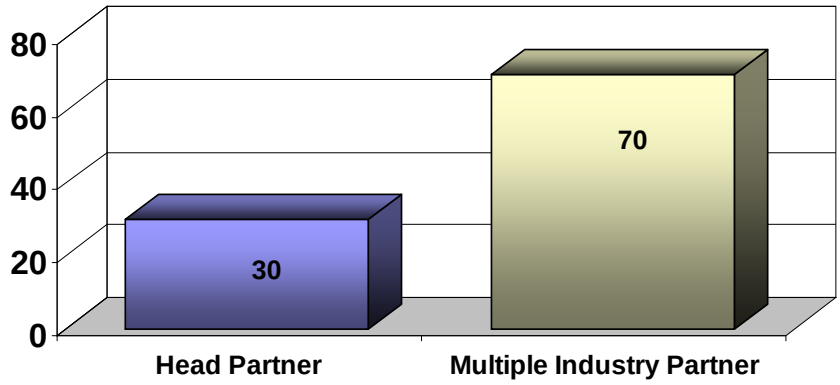
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry- Extent of Involvement with SFI Programmes (%)



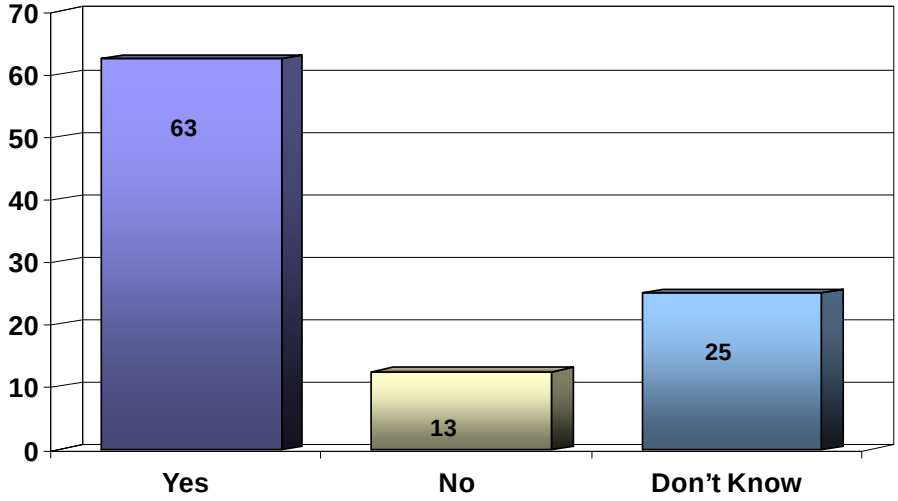
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Type of Association with SFI (%)



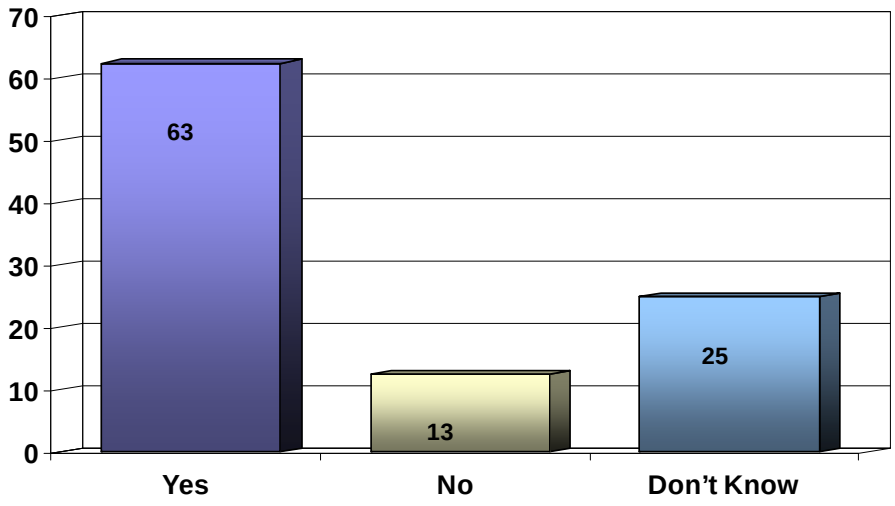
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - If not currently involved with SFI, whether such involvement would be of benefit to Company? (%)



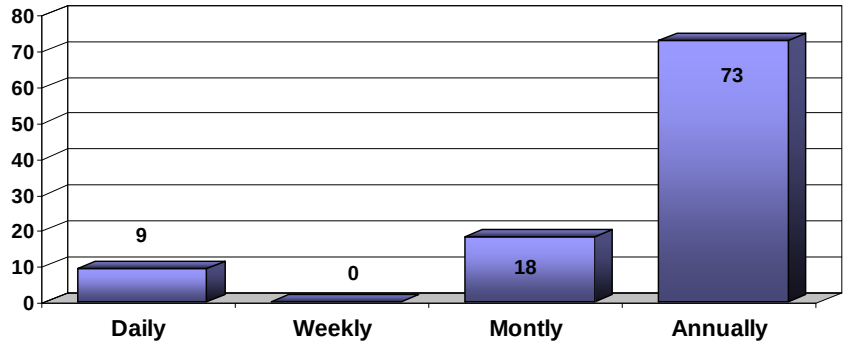
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - If involved with SFI who initiated contact with the latter (%)



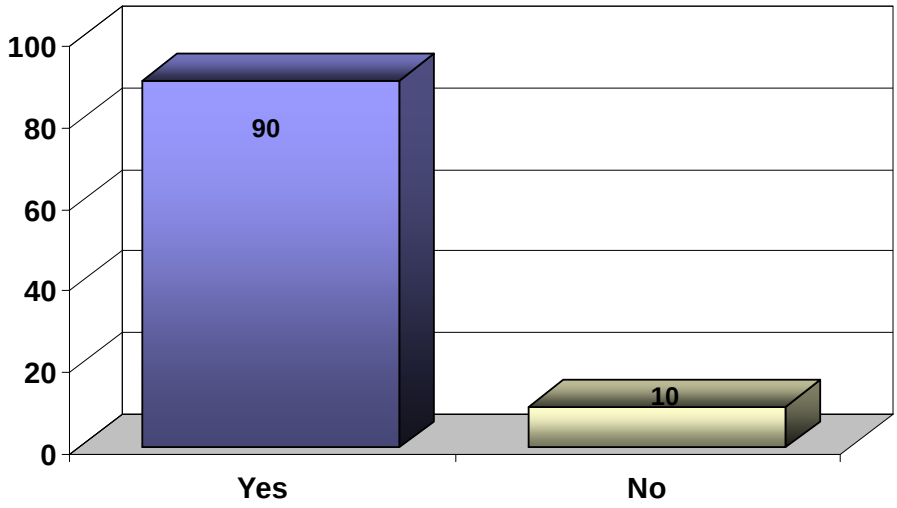
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Frequency of Contact with SFI (%)



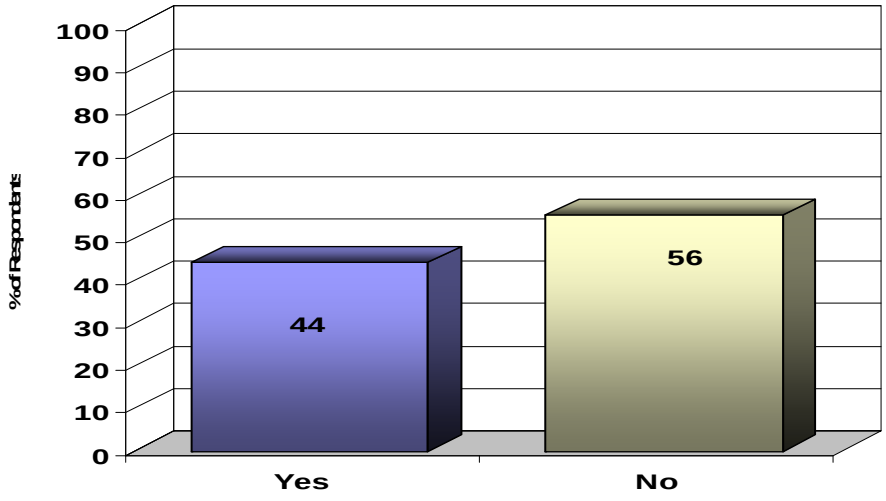
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Whether or not contact with SFI was perceived as Productive (%)



Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Whether or not Company has been involved with CSETs



Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Is Your Company Aware of the Following Award?

SFI Award	% Yes	% No	% Total
Investigator Programme Grants (including Fellow Awards)	42%	58%	100%
Research Professorships	54%	46%	100%
Centres for Science, Engineering and Technology (CSETs)	59%	41%	100%
President of Ireland Young Researchers Awards (PIYRAs)	26%	74%	100%
ETS Walton Visitor Awards	37%	63%	100%
Research Frontiers Programme	15%	85%	100%

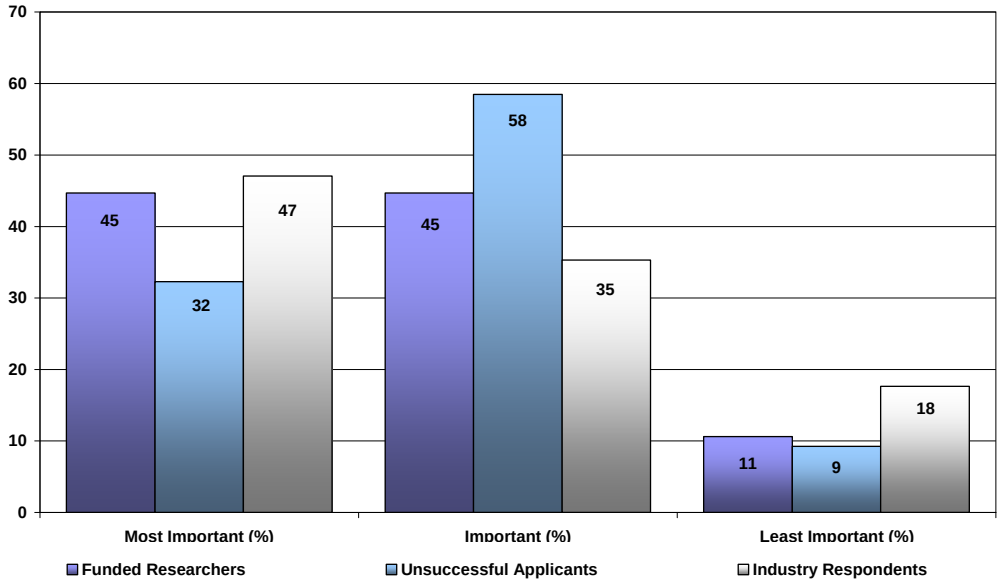
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - List of Supports and Agencies Accessed by Companies Responding to Survey

Support	Agency
Joint funding of post-grad	IRCSET
Collaboration with CSETS	SFI
Grant aid for R&D	IDA
Employee grants	IDA
RTI	EI
Innovation Partnership	EI
RTI	EI
CSET	SFI
Grant Aid	IDA
RTI Grant	IDA
Incremental R&D Tax Credit	Revenue Commissioners
R&D Capability Development	IDA
RTI Grant	EI
Innovation Partnership Scheme	EI
Xilnix Research Labs	IDA
Kevlar Project	EI
Research and development skills grant	IDA
Partner to CSET	SFI
BDI	SFI
RTD Project Support	Marine Institute/EPA
Gensis Programme Feasibility Grants	EI
Headcount based aid	IDA
Patent Support	EI
CORD Business start up Grant	EI

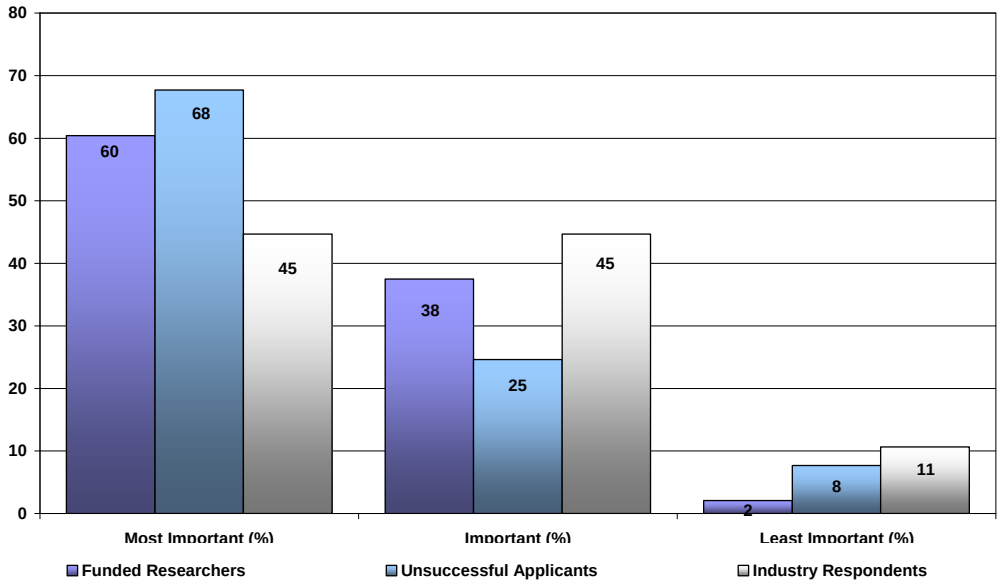
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - - Respondents Ranking of Importance of SFI Objectives – Develop Human Capital (%)



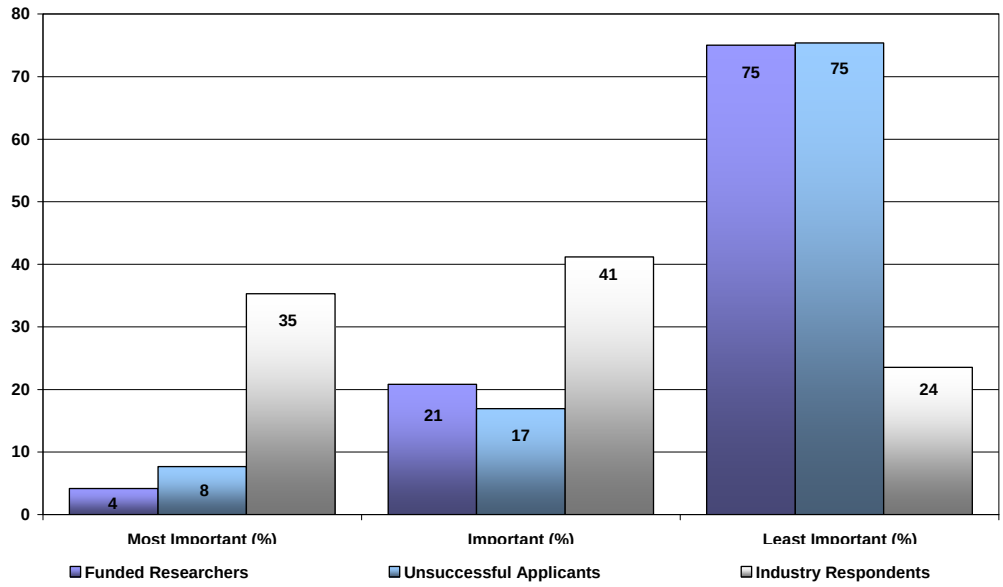
Source: Indecon Analysis of Survey Data

Survey of Industry - Respondents Ranking of Importance of SFI Objectives - Support Strong Ideas (%)



Source: Indecon Analysis of Survey Data

Survey of Industry - Respondents Ranking of Importance of SFI Objectives - Promote Partnerships (%)



Source: Indecon Analysis of Survey Data

Comparison between SFI and Other Research Funding Schemes, across the Following Issues, (%) – Views of SFI Funded Researchers

Issue	Much Better than Ave of Other Organisations (%)	Better than Ave of Other Organisations (%)	Similar (%)	Worse than Other Organisations (%)	Much Worse than Other Organisations (%)	Total (%)
Overall SFI Funding Application Process	25.3	48.3	18.4	6.9	1.1	100
Appropriateness of Selection Criteria	20.9	40.7	31.4	5.8	1.2	100
Administrative Procedures	9.4	38.8	35.3	16.5	0.0	100
Time Involved in Overall Application Process	9.2	28.7	36.8	19.5	5.7	100
Peer Review Process	34.5	36.8	19.5	6.9	2.3	100
Terms and Conditions of SFI Grants	11.5	34.5	46.0	5.7	2.3	100
Contracts/Payments and Financial Management	8.2	34.1	43.5	12.9	1.2	100
Communications between SFI and Researchers	25.0	38.6	26.1	8.0	2.3	100
Clarity on how value of research will be measured	10.5	41.9	33.7	9.3	4.7	100

Source: Indecon Survey of SFI Funded Researchers

The table above compares SFI and other funding programmes over a number of issues. The first issue considered was the overall SFI funding application process. 73.6% of respondents stated that the process was either much better or better than average compared to other organisations. This is a positive finding. The second issue considered is the appropriateness of selection criteria. Nearly 21% of respondents noted that the appropriateness of selection criteria was much better than average in relation to other organisations, and a further 40% said that it was better than average of other organisations. A further 31.4% said it was similar to that of other organisations. On the issue of administrative procedures, the majority of respondents stated that SFI programmes were better or similar to other organisations. Nearly 17% said that administrative procedures were worse than other organisations but no respondents stated that SFI were much worse than other funding schemes. The time involved in the overall application process was considered by a majority to be either better than other organisations or similar to organisations but a sizeable percentage, 19.5%, believe that it was worse than other organisations.

71.3% of respondents believed that the SFI peer review process was much better or better than that of other research funding schemes. 19.5% believed that it was similar to that in other funding schemes. Very few respondents classed it as worse or much worse regarding this issue. Regarding the Terms and Conditions of SFI grants, 11.5% believed that SFI was much better that average of other organisations, 34.5% believed that it was better than average of other organisations, and 46% said it was similar to other organisations. Only 8% of respondents classed it as either worse or much worse than other organisations. In relation to contracts/payments and financial management, 8.2% believed that SFI was much better that average of other organisations, 34.1% believed that it was better than average of other organisations, and 43.5% said it was similar to other organisations. 12.9% of funded researchers surveyed classed SFI as worse than average of other organisations, and 1.2% classed it as much worse than average of other organisations.

Of the responses received on the issue of Communications between SFI and researchers, 25% regarded SFI as much better than average of other organisations, 38.6% said SFI was better than average of other organisations, 26.1% said it was similar to that of other organisations, 8% said that they were worse than average of other organisations and 2.3% said they were much worse than average of other organisations.

The last issue considered in this table is in relation to the clarity on how the value of research will be measured. 10.5% regarded SFI as much better than average of other organisations, 41.9% said SFI was better than average of other organisations, 33.7% said it was similar to that of other organisations, 9.3% said that they were worse than average of other organisations and 4.7% said they were much worse than average of other organisations.

Overall the sentiment of funded researchers in relation to SFI seems to be positive. On the issues mentioned above, the majority of respondents gave mainly positive views on all aspects considered with very few negative responses.

To provide further comparative analysis, the table below has the views of unsuccessful applicants for SFI funding on some of the issues considered above. The overall SFI funding application process is viewed in a much more negative light by unsuccessful applicants. Only 5% of respondents stated that this issue was much better than average of other organisations, 18% said that is was better than average of other organisations and 53% stated that it was similar to that of other organisations. 24% stated that it was worse or much worse than other organisations. In relation to the appropriateness of selection criteria, no respondents thought that it was much better than average of other organisations, 19% said it was better than average of other organisations, 48% said it was similar to other organisations, 27% said it was worse than other organisations and 6% said it was much worse than other organisations. On the issue of administrative procedures, 2% of unsuccessful applicants thought that it was much better than average of other organisations, 24% said it was better than average of other organisations, 50% said it was similar to other organisations, 15% said it was worse than other organisations and 9% said it was much worse than other organisations. The time involved in the overall application process was viewed in the following manner: 3% said SFI was much better than average, 18% said it was better than average, 39% said it was similar to other organisations, 27% said it was worse than other organisations, and 12% said that it was much worse than other organisations. These responses view the issue more negatively that

Comparison between SFI and Other Research Funding Schemes, across the Following Issues, (%) – Views of Unsuccessful Applicants for SFI Funding

Issue	Much Better than Average of Other Organisations (%)	Better than Average of Other Organisations (%)	Similar (%)	Worse than Other Organisations (%)	Much Worse than Other Organisations (%)	Total Responses (%)
Overall SFI Funding Application Process	5	18	53	18	6	100
Appropriateness of Selection Criteria	0	19	48	27	6	100
Administrative Procedures	2	24	50	15	9	100
Time Involved in Overall Application Process	3	18	39	27	12	100
Peer Review Process	6	20	45	15	14	100
Communications between SFI and Applicants	9	23	38	21	9	100

Source: Indecon Survey of Unsuccessful Applicants for SFI funding

Whether SFI is Operating Efficiently? – Views of Funded Researchers

Response	% of Total Responses
Yes	68.3
No	14.6
Don't Know	17.1
Total Responses	**100.0**

Source: Indecon Survey of SFI Funded Researchers

Whether SFI is Operating Efficiently? – Views of Industry

Response	% of Total Responses
Yes	21.7
No	4.3
Don't Know	73.9
Total Responses	**100.0**

Source: Indecon Survey of Leading Companies and Industry Partners

The responses below clearly indicate that funded researchers believe that SFI is effective in meeting its objectives; 86% believe that it is effectively meeting these objectives while only 3.5% think its not.

Whether SFI is Effective in Meeting its Objectives? – Views of Funded Researchers

Response	% of Total Responses
Yes	86.0
No	3.5
Don't Know	10.5
Total Responses	**100.0**

Source: Indecon Survey of SFI Funded Researchers

Whether SFI is Effective in Meeting its Objectives? – Views of Industry

Response	% of Total Responses
Yes	40.9
No	0.0
Don't Know	59.1
Total Responses	**100.0**

Source: Indecon Survey of Leading Companies and Industry Partners

Also 79.3% of funded researchers believe that SFI programmes and activities are likely to lead to the desired outcomes compared to only 4.6% that do not believe so. The Table below outlines this result.

Whether SFI Programmes and Activities are Likely to Lead to the Desired Outcomes? – Views of Funded Researchers

Response	*% of Total Responses*
Yes	*79.3*
No	*4.6*
Don't Know	*16.1*
Total Responses	***100.0***

Source: Indecon Survey of SFI Funded Researchers

Whether SFI Programmes and Activities are Likely to Lead to the Desired Outcomes? – Views of Industry

Response	*% of Total Responses*
Yes	*63.6*
No	*0.0*
Don't Know	*36.4*
Total Responses	***100.0***

Source: Indecon Survey of Leading Companies and Industry Partners

Whether SFI is having a Positive Impact on the Research System as a Whole? – Views of Funded Researchers

Response	*% of Total Responses*
Yes	*96.5*
No	*2.3*
Don't Know	*1.2*
Total Responses	***100.0***

Source: Indecon Survey of SFI Funded Researchers

Whether SFI is having a Positive Impact on the Research System as a Whole? – Views of Industry

Response	*% of Total Responses*
Yes	*58.3*
No	*0.0*
Don't Know	*41.7*
Total Responses	***100.0***

Source: Indecon Survey of Leading Companies and Industry Partners

Whether SFI Objectives are still Consistent with the Current State of the Irish Research System/Science Base? – Views of Funded Researchers

Response	*% of Total Responses*
Yes	*80.5*
No	*6.9*
Don't Know	*12.6*
Total Responses	***100.0***

Source: Indecon Survey of SFI Funded Researchers

Whether SFI Objectives are still Consistent with the Current State of the Irish Research System/Science Base? – Views of Industry

Response	*% of Total Responses*
Yes	*41.7*
No	*8.3*
Don't Know	*54.2*
Total Responses	***100.0***

Source: Indecon Survey of Leading Companies and Industry Partners

Whether SFI Objectives are still Consistent with National Research and Innovation Policies? – Views of Funded Researchers

Response	*% of Total Responses*
Yes	*81.6*
No	*5.7*
Don't Know	*12.6*
Total Responses	***100.0***

Source: Indecon Survey of SFI Funded Researchers

Whether SFI Objectives are still Consistent with National Research and Innovation Policies?- Views of Industry

Response	*% of Total Responses*
Yes	*40.0*
No	*16.0*
Don't Know	*44.0*
Total Responses	***100.0***

Source: Indecon Survey of Leading Companies and Industry Partners

Views of SFI-funded Researchers on Whether SFI has had or is likely to have a Significant Impact

SFI Impact	Very Significant Impact (%)	Significant Impact (%)	Moderate Impact (%)	Neither Significant nor Insignificant Impact (%)	No Impact (%)	Don't Know (%)	Total Responses (%)
Attraction of Outstanding Researchers to Ireland	39.7	46	5	6	1	0	100
Providing Increased Support to Existing High Quality Researchers in Ireland	60.3	34	2	3	0	0	100
Increase in High Quality Publications by SFI Funded Researchers	46.8	39	7	0	1	7	100
Increase IP/Patents	11.5	41	5	5	1	38	100
Increase in Licences	9.0	23	9	3	1	55	100
Increase in Research Based Spin-off	3.8	32	16	3	3	40	100
Training of Postgraduates for Employment in Ireland	35.9	47	7	5	0	5	100
Training of Postgraduates for Employment Internationally	35.9	53	7	1	0	5	100
Improved Capacity in Irish System to Undertake High Quality Research	69.2	26	1	3	0	1	100
Enhanced Research Reputation for Ireland	79.5	17	1	3	0	0	100
Stimulation of Greater Research and Development by Industry	15.4	33	11	10	5	24	100
Supporting the Attraction of Foreign Direct Investment Research and Development Activities	12.8	33	7	2	1	44	100

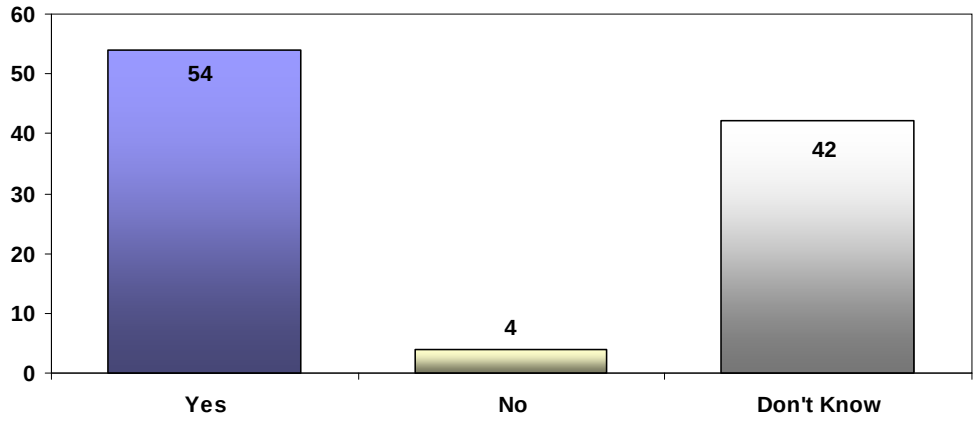
Source: Indecon Survey of SFI Funded Researchers

Views of Unsuccessful Applicants for SFi Funding on Whether SFI has had or is likely to have a Significant Impact

SFI Impact	Very Significant Impact %	Significant Impact %	Moderate Impact %	Neither Significant nor Insignificant Impact %	No Impact %	Don't Know %	Totals %
Attraction of Outstanding Researchers to Ireland	26.6	53.1	6.3	10.9	1.6	1.6	100.0
Providing Increased Support to Existing High Quality Researchers in Ireland	33.8	43.1	6.2	15.4	0.0	1.5	100.0
Increase in High Quality Publications by SFI Funded Researchers	14.3	55.6	12.7	6.3	7.9	3.2	100.0
Increase IP/Patents	3.1	35.9	14.1	10.9	9.4	26.6	100.0
Increase in Licences	3.1	26.6	15.6	12.5	10.9	31.3	100.0
Increase in Research Based Spin-off	3.1	29.7	12.5	17.2	7.8	29.7	100.0
Training of Postgraduates for Employment in Ireland	20.3	54.7	6.3	9.4	3.1	6.3	100.0
Training of Postgraduates for Employment Internationally	20.3	50.0	6.3	10.9	6.3	6.3	100.0
Improved Capacity in Irish System to Undertake High Quality Research	35.9	42.2	7.8	7.8	3.1	3.1	100.0
Enhanced Research Reputation for Ireland	35.9	45.3	6.3	6.3	3.1	3.1	100.0
Stimulation of Greater Research and Development by Industry	3.1	33.8	12.3	18.5	13.8	18.5	100.0
Supporting the Attraction of Foreign Direct Investment Research and Development Activities	4.7	32.8	9.4	18.8	9.4	25.0	100.0

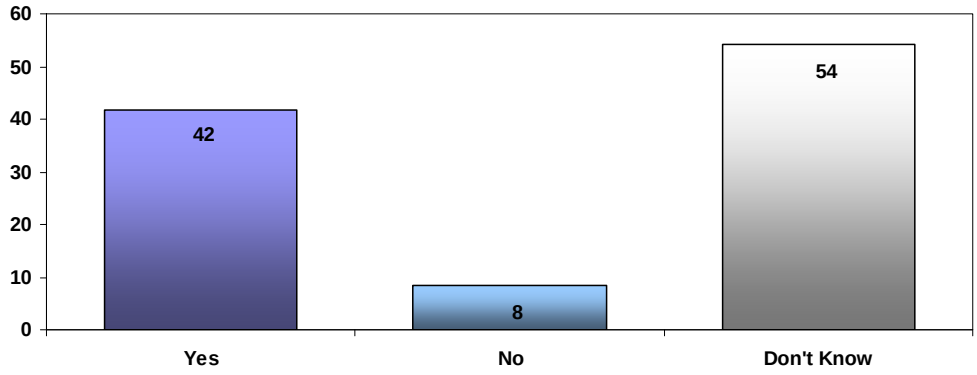
Source: Indecon Survey of Unsuccessful Applicants for SFI funding

Survey of Industry – Whether there have been Substantive Improvements in Relevant Research as a Result of SFI Funding/Influence



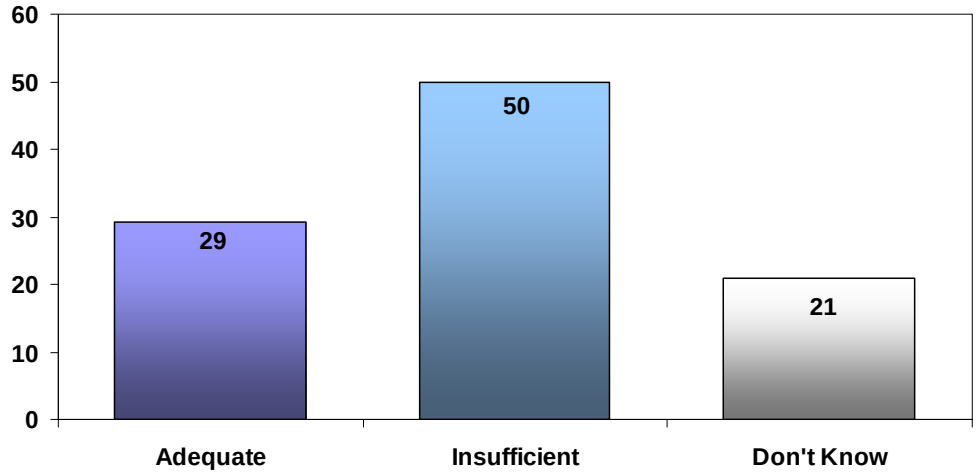
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Whether SFI Objectives are still Consistent with the Current State of the Irish Research System/Science Base?



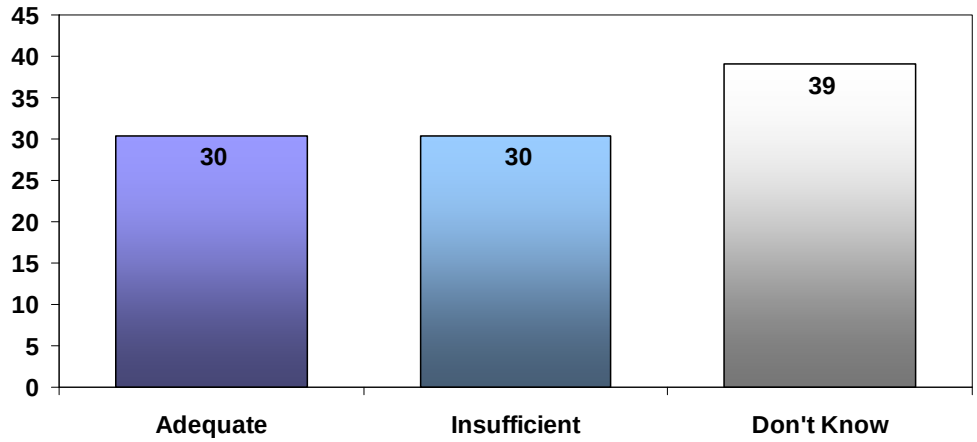
Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Perceived Adequacy of Funding allocated to Applied Research



Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Perceived Adequacy of Funding allocated to Basic/Fundamental Research



Source: Indecon Survey of Leading Companies and Industry Partners

Survey of SFI- Funded Researchers - Timeframe for Completion of SFI Funded Research Work from Date of Commencement

Summary Statistic	Value
Mean	4.11
Median	4
Mode	4
Max	15
Min	0.50
Standard Deviation	2.09
Variance	4.39

Source: Indecon Survey of Funded Researchers

Survey of Industry – Whether Company was Aware of the Following SFI Objectives?

Objective	Yes (%)	No (%)	Total Reponses (%)
Develop Human Capital	67	33	*100*
Support Strong Ideas	54	46	*100*
Promote Partnerships	70	30	*100*

Source: Indecon Survey of Leading Companies and Industry Partners

Survey of Industry - Companies Views on the Effectiveness of SFI Funding Mechanisms - % Responses

Funding Mechanism	Very Effective (%)	Effective (%)	Neither Effective Nor Ineffective (%)	Ineffective (%)	Very Ineffective (%)	Total (%)
Investigator Programme Grants (including Fellow Awards)	13	63	13	13	0	100
Research Professorships	25	38	25	13	0	100
Centres for Science, Engineering and Technology (CSETs)	55	27	9	9	0	100
President of Ireland Young Researchers Awards (PIYRAs)	0	43	43	14	0	100
ETS Walton Visitor Awards	0	44	44	11	0	100
Research Frontiers Programme	17	0	67	17	0	100

Source: Indecon Survey of Leading Companies and Industry Partners

Annex 6 Copies of Survey Questionnaires

SEE OVERLEAF COPIES OF QUESTIONNAIRES FOR:

(I) **INDECON SURVEY OF SFI-FUNDED RESEARCHERS**

(II) **INDECON SURVEY OF UNSUCCESSFUL APPLICANTS FOR SFI FUNDING**

(III) **INDECON SURVEY OF LEADING COMPANIES AND INDUSTRY PARTNERS**

Value for Money Review of Science Foundation Ireland – Confidential Survey of SFI-Funded Academic Researchers

We would be very grateful if you could complete this questionnaire and return by fax to 01-6777417 or in the pre-addressed envelope provided, to Indecon Economic Consultants, Indecon House, 4 Fitzwilliam Place, Dublin 2 by Friday, 24h August, 2007. This survey will be treated as Strictly Confidential and the individual responses to all completed questionnaires received will be used in aggregated form only. Thank you for your assistance with this important study for the Department of Enterprise, Trade and Employment.

Background Details

1. Please indicate the name of the university and research group where you are based (optional): _____
_____

2. Please indicate (✓) if you are a: Principal Investigator ☐, Research Scientist/Research Fellow ☐,
Post-doctoral researcher ☐, Postgraduate student ☐, Intern ☐, Support staff ☐, Other ☐,
Please describe if other _____ _____ _____

3. Please indicate if you moved to Ireland from abroad specifically to take up your current position: Yes ☐ No ☐

4. Please indicate the number of years you have been based with your current research group: _____ years

5. Please indicate and describe the sector in which your research group is principally engaged: ICT ☐ Biotechnology ☐
Other ☐ Please describe _____

Involvement with SFI

6. Under which Science Foundation Ireland (SFI) programme(s) are you or have you been funded?
_____
_____
_____

7. Are you aware of the following SFI awards?

SFI Awards	Yes	No
Investigator Programme grants (including SFI Fellow Awards)	☐	☐
Research Professorships	☐	☐
Centres for Science, Engineering and Technology (CSETs)	☐	☐
President of Ireland Young Researchers Awards (PIYRAs)	☐	☐
ETS Walton Visitor Awards	☐	☐
Research Frontiers Programme	☐	☐

8. Please indicate whether you were previously aware of the following SFI objectives:

SFI Objectives	Yes	No
Develop human capital	☐	☐
Support strong ideas	☐	☐
Promote partnerships	☐	☐

9. In relation to question 8 above, please also give your ranking of the objectives in order of the importance you think should attach to SFI objectives:

SFI Objectives	Ranking of Importance (1 = most important, 2 = important, 3 = least important)
Develop human capital	
Support strong ideas	
Promote partnerships	

10. Please indicate who initiated your contact with SFI: You ☐ SFI ☐ Other ☐
Please specify if other _____

11. Please indicate if you feel that your contact with SFI has been productive: Yes ☐ No ☐

12. (a) What proportion of your total current funding comes through SFI programmes? _____%.

(b) Please also list below the other main sources of funding you have accessed and their overall percentage contribution to your overall research expenditure budget over the period 2002-2007:

(i) _____ %: _____

(ii) _____ %: _____

(iii) _____ %: _____

(iv) _____ %: _____

13. Prior to receiving funding comes from SFI, please list the main sources of your funding since 2000 and their overall percentage contribution:

(i) _____ %: _____

(ii) _____ %: _____

(iii) _____ %: _____

(iv) _____ %: _____

Views on SFI Management and Operations

14. Please indicate your views on the following issues related to SFI funding in terms of how you would rate SFI compared to other research funding schemes. Please ✓ below.

Issues	Much Better than Average of Other Organisations	Better than Average of Other Organisations	Similar	Worse than Other Organisations	Much Worse than Other Organisations
Overall SFI funding application process	☐	☐	☐	☐	☐
Appropriateness of selection criteria	☐	☐	☐	☐	☐
Administrative procedures	☐	☐	☐	☐	☐
Time involved in overall application process	☐	☐	☐	☐	☐
Peer review process	☐	☐	☐	☐	☐
Terms and Conditions of SFI grants	☐	☐	☐	☐	☐
Contracts/Payments and Financial Management	☐	☐	☐	☐	☐
Communications between SFI and Researchers	☐	☐	☐	☐	☐
Clarity on how value in your research will be measured	☐	☐	☐	☐	☐

15. Please indicate your views on the merits of the following SFI funding mechanisms (please ✓ below):

SFI Funding Mechanisms	Very Good	Good	Not Good	Don't Know
Investigator Programme Grants (including Fellow Awards)	☐	☐	☐	☐
Research Professorships	☐	☐	☐	☐
Centres for Science, Engineering and Technology (CSETs)	☐	☐	☐	☐
President of Ireland Young Researchers Awards (PIYRAs)	☐	☐	☐	☐
ETS Walton Visitor Awards	☐	☐	☐	☐
Research Frontiers Programme	☐	☐	☐	☐

16. Do you believe SFI should: Continue to develop mechanisms to support applied R&D? ☐
Focus on supporting fundamental research? ☐

17. Would you like to see stronger monitoring and evaluation of SFI's progress using quantitative and qualitative indicators to gauge scientific and industrial impacts? Yes ☐ No ☐ Don't know ☐

18. Please indicate your views on the general concept of state investment in basic research as a way to drive industrial innovation and economic growth? Please use additional pages if necessary.

_____
_____
_____
_____
_____
_____
_____
_____

Impact of Involvement with SFI

19. Please indicate if you believe there have been substantive improvements in the volume and/or quality of relevant research being performed in your research group/institution as a result of SFI's funding or influence: Yes ☐ No ☐ Don't know ☐

20. Please indicate if you believe there have been substantive improvements in the volume and/or quality of relevant research being performed in other research groups/institutions as a result of SFI's funding or influence: Yes ☐ No ☐ Don't know ☐

21. Please indicate if you believe that SFI has had a positive influence on your research group/institution:
Yes ☐ No ☐ Don't know ☐

For Graduate Student Researchers

22. Please indicate whether SFI research assisted you in being prepared for:

		Yes	No
-	Employment opportunities in Ireland	☐	☐
-	Employment opportunities internationally	☐	☐

Influence of SFI on Type of Research Undertaken

23. Has SFI funding influenced the way you have carried out your research (for example, in collaboration with industry partners or in other ways which altered the nature/process of your research) Yes ☐ No ☐

Wider Impact of SFI

24. Please indicate if you believe SFI to be effective in meeting its objectives: Yes ☐ No ☐ Don't know ☐

25. Please indicate if you believe the SFI programmes and activities are likely to lead to the desired outcomes:
Yes ☐ No ☐ Don't know ☐

26. Please indicate if you believe that SFI is operating efficiently: Yes ☐ No ☐ Don't know ☐

27. Please indicate if you believe that SFI is having a positive impact on the research system as a whole:
Yes ☐ No ☐ Don't know ☐

28. Please indicate if you believe that the objectives of SFI are still consistent with the current state of the Irish research system/science base: Yes ☐ No ☐ Don't know ☐

29. Please indicate if you believe that the objectives of SFI are still consistent with national research and innovation policies:
Yes ☐ No ☐ Don't know ☐

Potential Improvements

30. Please specify any potential improvements which you think could be made in the overall SFI agency strategy for supporting outstanding researchers, including any views you may have on existing SFI indicators:

_____
_____
_____
_____
_____

Views on Long Term versus Short Term Research

31. Please indicate any views you have on whether SFI should favour long term versus short term or incremental research or should encourage a mix of both.

_____
_____
_____
_____
_____

Time Horizon for Your Work

32. Please indicate the approximate timescale for completion of your SFI-funded research work from date of commencement: _____

33. Please indicate whether you expect your research to have a commercial impact over the following time periods:

Short Term	Medium Term	Long Term
> 5 years	5 – 10 years	10+ years
☐	☐	☐

34. Please indicate your views on whether SFI has had a significant impact or not in the areas specified below.

Assessment of Significance of SFI Impacts						
	Very significant impact	Significant impact	Neither significant nor insignificant impact	Moderate impact	No impact	Don't know
Attraction of outstanding researchers to Ireland	☐	☐	☐	☐	☐	☐
Providing increased support to existing high quality researchers in Ireland	☐	☐	☐	☐	☐	☐
Increase in high quality publications by SFI funded researchers	☐	☐	☐	☐	☐	☐
Increase in IP/Patents	☐	☐	☐	☐	☐	☐
Increase in Licences	☐	☐	☐	☐	☐	☐
Increase in research based spin off	☐	☐	☐	☐	☐	☐
Training of post graduates for employment in Ireland	☐	☐	☐	☐	☐	☐
Training of post graduates for employment internationally	☐	☐	☐	☐	☐	☐
Improved capacity in Irish system to undertake high quality research	☐	☐	☐	☐	☐	☐
Enhanced research reputation for Ireland	☐	☐	☐	☐	☐	☐
Stimulation of greater R+D by industry	☐	☐	☐	☐	☐	☐
Supporting the attraction of FDI R+D activities	☐	☐	☐	☐	☐	☐

Other Comments

35. Please indicate below any further comments you may have in relation to SFI (please use additional pages if necessary):

Thank you very much for completing this Confidential Survey. Please return by Friday, 24th August to Indecon (fax: 01-6777417), or in the pre-addressed envelope provided, to Indecon Economic Consultants, Indecon House, 4 Fitzwilliam Place, Dublin 2. If you have any queries re this questionnaire, please contact William H. Batt at +353 1 6777144 or whbatt@indecon.ie

Value for Money Review of Science Foundation Ireland – Confidential Survey of Applicants for SFI Funding

We would be very grateful if you could complete this questionnaire and return by fax to 01-6777417 or in the pre-addressed envelope provided, to Indecon Economic Consultants, Indecon House, 4 Fitzwilliam Place, Dublin 2 by Friday, 24h August, 2007. This survey will be treated as Strictly Confidential and the individual responses to all completed questionnaires received will be used in aggregated form only. Thank you for your assistance with this important study for the Department of Enterprise, Trade and Employment.

Background Details

1. Please indicate the name of the university and research group where you are currently based (optional):
   _____

2. Please indicate (✓) if you are a: Group Leader ☐, Research Scientist/Research Fellow ☐,
   Post-doctoral researcher ☐, Postgraduate student ☐, Intern ☐, Support staff ☐, Other ☐,
   Please describe if other _____ _____ _____

3. Please indicate if you moved to Ireland from abroad specifically to take up your current position: Yes ☐ No ☐

4. Please indicate the number of years you have been based with your current research group: _____ years

5. Please indicate and describe the sector in which your research group is principally engaged: ICT ☐ Biotechnology ☐
   Other ☐ Please describe _____

Involvement with/Awareness of Science Foundation Ireland

6. Are you aware of the following SFI awards?

SFI Awards	Yes	No
Investigator Programme grants (including SFI Fellow Awards)	☐	☐
Research Professorships	☐	☐
Centres for Science, Engineering and Technology (CSETs)	☐	☐
President of Ireland Young Researchers Awards (PIYRAs)	☐	☐
ETS Walton Visitor Awards	☐	☐
Research Frontiers Programme	☐	☐

7. Have you ever received funding through any of Science Foundation Ireland (SFI)'s research funding programmes?)
   Please ✓ - Yes ☐ No ☐

8. Please indicate below the number and timing of applications which you have submitted to SFI and the programmes to which these applications apply.

SFI Programme	Year of Application	No. of Applications
Investigator Programme grants (including SFI Fellow Awards)		
Research Professorships		
Centres for Science, Engineering and Technology (CSETs)		
President of Ireland Young Researchers Awards (PIYRAs)		
ETS Walton Visitor Awards		
Research Frontiers Programme		

9. Please indicate who initiated your original contact with SFI: You ☐ SFI ☐ Other ☐
   Please specify if other _____

10. Please indicate whether you were previously aware of the following SFI objectives:

SFI Objectives	Yes	No
Develop human capital	☐	☐
Support strong ideas	☐	☐
Promote partnerships	☐	☐

11. In relation to question 8 above, please also give your ranking of the objectives in order of the importance you think should attach to SFI objectives:

SFI Objectives	Ranking of Importance (1 = most important, 2 = important, 3 = least important)
Develop human capital	
Support strong ideas	
Promote partnerships	

Views on SFI Management and Operations

12. Please indicate your views on the following issues related to the application process for SFI funding in terms of how you would rate SFI compared to other research funding schemes. Please ✓ below.

Issues	Much Better than Average of Other Organisations	Better than Average of Other Organisations	Similar	Worse than Other Organisations	Much Worse than Other Organisations
Overall SFI funding application process	☐	☐	☐	☐	☐
Appropriateness of selection criteria	☐	☐	☐	☐	☐
Administrative procedures	☐	☐	☐	☐	☐
Time involved in overall application process	☐	☐	☐	☐	☐
Peer review process	☐	☐	☐	☐	☐
Communications between SFI and Applicants	☐	☐	☐	☐	☐

13. Please indicate your views on the merits of the following SFI funding mechanisms (please ✓ below):

SFI Funding Mechanisms	Very Good	Good	Not Good	Don't Know
Investigator Programme Grants (including Fellow Awards)	☐	☐	☐	☐
Research Professorships	☐	☐	☐	☐
Centres for Science, Engineering and Technology (CSETs)	☐	☐	☐	☐
President of Ireland Young Researchers Awards (PIYRAs)	☐	☐	☐	☐
ETS Walton Visitor Awards	☐	☐	☐	☐
Research Frontiers Programme	☐	☐	☐	☐

14. Do you believe SFI should: Continue to develop mechanisms to support applied R&D? ☐
Focus on supporting fundamental research? ☐

15. Would you like to see stronger monitoring and evaluation of SFI's progress using quantitative and qualitative indicators to gauge scientific and industrial impacts? Yes ☐ No ☐ Don't know ☐

16. Please indicate your views on the general concept of state investment in basic research as a way to drive industrial innovation and economic growth? Please use additional pages if necessary.

_____
_____
_____
_____
_____
_____
_____
_____

Impacts of SFI

17. Please indicate your views on whether you believe SFI has had or is likely to have a significant impact in the areas specified below.

Assessment of Significance of SFI Impacts						
	Very significant impact	Significant impact	Neither significant nor insignificant impact	Moderate impact	No impact	Don't know
Attraction of outstanding researchers to Ireland	☐	☐	☐	☐	☐	☐
Providing increased support to existing high quality researchers in Ireland	☐	☐	☐	☐	☐	☐
Increase in high quality publications by SFI funded researchers	☐	☐	☐	☐	☐	☐
Increase in IP/Patents	☐	☐	☐	☐	☐	☐
Increase in Licences	☐	☐	☐	☐	☐	☐
Increase in research based spin off	☐	☐	☐	☐	☐	☐
Training of post graduates for employment in Ireland	☐	☐	☐	☐	☐	☐
Training of post graduates for employment internationally	☐	☐	☐	☐	☐	☐
Improved capacity in Irish system to undertake high quality research	☐	☐	☐	☐	☐	☐
Enhanced research reputation for Ireland	☐	☐	☐	☐	☐	☐
Stimulation of greater R+D by industry	☐	☐	☐	☐	☐	☐
Supporting the attraction of FDI R+D activities	☐	☐	☐	☐	☐	☐

Potential Improvements

18. Please specify any potential improvements which you think could be made in the overall SFI agency strategy for supporting outstanding researchers.

_____
_____
_____
_____
_____

19. Please specify below any improvements which you think could be made in relation to the application process for SFI funding or the approach to advertising and management of funding programmes.

_____
_____
_____
_____
_____

Views on Long Term versus Short Term Research

20. Please indicate any views you have on whether you believe SFI should favour long term versus short term or incremental research or should encourage a mix of both.

_____
_____
_____
_____
_____

Other Comments

21. Please indicate below any further comments you may have in relation to SFI and its research funding programmes (please use additional pages if necessary):

Thank you very much for completing this Confidential Survey. Please return by Friday, 24th August to Indecon (fax: 01-6777417), or in the pre-addressed envelope provided, to Indecon Economic Consultants, Indecon House, 4 Fitzwilliam Place, Dublin 2. If you have any queries re this questionnaire, please contact William H. Batt at +353 1 6777144 or whbatt@indecon.ie

Value for Money Review of Science Foundation Ireland – Confidential Survey of Leading Companies and Industry Partners in Ireland

We would be very grateful if you could complete this questionnaire and return by fax to 01-6777417, or in the pre-addressed envelope provided, to Indecon Economic Consultants, Indecon House, 4 Fitzwilliam Place, Dublin 2 by Friday, 24th August, 2007. This survey will be treated as Strictly Confidential and the individual responses to all completed questionnaires received will be used in aggregated form only. Thank you for your assistance with this important study for the Department of Enterprise, Trade and Employment.

Background Details

1. Name of company/business (optional): _____

2. Please indicate the number of years your company/business has been operating in Ireland: _____ years

3. Please indicate the current number of full-time equivalent employees (FTEEs) in your company:
   Ireland : _____ FTEs Worldwide _____ FTEs

4. Please indicate your company's approximate annual expenditure on R+D in Ireland during 2006: € _____

5. Please describe the nature of activity/sector in which your company/business is principally engaged: please ✓ below:

ICT – Software/Computers ☐	Biotechnology – Pharmaceuticals and Medicines ☐
ICT – Electrical/Electronic Equipment ☐	Biotechnology – Other Chemicals ☐
ICT – Medical Devices, Other Instruments & Diagnostic Equip. ☐	Biotechnology – Other ☐ - Please State _____
ICT – Other ☐ - Please State _____	

R&D Activity

6. Please indicate the importance of R&D activities in your company: Very important ☐ Important ☐ Not important ☐ Don't know ☐ Other ☐ Please specify if other _____

7. What kinds of R&D activities does your company conduct in Ireland: Long term ☐ Product/process development ☐ Local adaptation ☐ Other ☐ Please specify if other _____

8. Please rate the importance of the following factors in influencing your choice of locating any R&D activity in Ireland:

Factors	Very Important	Important	Not Important	Don't Know
Ireland's Corporate Tax Rate	☐	☐	☐	☐
SFI Activities/Funds	☐	☐	☐	☐
Quality of Research Personnel	☐	☐	☐	☐
Quality of Irish Education Institutions	☐	☐	☐	☐
Others (please list)	☐	☐	☐	☐

9. Please list your main academic partners in Ireland (if any):
   (i) _____

   (Ii) _____

   (iII) _____

10. Please indicate the type of work you undertake with your academic partners: Joint project work ☐ Parallel work while observing HEI research ☐ Recruitment of human resources from the HEIs ☐ Sharing facilities ☐ Scientific fire-fighting ☐ Other ☐ Please specify if other _____

11. Please indicate if the nature of your relationship with the HEIs is changing: Yes ☐ No ☐ If Yes, please specify:
_____

12. Please list the forms of public support for R&D that you currently access in Ireland, and through which agency:

(i) _____ Agency: _____

(Ii) _____ Agency: _____

(iII) _____ Agency: _____

Awareness of SFI (Science Foundation Ireland)

13. Are you aware of the following SFI objectives (please ✓):

SFI Objectives	Yes	No
Develop human capital	☐	☐
Support strong ideas	☐	☐
Promote partnerships	☐	☐

14. In relation to question 13 above, please also give your ranking of the objectives in order of the importance you think should attach to SFI objectives:

SFI Objectives	Ranking of Importance (1 = most important, 2 = important, 3 = least important)
Develop human capital	
Support strong ideas	
Promote partnerships	

15. Are you aware of the following SFI awards (please ✓):

SFI Awards	Yes	No
Investigator Programme Grants (including Fellow Awards)	☐	☐
Research Professorships	☐	☐
Centres for Science, Engineering and Technology (CSETs)	☐	☐
President of Ireland Young Researchers Awards (PIYRAs)	☐	☐
ETS Walton Visitor Awards	☐	☐
Research Frontiers Programme	☐	☐

Involvement with SFI

16. Please indicate if you have had any direct contacts with SFI: Yes ☐ No ☐

17. If yes, please indicate if your company has been associated with any SFI-programmes and, if so, please specify involvement with SFI:
No involvement with SFI ☐ CSET ☐ Strategic Research Cluster ☐ Principal Investigator Industry Supplement ☐

18. If you are associated with an SFI Programme, please indicate if you are:
The Head Partner ☐ Part of a Multiple Industry Partner ☐

19. If you are not associated with an SFI programme, please indicate whether you would such involvement would be of potential interest: Yes ☐ No ☐ Don't Know ☐

20. If you are involved with SFI, please indicate who initiated the contact: You ☐ SFI ☐ Other ☐
Please specify if other _____

21. Please indicate the frequency of your contact with SFI: Daily ☐ Weekly ☐ Monthly ☐ Annual ☐

22. Please indicate if you feel that your contact with SFI has been productive: Yes ☐ No ☐

23. Please indicate if you have been involved in the SFI sponsored Centres for Science, Engineering and Technology (CSETs): Yes ☐ No ☐ If so, explain the nature of your involvement _____
_____

Views on SFI

24. Please indicate your views on the effectiveness of the following SFI funding mechanisms (please ✓):

SFI Funding Mechanisms	Very Effective	Effective	Neither Effective Nor Ineffective	Ineffective	Very Ineffective
Investigator Programme Grants (including Fellow Awards)	☐	☐	☐	☐	☐
Research Professorships	☐	☐	☐	☐	☐
Centres for Science, Engineering and Technology (CSETs)	☐	☐	☐	☐	☐
President of Ireland Young Researchers Awards (PIYRAs)	☐	☐	☐	☐	☐
ETS Walton Visitor Awards	☐	☐	☐	☐	☐
Research Frontiers Programme	☐	☐	☐	☐	☐

25. Do you believe SFI should: Continue to develop mechanisms to support applied R&D ☐ Focus on supporting fundamental research ☐

26. Are you satisfied with the monitoring and evaluation of SFI's progress using quantitative and qualitative indicators to gauge scientific and industrial impacts? Yes ☐ No ☐ Don't know ☐

27. Please indicate your views on the general concept of state investment in basic research as a way to drive industrial innovation and economic growth? Please use extra pages if necessary. _____
_____
_____
_____
_____

Impact of Involvement with SFI

28. Please indicate if you believe there have been substantive changes in the volume and/or quality of relevant research being performed in Irish institutions as a result of SFI's funding or influence: Yes ☐ No ☐ Don't know ☐

29. Please indicate if you believe that SFI has had a positive influence on your business: Yes ☐ No ☐ Don't know ☐

30. One of the main potential outputs of SFI investments will be highly trained people. Please indicate if this is of interest to your company: Yes ☐ No ☐ Don't know ☐

31. Please indicate if you are expecting to try to recruit personnel that have been trained through SFI grants: Yes ☐ No ☐ Don't know ☐

32. Please indicate if your own research strategy or investments have changed as a result of the work of SFI: Yes ☐ No ☐ Don't know ☐

33. Please indicate if there have been any other changes to your business (e.g. with respect to the organisation of R&D, research collaboration, employment, etc.) in the period as a result of the influence of SFI? Yes ☐ No ☐ Don't know ☐ Please specify changes if Yes _____

Wider Impact of SFI

34. Please indicate if you believe SFI to be effective in meeting its objectives: Yes ☐ No ☐ Don't know ☐

35. Please indicate if you believe the SFI programmes and activities are likely to lead to the desired outcomes: Yes ☐ No ☐ Don't know ☐

36. Please indicate if you believe that SFI is operating efficiently: Yes ☐ No ☐ Don't know ☐

37. Please indicate if you believe that SFI is having a positive impact on the research system as a whole: Yes ☐ No ☐ Don't know ☐

38. Please indicate if you believe that the objectives of SFI are consistent with the current state of the Irish research system/science base: Yes ☐ No ☐ Don't know ☐

39. Please indicate your views on the adequacy of Irish government funding either through SFI, Enterprise Ireland or other sources for Applied Research versus Basic/Fundamental Research. Please ✓ below:

	Adequate Public Funding Available	Insufficient Public Funding Available	Don't Know
Applied Research	☐	☐	☐
Basic/Fundamental Research	☐	☐	☐

40. Please indicate if you believe that the objectives of SFI are consistent with national research and innovation policies: Yes ☐ No ☐ Don't know ☐

Other Comments

41. Please give any other comments you might have in relation to the value for money of SFI expenditures (or use additional paper if necessary):

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Thank you very much for completing this Confidential Survey. Please return by Friday, 24th August to Indecon (fax: 01-6777417), or in the pre-addressed envelope provided, to Indecon Economic Consultants, Indecon House, 4 Fitzwilliam Place, Dublin 2. If you have any queries re this questionnaire, please contact William H. Batt at +353 1 6777144 or whbatt@indecon.ie