

SCIENCE FOUNDATION IRELAND
THE FIRST YEARS 2001-2005

REPORT OF AN
INTERNATIONAL EVALUATION PANEL

Independent consultants were commissioned to undertake three studies on behalf of the panel. The reports are provided in the attached CD-ROM. The studies cover SFI's peer review process, its bibliometric performance, and the views of a sample of industrialists about SFI.

SCIENCE FOUNDATION IRELAND
THE FIRST YEARS 2001-2005

REPORT OF AN
INTERNATIONAL EVALUATION PANEL

OCTOBER 2005

Contents

Preface	5
Executive Summary	6
1 Introduction	10
1.1 The Economic Background	10
1.2 Origins of Science Foundation Ireland	10
1.3 Advisory Group on Implementation	12
1.4 Baseline Study	13
1.5 Summary	13
2 Development of Science Foundation Ireland	14
2.1 First Call for Proposals	14
2.2 Recruitment of Director General	14
2.3 Legal Status of SFI	14
2.4 Board, Management and Staffing	14
2.5 SFI Objectives	16
2.6 Ensuring Excellent Research	16
2.7 Range of SFI Programmes	16
2.8 Strategic Considerations	18
2.9 Oversight and Financial Control	18
3 The Research Context	20
3.1 Background	20
3.2 Higher Education Authority (HEA)	20
3.3 Industrial Development Agencies	20
3.4 Teagasc – Agriculture and Food Development Authority	21
4 Evaluation Methodology	22
4.1 Background to the Evaluation	22
4.2 Methodologies Employed in the Evaluation	22
5 Considerations of the Panel	24
5.1 Introduction	24
5.2 Rate of Development	24

5.3	Current Operations of SFI	24
5.3.1	Outputs	24
5.3.2	The Peer Review Process	25
5.3.3	Monitoring	26
5.3.4	The Style of SFI Operations	26
5.3.5	Provision of Continuity	27
5.4	Impacts and Interfaces	28
5.4.1	Higher Education Authority	28
5.4.2	Universities	28
5.4.3	Industrial Development Agencies	28
5.4.4	International Links	29
5.5	Trends for Future Operations of SFI	29
5.6	Summary	30
6	External Studies	31
6.1	Introduction	31
6.2	The Peer Review Process	31
6.3	Bibliometric Analysis	32
6.4	Industry Views of SFI	33
7	The Commercialisation Challenge	35
7.1	The Issues	35
7.2	Role of the Research Funders	35
7.3	Role of the Higher Education System	35
7.4	Role of Enterprise Ireland	36
7.5	Summary	36
8	Conclusions and Recommendations	37
8.1	Conclusions	37
8.2	Recommendations	39
	Appendices	41
1	Membership of Panel	42
2	Terms of Reference for Evaluation of SFI	43
3	Organisations and Individuals Consulted	44

Preface

In the last five years, an initiative has been undertaken in Ireland to develop a distinctive culture of higher education research; this culture should, by matching the highest of international standards in the disciplines of biotechnology and information technology, be well placed to contribute to the future well-being and prosperity of the country. The agency for the enactment of the initiative has been Science Foundation Ireland.

As with all policy ventures, there is a natural wish to know at an early stage whether progress is in keeping with aspiration. There is at the same time the recognition that the fruits of research, dramatic as they can be over the longer term, are often long in gestation. Forfás has accordingly seen fit to conduct a review of the work and contribution of SFI, but one which could be alert both to the concerns of the policy-maker confronted by political and economic requirements and to the concerns of the researcher confronted by the challenges of original and far-reaching investigation.

A small international review panel, consisting of myself and five colleagues, was accordingly appointed by the Minister for Enterprise, Trade and Employment. It set about its task in November 2004 and its report is presented in the following pages.

It is important to recognise at this point the great courtesies extended to the panel by all those with whom it interacted. All discussions were conducted in the best of research spirit, i.e. where the objective is to share in an exploration of the theme with the intent of reaching understanding. The report seeks to make it clear to the reader where issues of fact and issues of opinion are being presented; the opinions expressed are entirely those of the panel members.

May I on behalf of the panel members thank Irish colleagues for the opportunity to have taken part in this review and may I wish them every success in their endeavour to ensure that research can play a full and fruitful role in the future of their country.



Richard Brook

Chair

Panel for the Review of Science Foundation Ireland

Executive Summary

Rationale and Objectives for Science Foundation Ireland (SFI)

- Science Foundation Ireland was set up by the Irish Government to undertake and support strategic research of world class status in key areas of scientific endeavour which would underpin economic development. It was to be a key mechanism in the rapid evolution of Ireland to a 'knowledge society'. SFI was established in 2000 and became operational in 2001.
- In the late 1990s Ireland lacked a research capability of sufficient quality and scale in a number of strategic areas. SFI's task was to establish a world class research capability in niche areas of information and communications technologies (ICT) and of biotechnology, including the underlying scientific disciplines. It should fund people and programmes which would meet the test of excellence of research quality determined by competitive international peer review.
- The research supported was expected to have strategic relevance to the economy.

Achievements of SFI

- SFI has gradually increased its research funding levels from €10 million in 2001 to €121 million in 2005. It has established 163 research groups led by principal investigators of whom 34 have come to Ireland from laboratories abroad; the groups employ over 1,150 research staff and nearly 450 PhD students. It has also established six Centres for Science, Engineering and Technology (CSETs) in the core thematic fields and with considerable industry involvement.

- International peer review is central to SFI's objective of supporting research excellence; an independent assessment of SFI's peer review process has found it to be operating to the highest international standards. This assessment is confirmed by the quality of the researchers whom the panel members met and by the findings from the bibliometrics study commissioned for this evaluation.
- SFI has played a major role in helping to internationalise the Irish research system, both by attracting people to work in Ireland and by facilitating and encouraging international association.
- There is considerable support among the firms interviewed as part of this review for SFI's objective to improve the quantity and quality of research performed within Irish higher education institutions (HEIs). There is also support for the strategy of focusing the research on the two areas of ICT and biotechnology. The importance of connecting users into the existing research activities and, in this way, of strengthening the technology transfer and intellectual property management mechanisms in the public sector was highlighted. SFI investments are seen as raising Ireland's international profile with regard to science and technology

Panel Comments

- SFI, with the help of other research funding agencies such as the Higher Education Authority (HEA), has been a most positive driving force for change in the Irish research system in recent years.

- While it is early in the life of SFI to assess the long-term cultural and economic impact of the research it supports, the panel members have gained a firm indication of the quality of its contribution to date. Impressive progress towards developing a strong research capability in biotechnology and ICT has been achieved in a very short time. SFI has responded with energy, with purpose, and with striking effect to meet the objectives originally set for it.
- Research of excellent quality is being funded by SFI and the existence of SFI funding is having a positive catalytic effect on the performance of research in Ireland in its two fields.
- Based on visits to four of the six Centres for Science, Engineering and Technology the panel members are enthusiastic about the CSET concept and are impressed by what has been achieved in the short time of its operation. It seems likely that these centres will have a strong influence on the interaction between academic research and industry within Ireland in the coming years
- The panel agree with the recent assessment of the Programme for Research in Third Level Institutions (PRTL) that there is a need for a more coordinated approach to exploit the synergy between SFI and PRTL.
- It would be helpful if SFI were to provide greater clarity in the information relating to some of its operating procedures, for example with respect to researchers applying for a second grant. In this context, SFI has now (June) posted its policy on second grants on its website.
- During this review panel members met researchers who were interested in the prospect of commercialising their work but who were less experienced in the relevant business techniques required to do so. If the work of the business schools were to be extended to include world class teaching and research in innovation processes and in the commercialisation of research then this would respond to the needs both of academic researchers and of Irish companies. It would be a contribution to Ireland's ability to extract value from research.
- While panel members have no formal authority for any auditing of financial accounting or control, they have been advised that SFI has put in place appropriate systems and procedures to safeguard the use of public money.

Recommendations

The panel commends the Irish State, for having had the vision to set up SFI, and the SFI Board, director general and staff, for their remarkable achievements over the past four years.

The panel recommends the following measures as appropriate for the Irish research system and for Ireland more broadly in its quest to evolve rapidly into a knowledge-based economy:

1. Recommendation to SFI

It is of paramount importance that SFI awards continue to be decided on the criterion of research excellence above all else.

SFI should ensure that the requirement for research excellence, confirmed through rigorous peer review, continues to be the paramount condition in grant award decisions.

Grants should continue to focus on strategic areas of science and technology relevant to Ireland. No extension beyond the two current research areas, biotechnology and ICT, should take place without there being the provision of additional funding for this purpose.

The proposal to focus on narrower topics within the broader research themes should not be allowed to jeopardise SFI's unique appeal to mobile researchers.

SFI should not be diverted into supporting peripheral activities, no matter how worthy or how great the temptation; its funding should be concentrated on excellent research, with the required ancillary activities being undertaken by other, more appropriate, agencies.

2. Recommendation to Government

It is essential to continue to take a long-term, strategic view of funding for research in Ireland.

Government should ensure that it is committed to sustaining and confirming the stability of funding for research. The panel believes that continuing support, based on research excellence, will bring increasingly identifiable benefits.

The funding agencies, with the backing of government, should ensure that this long-term funding commitment is communicated clearly to the research community, to the higher education system and to industry.

3. Recommendation to Government and its Research Funding Agencies

All relevant agencies must assume a shared responsibility for a coherent and coordinated approach to the development and consolidation of the Irish research system.

Government should orchestrate the coordination of the activities of agencies responsible for the funding of higher education research, both for infrastructure and projects, and for nurturing the higher education-industry interface. The panel believes that the funding of infrastructure and the funding of projects can be made to operate efficiently and effectively when assigned – as now – to separate bodies.

SFI, the Higher Education Authority and the other research funding bodies should work closely together to ensure a coherent and coordinated approach to the support of the research system, including a greater community interaction with SFI leadership and influence upon it.

The higher education institutions should continue to foster the move towards an intensified research culture, including substantive career development tracks for researchers, and effective knowledge transfer policies.

4. Recommendation to Higher Education Institutions, Enterprise Ireland and the Higher Education Authority

Commercialisation of SFI funded research should be supported through an integrated system built on a foundation of realistic expectations.

Higher education institutions, Enterprise Ireland and the Higher Education Authority should work together with researchers and SFI to develop a process for identifying outputs from SFI funded research with potential for commercialisation and a mechanism for linking these to industry.

Higher education institutions and the HEA should encourage business schools to extend their activities to include world class teaching and research in innovation processes and in the commercialisation of research, aimed at the needs both of academic researchers and of Irish companies.

Enterprise Ireland should move ahead quickly with plans to develop ‘competence centres’ to address industrial needs for more applied research and to help link industry to the research outputs of SFI.

5. Recommendation to Science Foundation Ireland

SFI should address a small number of operational issues which need attention.

In particular, SFI should work with the research community to ensure that there is both actual and perceived consistency and clarity in relation to issues like new grants, mid-term reviews and overheads.

1 Introduction

1.1 The Economic Background

The 1990s was a period of rapid economic expansion in Ireland, driven largely by phenomenal growth in exports of manufactured goods. Merchandise exports increased from €19 billion in 1991 to €90 billion in 2002 and more than 70 per cent of these exports were from high technology industries. Crucially, most of these industries are foreign owned and are the fruit of a very successful inward investment policy followed since the early 1970s.

Because of this strong growth Ireland has become one of the highest income countries in the OECD, as measured by GDP per head. Hence, one traditional incentive for inward investment – a low cost economy – is no longer available and the other major plank of Ireland’s attractiveness – low tax rates – is being adopted by competitors in Eastern Europe and elsewhere. Addressing this threat to national competitiveness became a major policy issue in Ireland in the late 1990s.

Against that background the Irish Council for Science, Technology and Innovation (ICSTI) undertook a ‘Technology Foresight’ exercise in 1998. The subsequent report concluded that Ireland should evolve rapidly to a knowledge society. The enormous potential of new technologies in areas such as computer science, telecommunications, nanotechnology, biotechnology and medical systems should be exploited. It identified technology as a key driver for knowledge societies and showed that Ireland lacked a world class research capability of sufficient scale in a number of strategic areas. It called for a dramatic increase in the level of research investment to address this gap as a matter of urgency.

Additional encouragement for this approach came from a report by the *Economic and Social Research Institute* (an independent policy agency) – ‘**Investment Priorities 2000-2006**’ – which stated that ‘the promotion of investment in R&D is seen to be at the heart of national development strategies. The case for support for R&D is extremely strong since it has very significant potential returns on investment. Current levels of public investment in R&D are low by international standards. We therefore recommend a substantial increase in public expenditure on R&D in the next decade.’

1.2 Origins of Science Foundation Ireland

The ICSTI Technology Foresight report *inter alia* specifically asked government to establish a fund which would enable Ireland to become a centre for world class research excellence in niche areas of ICT, biotechnology and their underlying sciences. Without such a research capability to support the technology-based industries, which now accounted for more than two thirds of manufacturing output in Ireland, it would be impossible to sustain the momentum built up by the inward investment policy. Ireland would gradually lose its comparative attractiveness for manufacturing industry and the basis of its export led growth in the 1990s.

The ICSTI recommendation was accepted by Forfás, which then widened the overall approach and agreed a joint proposal to government with the Department of Enterprise, Trade and Employment (DETE). This argued that investing in basic research is an activity undertaken by all developed countries for cultural, educational, scientific and economic development reasons.

Why the State Supports Research

The genesis of the research support systems in modern economies is usually traced to Vannevar Bush's 1945 report *'Science – The Endless Frontier'*, which provided the intellectual basis for the establishment of the National Science Foundation and the National Institutes of Health in the US. In his report Bush wrote that "basic research is the pacemaker of technological progress". Europe has an even longer tradition of public support for research; for instance, the Kaiser Wilhelm Society was founded in 1911 and became the Max Planck Society after the second world war. Since 1945 most developed countries have set up institutions and mechanisms for supporting basic or fundamental research. By the establishment of SFI Ireland has now joined the other developed countries in making this investment for the future.

In the years since Bush's report was published there has been extensive discussion among social scientists, economists and science policy experts concerning the role of research and its contribution to economic and social development. Governments are ultimately interested in funding basic research because of the benefits it is perceived to bring to society. In recent years there has been an acceptance of an increased importance for basic research through the emergence of certain technologies (such as biotechnology, genomics and nanotechnology) which require very basic research but can then quickly produce marketable products. Economic benefits include: increasing the stock of knowledge in strategic technologies; increasing the output of highly trained people who are at the forefront of developments in their scientific field and have established links to their counterparts around the world, enabling them to stay in touch with the latest advances; creating new instrumentation and methods; and creating spin-off companies.

Recent studies have confirmed the convergence of basic and applied research, with basic research more and more having closer links to applicability¹. Hence the economic argument for public support for research is becoming stronger. But, even more importantly, in the modern world of rapid change and increasing uncertainty countries invest in research to ensure they will have the skilled people who can handle the next period of change.

Resource constraints had inhibited such investment in Ireland in the past. One serious consequence was a continuing loss to the country of the best graduates and academic faculty through emigration, so that the Irish universities were unable to realise fully their potential. The improved economic climate provided an opportunity to rectify this situation, one which had to be taken.

The argument for strategic research funding was made to Cabinet in February 2000 by representatives of ICSTI, Forfás and officials of DETE. The government responded actively and promptly to these proposals by establishing a *Technology Foresight Fund* of over €630 million for the seven year period of the National Development Plan 2000-2006. It accepted that such a research

¹ For example, *Calvert & Martin: Changing Conceptions of Basic Research?* SPRU (2001).

fund was necessary (i) to develop world-class research capabilities in strategic technologies to underpin the future development and competitiveness of Irish owned industry, (ii) to facilitate the undertaking of R&D in this country by multinational companies in order to support the further development of that sector in Ireland, (iii) to attract more high technology companies to Ireland in the future, and (iv) to enhance the environment for the creation of new technology-based firms.

The government also approved the establishment of a '*National Strategic Research Foundation*' to undertake and support strategic research of world class status in key areas of scientific endeavour including niche areas of information and communications technologies (ICT) and of biotechnology. It set up an Advisory Group on Implementation to progress this foundation.

1.3 Advisory Group on Implementation

Established by the government decision of February 2000, the Advisory Group began its work immediately and reported in July 2000.

In its report the Group accepted that

- Strategic research represents a public good for which significant State funding is economically justifiable and necessary
- There is increasing interest from industry in strategic research.

It confirmed that the fundamental objective of the new foundation (Science Foundation Ireland) is to develop and maintain in Ireland an enhanced capability in research that

- Is of intrinsic excellence acknowledged internationally
- Is of sufficient scale and critical mass to be effective
- Strengthens the scientific foundations underpinning industry.

It agreed that this capability would concentrate, in the first instance, on ICT and biotechnology and their underlying sciences. In order to establish the extent of the existing capability, it recommended that a baseline study should be undertaken urgently to establish the present level, quality and capability in research in those two areas.

The Group confirmed that SFI should fund programmes of research which would meet the tests of world class excellence determined by competitive international peer review. Structures would need to be put in place to help SFI in the recycling of the proceeds of the exploitation of intellectual property rights arising from the work supported by the Foundation. This reflected the expectation that the research supported would have strategic relevance to the economy.

Finally, the Group agreed that the appointment of a suitable chief executive should proceed as quickly as possible and that the person sought should have high visibility within the international research community, including industry.

Science Foundation Ireland was established in 2000 and became operational in 2001.

1.4 Baseline Study

The baseline study of the public research system, recommended by the Advisory Group, was commissioned in 2001 to assess the level and quality of ICT and biotechnology research and the capabilities of the Irish research base, to establish how that base compared internationally and to provide parameters against which the progress of SFI could be evaluated in the future.

The study, commissioned by Forfás, included a bibliometric exercise to provide an assessment of the quantity and impact of publications produced by researchers in Ireland in ICT and biotechnology.

The major finding of the study was the high degree of fragmentation within Irish research and the absence of the critical mass necessary for research groups to survive and prosper over time. Universities had been mainly driven in the past by a teaching agenda and this had influenced both the recruitment of junior staff and the time available for research. More generally, the absence of a career structure and of a secure source of research funding for researchers in academia hindered the ability to develop research groups and attract researchers to Ireland.

Despite these problems the Irish research base had made maximum use of the European Union Framework Programmes to compensate for the shortage of national research funds. The study found that Irish researchers had, as a result, developed excellent international collaborative networks. Participation by higher education researchers in Ireland in the Fourth Framework Programme 1994-1998 (FP4) was greatly in excess of the European average levels. During this period the higher education sector received a total of €96 million from FP4; in 1998 alone its FP4 funding amounted to €33 million, representing almost 30 per cent of total Irish higher education research funding of €115 million in that year.

The bibliometric study, which considered research outputs from 1991-2000, revealed strong areas of competence spread throughout the different research institutions. The broad conclusions reached were:

- Performance for biotechnology was slightly above the world average. However, this performance over the latest few years of the study appeared to have been gently falling
- Performance in ICT was at, or slightly above, world average. However, performance varied significantly from year to year in recent results.

The study found a small number of research departments in both areas which were already of the highest international standard or close to it.

1.5 Summary

By 2001, SFI was in place and had begun its task of funding research excellence in biotechnology and ICT. A baseline study of existing research quality and capacity in those two areas, relative to international performance, had been undertaken to provide parameters against which the progress of SFI could be measured in the future.

2 Development of Science Foundation Ireland

2.1 First Call for Proposals

The recruitment process for the head of SFI began in mid 2000 and, pending the outcome which was not expected for at least six months, Forfás undertook the first call for proposals in July 2000. In preparation for this, two international Advisory Committees were set up, one for ICT and one for biotechnology. The ICT Committee was chaired by Eoin O'Driscoll of Lucent (Ireland); the Biotechnology Committee by Frank Gannon of EMBO (European Molecular Biology Organisation).

With the help of these Committees an extensive consultation exercise took place to identify a process which would deliver the excellent research and top class researchers which SFI sought. Research funding bodies in a number of countries were contacted. These included the Deutsche Forschungsgemeinschaft (DFG) in Germany, a number of Research Councils and the Wellcome Trust in the UK, and the National Science Foundation and the National Institutes of Health in the US.

The approach taken in the assessment of the proposals received in response to the first call involved international postal peer review, further external assessment by the Advisory Committees and final approval by the SFI Board. The methodology adopted did not replicate that of any single existing 'model' agency. However, full benefit was taken of the many contacts and discussions with colleagues in other research support systems and, in the case of the National Science Foundation, of visits by Forfás staff to Washington to study their systems and procedures.

The closing date for the first call was 26 September 2000 and the first awards were made in early 2001.

2.2 Recruitment of Director General

In the second half of 2000 a small task force, chaired by a prominent industrialist and including representatives from academia, industry and ICSTI, was established to identify and recruit the type of leader who would be capable of setting up and running the research funding organisation outlined above. A shortlist of candidates from Australia, the US, the UK and continental Europe was considered by the task force.

At the end of this process Dr. William Harris, formerly head of the Mathematics and Physical Sciences Directorate at the US National Science Foundation and at that time Vice President for Research at the University of South Carolina, was offered the position and he joined SFI in September 2001.

2.3 Legal Status of SFI

Science Foundation Ireland was constituted originally as a division of Forfás. In 2003 legislation was introduced to establish SFI as a body corporate and as a separate agency. The Bill was passed by the Dáil (Parliament) in July 2003 with the support of all parties.

2.4 Board, Management and Staffing

When SFI was established by legislation in 2003 a Board of twelve people was appointed, chaired by Professor Fottrell, former President of NUI Galway. Board members included the Director General of SFI and eleven others from academia, industry and the public sector. Four are non-residents, three from the US and one from the UK. The SFI Board meets four times a year, with a full day plenary session and a second day dedicated to meetings of its various committees.

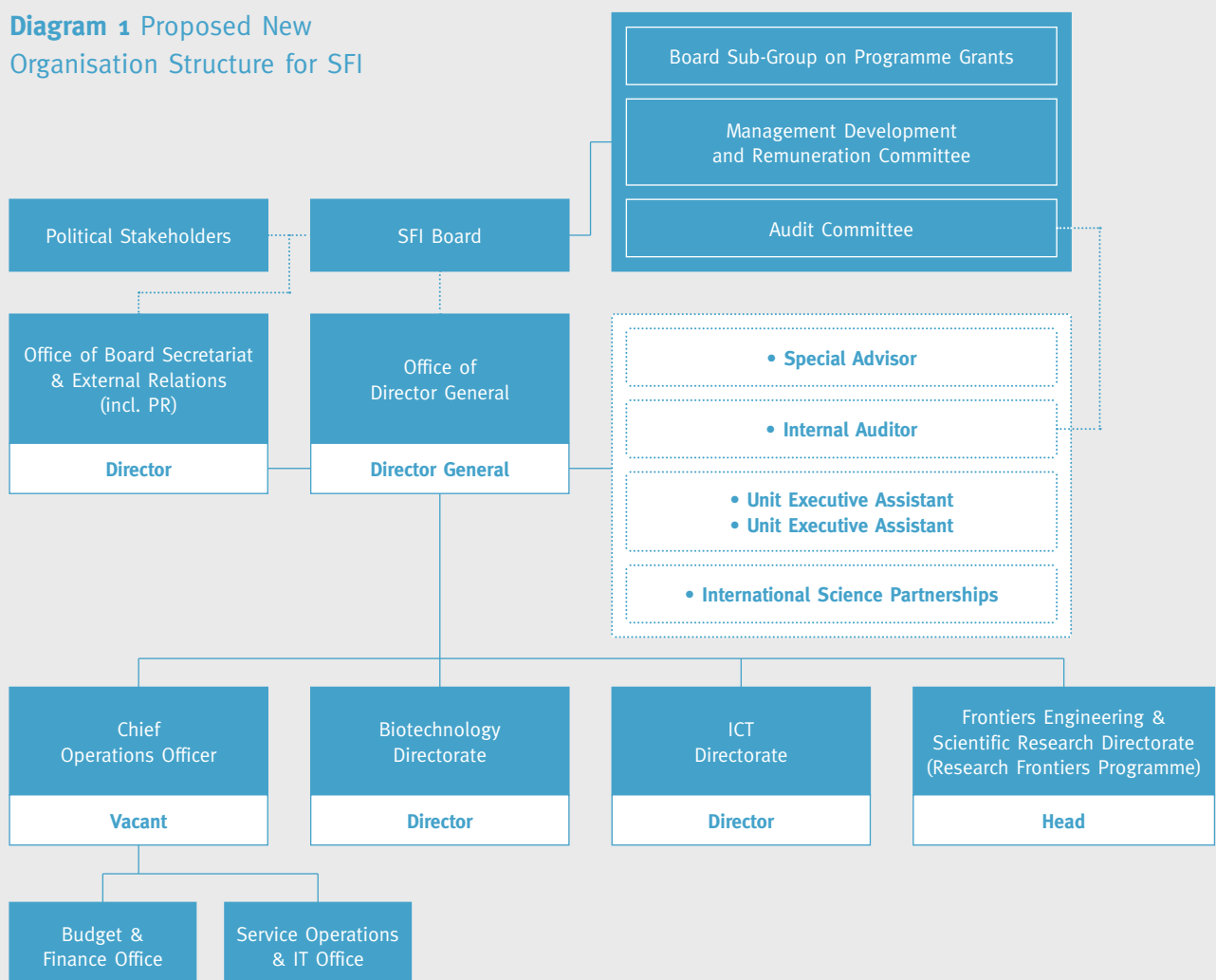
The Board delegates various powers to an executive committee, a board sub-group on programme grants, an audit committee and an internal auditor. There are six senior management positions: the Director General, the Director for Corporate Affairs, the Director for Biotechnology, the Director for ICT, the Head of the Research Frontiers Programme and the Head of Management, Budget and Operations. Programme Officers report to the directors and coordinate the project selection process, monitoring and reporting.

It was universally acknowledged in all the panel's interviews that Dr. Harris brought exceptional qualities of energy, enthusiasm and commitment to SFI. His dynamism has been a crucial element in shaping the character of the organisation over

the first few years and in enabling it to achieve so much. He has been articulate and persistent in working with the other agents in the research system, including the higher education institutions, in presenting an example of what needed to be done and in persuading them to cooperate with SFI in introducing major changes to the system.

For the first two years of its existence SFI had a total staff of sixteen people; from 2003 until early 2005 this increased to around 25. It has now been agreed to increase staffing levels to 45, reflecting the increased expenditure levels of SFI and the expansion in the number of its programmes. The proposed new structure of the organisation is shown in Diagram 1.

Diagram 1 Proposed New Organisation Structure for SFI



2.5 SFI Objectives

The Technology Foresight report recommended a focus on biotechnology and ICT to underpin technology-based industry. It was envisaged from the outset that the SFI budget, while large relative to historical levels of research funding in Ireland, could not sustain a strong research effort across all fields of ICT and biotechnology. The fundamental approach adopted from the start involved the recruitment of first class researchers or 'investigators' in these two fields, in the belief that such people would have a clear understanding of the opportunities and potential impact of work within these specialisms. A centralised attempt to 'pick winning research areas' by committee was considered inappropriate.

With this mandate SFI placed a very high emphasis on the excellence of research quality as a means of meeting its objectives. Leading investigators conducting excellent research personify the bed-rock upon which success of SFI will be built.

2.6 Ensuring Excellent Research

From the outset, international peer review has been the basis on which all SFI awards have been made. This has throughout been recognised as the surest method for establishing the quality of research proposals. The SFI peer review process is illustrated in Diagram 2, and discussed in Chapter 6.

2.7 Range of SFI Programmes

The current portfolio of SFI awards includes the following:

- Investigator Programme Grants (including Fellow Awards) – typically between €100,000 and €200,000 per annum, but exceptionally up to €1 million per annum, for up to five years;
- Research Professorships – typically €500,000 per annum and exceptionally up to €1 million (total commitments to date €30 million);
- Centres for Science, Engineering and Technology (CSETs) – €1 million to €5 million per annum for five years initially, supporting collaborative research between academic scientists and industry, with 20 per cent cost-sharing by strategic partners (six awards to date with a total commitment of €108 million);
- President of Ireland Young Researcher Awards (PIYRAs) – for outstanding young researchers, valued at €1.2 million over five years. Introduced in 2004, four awards were made that year;
- ETS Walton Visitor Awards – to enable highly qualified researchers from outside Ireland to carry out projects at an Irish institution for up to one year, usually with a budget of up to €200,000 per year, including salary, laboratory and moving expenses (31 awards in 2002-2004 and a total commitment to date of €4.3 million); and
- Research Frontiers Programme – typically €200,000 over three years for research projects in any area of science and engineering (106 awards in 2004). SFI took over the operation of this programme in 2004 and plans new commitments of about €8 million per year, a total budget of €15 million in 2005 and €24 million in 2006.

SFI also funds a number of smaller programmes including supplements (for equipment, additional staff and to help SFI award recipients to work with industry), grants for teachers and undergraduate students to work in research laboratories during the summer and programmes to encourage women in science and engineering. Total commitments to date and budget allocations for 2005 are shown in the tables below.

Diagram 2 Peer Review Process

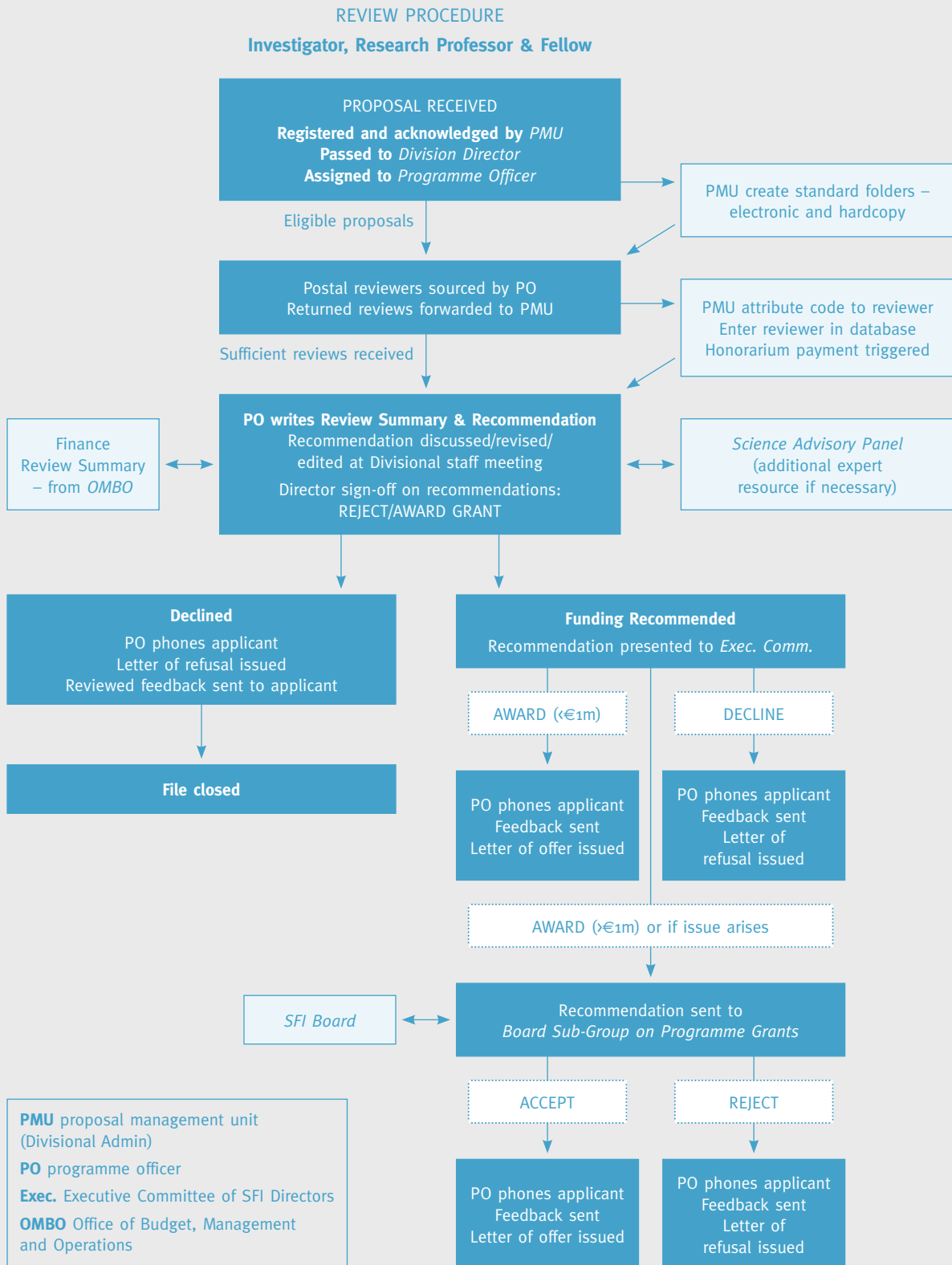


Table 1 SFI Commitments to Date

Schemes	€m Committed 2001-2005 (April)	Number of Awards* 2001-2005
Investigators and Fellows	254	140
CSETs	108	6
Research Professorships	30	12
Research Frontiers	19	107
Young Researcher	5	4
Other	48	51
Total	464	320

* Excludes supplements.

Table 2 Awards Budget 2005

Schemes	Budget (€000)
New Awards 2005	32,824
Investigator Programme	5,974
CSETs	13,700
Young Researcher	1,250
ETS Walton Visitors	650
Research Frontiers	8,000
Others	3,250
Existing Commitments 2005	88,376
CSETs	16,386
Other Awards	71,990
Total 2005	121,200


2.8 Strategic Considerations

Recent thinking within SFI appears to be moving towards a higher degree of concentration on specific themes within biotechnology and ICT and even toward the support of preferred individuals and teams within these specific themes. This is encapsulated in a three stage model for development, namely: first, the seeding of isolated research teams; secondly, the clustering of these teams; and thirdly, the further grouping of clusters to address a limited number of specific thematic areas. These areas are to be chosen through SFI office initiative, following workshops with the community.

This concentration of topics within biotechnology and ICT is countered by a diversification to other subject areas, e.g. mathematics and chemistry, within the Frontiers Engineering and Science Directorate which has resulted from the transfer in 2004 of the Basic Research Grants from Enterprise Ireland.

2.9 Oversight and Financial Control

The Board has formally adopted the Department of Finance's 'Code of Practice for the Governance of State Bodies'. Appropriate powers have been delegated to an executive committee, a board sub group on programme grants, an audit committee and an internal auditor. In line with the Code of Practice there is a regular external review of financial control procedures. The most recent was undertaken by PricewaterhouseCoopers in October 2004 and the findings presented to the SFI audit committee.



The vast majority of SFI funds are allocated to multi-annual research projects or programmes with significant scale. The awards are disbursed by SFI to the higher education sector by way of contracts and the institutions are responsible for monitoring and accounting for their grants. SFI's auditors have been instructed to monitor the implementation of these contracts, including by visits to individual academic departments and research centres.

In relation to the research work itself all projects and programmes are required to submit to SFI an annual progress report. These reports are assessed by the programme officers and action taken where appropriate. Approximately half way into the life of the bigger projects, and many of the smaller ones, an interim review is conducted, involving a visit by external peers to assess progress and prospects.

3 The Research Context

3.1 Background

SFI is an important component of the Irish research landscape. Together with the Higher Education Authority, Health Research Board, the two Research Councils and a number of government departments it constitutes the public research funding system.

At the same time it is a key element of the industrial development agency structures of the Department of Enterprise, Trade and Employment, involving also IDA Ireland and Enterprise Ireland.

The major research performers funded by this system are the higher education institutions, a small number of public research organisations (mainly Teagasc – the Agriculture and Food Development Authority – and the Marine Institute) and the enterprise sector. Finally, the Chief Science Adviser to the Government has an overarching role in relation to these bodies. SFI's interaction with some of these players is considered here briefly.

3.2 Higher Education Authority (HEA)

HEA, through the Programme for Research in Third Level Institutions (PRTL), is the other major source of research funding in Ireland. Under the current National Development Plan (2000-2006) both HEA and SFI were allocated over €600 million each to fund their respective activities.

The objectives of PRTL are to develop high quality research capabilities in higher education institutions, including support for individual researchers and teams. According to the recently published *'Impact Assessment of PRTL'* the fundamental purpose of PRTL is "to build internationally competitive and collaborative research centres in third level institutions and to network them globally". This had to be achieved in the context of past under-funding of research and PRTL was the first attempt to address the research infrastructure deficit identified, among others, by

the 1995 report of the government's STI Advisory Council (*'Making Knowledge Work for Us'*). PRTL has enabled new research laboratories to be built, existing laboratories to be renovated and modern equipment to be acquired. In Cycle 3 (2002-6), it has increasingly begun to fund research projects.

The report of the International Assessment Committee on PRTL, chaired by Professor Enric Banda, commented on the obvious synergy between SFI and PRTL but believed it to be relatively unplanned. Their view is that "PRTL provides the backbone and the deeper foundation on which specific initiatives like SFI can build and without which they cannot be fully effective". The Committee remarked that the established demarcation between SFI and PRTL "appears to be breaking down" and recommended more coherence between their funding decisions.

In its written and oral submissions to this review the HEA praises the very positive contribution SFI has made to the Irish research system. It sees clearly distinct and complementary roles for the research funding agencies such as SFI, HEA and the research councils. The HEA believes that there is now general acceptance of the roles of the different agencies. New mechanisms have been put in place to encourage and facilitate better coherence and coordination between the funding agencies, in particular SFI and HEA.

3.3 Industrial Development Agencies

In recent years the industrial development agencies – IDA Ireland and Enterprise Ireland – have been placing a much higher emphasis on the role that research and development plays in their activities. IDA Ireland, in particular, views the need to build a strong national research capability as being vital to the continued attractiveness of Ireland as a location for inward investment. It believes Ireland

is no longer competitive for purely manufacturing projects and research-based investment will only locate to countries and regions that boast an international reputation in relevant research fields.

Therefore, IDA supports what SFI is doing and is using the technical expertise, both within SFI itself and in the SFI research groups, in its contact with overseas enterprises. The introduction of the CSETs, with industry involvement up front, is particularly welcomed.

Enterprise Ireland strongly endorses SFI's push for world-class research in areas of long-term strategic relevance to Ireland. Enterprise Ireland's initiatives to promote the commercialisation of the research outputs in the higher education sector will only be effective if the SFI investments are continued and made an established part of the innovation system. In this context Enterprise Ireland also supports the calls for greater collaboration between the State agencies involved in research funding and in industrial development.

3.4 Teagasc – Agriculture and Food Development Authority

Teagasc is Ireland's major public research organisation, with a research budget of over €50 million annually. It is an applied research institute with long established links to the Irish food industry. Its parent government department (Agriculture and Food) has a history of supporting research in Ireland and one of its research support programmes in the early 1990s led to collaboration between Teagasc and University College Cork. This collaboration has led to the involvement of both parties in the Alimentary Pharmabiotics CSET in UCC.

Teagasc acknowledges that SFI funding has helped to put its own biotechnology research capabilities on a different level, enabling publications in higher impact journals and raising expectations across the organisation. Teagasc involvement with SFI is seen as facilitating technology transfer from the joint research programmes to indigenous industry.

4 Evaluation Methodology

4.1 Background to the Evaluation

The Department of Enterprise, Trade and Employment, which funds SFI, is conscious of the innovative nature of what is being attempted and had therefore asked Forfás to organise a review of the performance and impact of SFI to date. There is full understanding that SFI is a long-term investment; nonetheless, there is also the understanding that the early stages are critical and therefore the wish to ensure that these have in fact been successfully conducted. A small international review panel, chaired by Professor Richard Brook of the Leverhulme Trust in the UK, was assembled to undertake the task.

The review panel (see Appendix 1) held an introductory meeting in Dublin in November 2004. The members, with Forfás providing the secretariat, decided to commission three focused external studies to support their analysis. They also resolved to conduct a series of visits to research groups and centres funded by SFI during a week at the end of March 2005.

In the view of the panel members, the relative youth of SFI sets bounds on the ability of an appraisal conducted at this stage to obtain a full picture of the eventual impact of SFI on the economy. There is common recognition² that the full effect of an increase in research spending, even on such academic criteria as publications, takes some five years to occur, with the impact on citations (a measure of research quality) taking some further two years. An impact on commercialisation and economic return will take at least as long. In contrast, there should be a more immediate and significant rise in research activity and in the number of PhD students following an increase in research funding.

It is the strong belief of the panel members, nonetheless, that it is not too early to form an initial impression about the operational performance of SFI to date, including its general impact on the Irish research system and how this is perceived. Specifically, there are three key questions to be answered:

- (i) have all the necessary mechanisms of a research funding system been put in place, including peer review, monitoring and procedures for continuity?
- (ii) have any required adjustments to the university research structures and to agencies other than SFI been acknowledged and addressed, with paths for dissemination of research outputs to the wider community, including industry?
- (iii) are any changes needed to ensure continuing operational effectiveness of the research system and its interaction with the economy?

4.2 Methodologies Employed in the Evaluation

The techniques used in the review have been targeted at answering the key questions set in the terms of reference (see box: *Evaluation Questions* and Appendix 2).

² See for instance *The Productivity of Science in an International Analysis*, Crespi & Geuna (SPRU, March 2004).

Evaluation Questions

- Is SFI effective in meeting its objectives?
- Are its programmes and activities likely to lead to the desired outcomes?
- What are the outputs and impacts of its activities?
- Is SFI operating efficiently?
- What impact is SFI having on the research system as a whole?
- Are the objectives for SFI still consistent with the current state of the Irish research system/science base and with national research and innovation policies?
- Is the investment in SFI appropriate to meet its objectives? What continuing investment will be necessary to sustain it?
- Are there sufficient and appropriate complementary measures to SFI which would allow the desired economic effects to materialise?

To this end, the panel undertook complementary activities between November 2004 and June 2005 as follows:

- 1 Discussions with a representative cross-section of:
 - a researchers, post-doctoral staff and students funded under SFI awards;
 - b SFI management and administration;
 - c higher education management from institutions housing SFI researchers;
 - d other key stakeholders from the public and private sectors.

A list of organisations and individuals consulted is provided in Appendix 3. Further information is given in the box *Principal Inputs to the Panel*.

Principal Inputs to the Panel

- Background materials provided by SFI
- Background report for the panel prepared by Forfás
- Panel meetings November 2004
- Panel visits to 15 research groups (Principal Investigators and four CSETs) in four higher education institutions in March/April 2005
- Responses to a written request for input sent to all SFI Investigators except those being visited in March/April 2005
- Consultancy studies on bibliometrics, peer review and industry views of SFI
- Consultations with other key stakeholders, including the Higher Education Authority, the Department of Enterprise, Trade and Employment, Office of the Chief Science Adviser, Enterprise Ireland and IDA Ireland.

- 2 Commissioned studies of
 - a Bibliometric data from SFI Principal Investigators;
 - b The operation of the peer review process; and
 - c Industry views of SFI.

5 Considerations of the Panel

5.1 Introduction

While it is too early in the life of SFI to assess the long-term cultural and economic impact of research it supports, the panel members have gained a firm indication of the quality of contribution represented by progress to date. This chapter presents some of the evidence underlying this indication.

5.2 Rate of Development

The table below shows the progress over time towards reaching the annual levels of research funding of over €100 million originally envisaged.

Table 3 SFI Budgets 2001-2005

Year	2001	2002	2003	2004	2005
Funding Approved €m	10	35	70	115	121

5.3 Current Operations of SFI

5.3.1 Outputs

The main contribution of SFI to date has been to establish an array of research groups, where the basis for selection has been the criterion of research excellence in the broadly identified – and economically relevant – sectors of biotechnology and of ICT.

Leading foreign research scientists have been attracted to Ireland. Irish researchers with distinguished careers conducted abroad have returned. Eighty one research groups in biotechnology and eighty two in ICT hold awards from SFI and to date over 1150 research staff have been supported by SFI. These include 163 group

leaders (‘principal investigators’), 34 of whom have come to Ireland from laboratories abroad, and 444 postgraduate students, mainly PhD. Greater detail is provided in the table.

Table 4 Research Personnel Funded by SFI

	Biotechnology	ICT	Total
Principal Investigators	81	82	163
Post-doctoral researchers	198	159	357
Postgraduate students	159	285	444
Interns ³	12	11	23
Support staff	98	66	164
Total	548	603	1151

The panel examined annual reports from SFI funded researchers. In reports from 48 Investigators in the ICT area, almost all identify publications and a quarter mention items of intellectual property disclosure, principally patent applications. Over two thirds are in receipt of grants other than their Investigator award, the highest proportion of these being from the EU or from other programmes of SFI. Grants also come from Enterprise Ireland, from the Irish Research Council for Science, Engineering and Technology (IRCSET) and from the Higher Education Authority, as well as from international sources or from other national funding bodies.

The main locations for collaborators are the UK, the rest of Europe and the US/Canada. One fifth report other non-EU collaborations. Over two thirds of these Investigators report collaborations with commercial enterprises.

³ Interns are typically people with a lower level of research experience, e.g. graduates not studying for a further degree.

Annual reports from 45 biotechnology Investigators show that over 80 per cent have brought work to publication but, as expected given the longer lead time in biotechnology, at this stage few have moved to intellectual property disclosure. Over 80 per cent are in receipt of grants other than their Investigator award, the highest proportion from the EU and the Health Research Board. Grants also come from other national funding bodies and other SFI programmes. Academic collaborations, with both international and national research teams, are common. The main locations for collaborators are the UK, the rest of Europe and the US/Canada. Almost half of these Investigators report some form of collaboration with commercial enterprises.

In both areas there are reports of workshops, conferences, visits to and from international sites and invited presentations. A number highlight prestigious awards and honours.

Six **Centres for Science, Engineering and Technology** (CSETs) have been established in the core thematic fields and with considerable industry involvement. The CSETs are in the following areas:

- Adaptive Nanostructures and Nanodevices (CRANN in Trinity College Dublin)
- Regenerative Medicine (REMEDI in NUI Galway)
- Digital Enterprise Research (DERI in NUI Galway)
- Alimentary Pharmabiotics (APC in University College Cork)
- Telecommunications Value Chain (in Trinity College Dublin)
- Human Proteomics (in the Royal College of Surgeons of Ireland, Dublin)

The first five were founded in 2003 and the last one in 2005.

Based on visits to the first four CSETs above the panel members are enthusiastic about the CSET concept and are impressed by what has been achieved in the short time of operation. They believe that these centres will have a strong influence on the research system and the higher education institutions in Ireland in coming years. The extent of the industrial involvement already visible, including the exchange of research staff, is also highly satisfactory but it will remain important to continue efforts to maximise industrial involvement.

5.3.2 The Peer Review Process

The detailed findings from the external assessment of the SFI peer review process are contained in chapter 6. The major conclusions are that the emphasis on international peer review and the strong professional backgrounds of the SFI personnel involved are substantial strengths of the review process. The process is seen in this assessment as efficient, flexible and responsive. A number of minor suggestions for improvement are made.

Peer review is central to SFI's objective of excellence and the independent assessment of SFI's peer review process has found it to be operating to the highest international standards. This is confirmed by the quality of the researchers whom the panel members met and by the findings from the bibliometrics study commissioned for this evaluation.

The panel endorses the approach adopted by SFI to meet its objectives. The focus on excellence is crucial and the peer review system in place should ensure that excellence is achieved. It would, however, urge that attention be given to the optimum number of reviews required for a given proposal. When an agency is new and little known, as with SFI, it is necessary, in the early stages of its operation, to approach a relatively large number of researchers to review proposals. However, after its reputation has been established, a set of three opinions per proposal would match international standards for typical project and investigator awards, and could normally be obtained by approaching four to five reviewers.

5.3.3 Monitoring

While panel members have no formal authority for the review of financial accounting or control, they believe that SFI has put in place appropriate systems and procedures to safeguard the use of public money.

At the project level, every SFI funded project is required to have a progress report submitted to SFI one year after commencement of the project and annually thereafter. The reports are read by the programme officers and followed up where necessary.

There were indications that a small number of researchers were not complying with these requirements. The argument was offered that, until recently, there were insufficient numbers of SFI project staff to ensure that all these cases were vigorously pursued.

Approximately mid-way through the funding cycle all major projects are subject to an external peer review visit. The review report is used by SFI to make any necessary adjustments to the project in collaboration with the research leader.

The panel members would urge SFI to ensure that the recent increases in programme staff lead to a tightening of the project monitoring function and hence that all research projects are submitting timely indicators of progress made.

It is important to track the future career paths of both post-docs and PhD students who leave SFI, in part to facilitate any further evaluations of the impact of SFI.

5.3.4 The Style of SFI Operations

Excellence

SFI's operating philosophy is based on the excellence of the research that it funds and the panel are fully in support of this approach.

Leadership

The new and radical nature of the SFI initiative required a strong and explicit leadership role at the outset. This caused some understandable disturbances in the existing system. Now that the situation has evolved there is scope to develop a more collaborative approach which would include greater community interaction with the leadership and influence upon it.

Consistency and Transparency

Because of SFI's novelty, and the generally under-developed state of the national research system, a few teething problems were encountered. A small number of examples were cited to the panel members where SFI has changed the rules in the perceived absence of adequate consultation. For example, SFI entered a national agreement for the payment of overheads as part of its awards, a standard practice in other countries but new to Ireland. SFI subsequently and unilaterally modified its way of allocating overheads to the HEIs by the introduction of the Annual Overhead Investment Plan (AOIP). This has given rise to concerns which were conveyed strongly to the panel by university representatives and by some researchers.

Another issue is a perceived lack of clarity among some researchers about the process of reviewing research progress. The panel draws attention to the need for consistency and clarity of operations on issues such as these.

5.3.5 Provision of Continuity

SFI's Future

A key issue of concern identified by the panel relates to the continuity of funding, and particularly to the view held by many researchers that SFI itself will only be funded until the end of the current National Development Plan in 2006. Lack of confidence about the future makes it more difficult to attract researchers to Ireland and to hold those nearing the end of their current funding cycle. The uncertainty persists in the minds of the research community even though the Department of Enterprise, Trade and Employment has confirmed that an expenditure profile for SFI up to 2009 has been agreed and that this will be rolled forward in subsequent years.

Extension of Awards

For Principal Investigator Awards researchers are unclear about how individual projects will be assessed as they come towards the end of their life and about opportunities for obtaining a second award. Researchers would welcome a decision about future grants as early as possible. This should be no later than the beginning of the last year of a project, given the intense international competition for good researchers and the need to sustain a confident research climate in the face of the difficulties many groups have found in trying to attract postdoctoral researchers to Ireland. SFI has now (June) posted its policy on second grants on its website.

For CSETs, panel members note that they are being funded for five years with an option to extend for a further five and that this approach should cater for the element of risk associated with these centres. This is an appropriate policy in the context of research funded through university structures rather than through independent SFI institutes. The panel suggests that applications for continued funding should be considered well in advance of the end of a current award, and that provision of a year's period of notice should be granted if the application is unsuccessful. This would assist CSETs in retaining staff as an award comes to an end, and allow Principal Investigators to seek alternative funding if necessary. Where CSET funding is being extended there should be a strong renewal of research goals in the context of the new operating plan.

Career Structures

Attracting foreign researchers to work in Ireland is a difficult task and SFI has done it well to date. If the best are to remain in Ireland then the universities need to be encouraged to offer them research positions when their SFI grants finish. The panel members noted the absence of any career structure in the universities for hiring permanent senior researchers, apart from a tenured academic post, and this will make it difficult to build up research centres. Larger research programmes need research staff, often with more maturity and continuity than post-docs can bring.

The panel notes with approval SFI's efforts to encourage young researchers via the PIYRA scheme and urges that this be continued and, if possible, strengthened.

5.4 Impacts and Interfaces

5.4.1 Higher Education Authority

The research infrastructure put in place by the Higher Education Authority's *Programme for Research in Third Level Institutions* (PRTL) has been vital for the success of SFI investments. Panel members concur with the findings in the PRTL Impact Assessment that a better organised collaboration between the HEA programme and SFI would benefit the research system. As already noted in Chapter 3, the PRTL Assessment states that PRTL should provide the backbone and the deeper foundation on which specific initiatives like SFI depend. It also commented on the absence of any agreement as to how the national innovation system works in Ireland.

The panel believes that the first requirement for an integrated system should be a recognition by all those involved that they have a mutual responsibility for the success of the 'knowledge economy'. Agencies and higher education institutions need to work closely together to ensure that all of the outputs and eventual impacts from the increased investment in research can be realised. While the Research Councils may provide occasional project funding in addition to the major activity of SFI, and while SFI may make occasional specific infrastructure provision alongside the major activity of HEA, full coordination of these activities should be sought.

During this review panel members met researchers who were interested in the prospect of commercialising their work but who lacked skills in the relevant business techniques to enable them to do so. The work of the business schools should be extended to include world class teaching and research in innovation processes and in the commercialisation of research, aimed at the needs both of academic researchers and of Irish companies, and to help the government identify all the ways by which Ireland can extract value from research.

5.4.2 Universities

Visits to four universities, and discussions with senior university administrators, have indicated the extent of the impact of SFI activities on university structures and attitudes. A rapid learning process was inaugurated by the introduction by the HEA of the PRTL, a change that has been accelerated by SFI. As a result, higher education institutions now see themselves as playing a much more significant role in the 'knowledge economy', with a strong research ethos and with the determination to develop the capability vital for this role. Universities are therefore rapidly adapting themselves, their staff and their students to this new environment.

The strategic priorities of higher education institutions need to take into account the options for funding from SFI (projects and associated infrastructure) and HEA (major infrastructure) and should link the relevant initiatives of these agencies. Where SFI provides finance for facilities used by more than one research group the universities may need to develop new systems to maintain these facilities and their staff at the state of the art.

5.4.3 Industrial Development Agencies

IDA Ireland

The panel found a good working relationship between IDA Ireland and SFI. IDA have made significant efforts to involve industry, both potential new inward investment clients and existing clients in Ireland, in SFI activities. This is enhancing SFI's industrial focus. IDA and SFI should continue this collaboration.

Enterprise Ireland

Enterprise Ireland has concentrated its involvement with SFI into working with the HE institutions to set up technology transfer offices responsible for the legal and operational commercialisation of research. This aspect of their work is considered further in chapter 7.

5.4.4 International Links

Globalisation is usually spoken of in relation to the behaviour of firms and economies. It is also increasingly important in research, which by its nature is international. The pace of change in both science and technology, involving not only the developed countries of the West and Japan but also China, India and the 'Asian Tigers', has resulted in research being principally conducted where there is the best array of talent, facilities and money. Breakthroughs can occur anywhere around the globe.

For this reason, and because success in research now commonly involves close integration between teams working on complementary aspects of a problem, an efficient national research system must be linked to the international system and capable of recognising and exploiting research outputs wherever they arise. Since modern industries utilise the latest ideas in scientific fields relevant to their product and process development, industry is also monitoring what is happening in research worldwide.

A specific issue arises in connection with the relatively modest size of the Irish research community when compared with that of the US, Germany or China. Initially, researchers need to be selected on the basis of excellence but they must then maintain active and close involvement with the international research community; they need to travel abroad to conferences, workshops and other fora for meeting fellow-researchers and for exchanging ideas. Almost ninety percent of the SFI scientists reviewed in 5.3.1 reported that they gave presentations at conferences or at other fora. Also, many of the PhD students whom the panel met on its visits to SFI research groups spoke enthusiastically of the regular opportunities they had for meeting leading scientists from around the world and of the value they obtained from such meetings.

SFI has played a major role in helping to internationalise the Irish research system, both by attracting people to work in Ireland and by facilitating and encouraging international association.

The panel commends the good start made by SFI in its helping to link Irish research more closely into the international research system and encourages SFI to continue these endeavours.

5.5 Trend for Future Operations of SFI

Research is by its nature unpredictable and risky. If it were not, industry would be expected to fund it totally and to reap the subsequent benefits. A research portfolio, like any investment portfolio, is likely to contain a mixture of projects with a broad spectrum of risk. SFI appear to have adopted such an approach, based on the panel's experiences from its visits.

Two CSETs provide an instructive example of this risk spectrum. One has been built on a long-standing research collaboration with strong links to industry while another represents a substantial investment in facilities and research groups in a relatively new area of science where many other countries are also hoping to be active.

The core function of SFI must continue to be support for excellent research in biotechnology and ICT, including the scientific disciplines underpinning them. By funding only the highest quality research, and by operating in broadly defined sectors of biotechnology and ICT, there is every expectation that researchers will keep future applications for their work in the forefront of their planning. There are other research fields which might be of relevance to Ireland, for example materials or engineering, and the panel members understand that a process will be put in place at a national level to identify such fields. SFI currently supports

research in two core areas and should not extend support into other core areas, with the exception of the Research Frontiers programme, without securing funding additional to that in the projected budget to 2009. Also, ICT and biotechnology are rapidly changing disciplines and SFI needs to continue to ensure that the span of the fields of research encompassed in its operations are updated on a regular basis. Nor should SFI be diverted into supporting too many peripheral activities, no matter how worthy or how great the need, but instead concentrate on the funding of excellent research. The nourishing of the necessary ancillary activities should be a consequence of a successful coordination of roles between the different agencies participating in the overall 'knowledge economy' endeavour.

The panel believes that it is essential to hold to the use of the excellence criterion above all else in the choice of projects. This, and the avoidance of top down imposition/selection of themes, have been major factors contributing to the success of SFI. Any strategy drift to central identification of specific themes or grand challenges (see section 2.8) risks making SFI just one other support agency among many and risks therefore losing its special status among mobile researchers.

SFI's investments face a number of uncertainties, some specific to Ireland, others common to most research programmes. There is growing international competition for scarce talent as a number of countries strengthen their research efforts in response to the knowledge economy imperative. International mobility of good researchers at all levels is increasing. Local issues in Ireland such as the high cost of housing and transport infrastructure deficiencies can then have significant impact. People attracted to research positions in Ireland must continue to find these positions attractive; they are likely to be particularly sensitive to any signs that the national commitment to research could be open to question.

5.6 Summary

Impressive progress towards developing a strong research capability in Ireland in biotechnology and ICT has been achieved in a very short time. The energy, enthusiasm and commitment of those whom the panel members met during their visits to Ireland, including researchers at four of the six CSETs, made a strong impression. The findings from this review, together with the results from the bibliometrics study and the analysis of preliminary outputs from the research groups, give every reason to believe that SFI has responded with energy, with purpose, and with striking effect to the objectives originally set for it.

6 External Studies

6.1 Introduction

Independent consultants were commissioned to undertake three studies on behalf of the panel. The first examined the peer review process used by SFI for the allocation of awards and compared it with best practice as found in comparable institutions and programmes worldwide. The second involved a bibliometric analysis of SFI researchers (a statistical analysis of the publications output of the researchers and the extent to which the publications were utilised by their fellow scientists.) The third study was a survey of the attitudes of industry in Ireland towards SFI. This chapter reports briefly on the findings from the studies. The full texts are contained in the CD ROM attached to this report.

6.2 The Peer Review Process

The assessment of the peer review system was carried out with the assistance of a specialist in the conduct of such studies. Briefing by SFI staff and examination of documents, including case files and review report forms, informed the study. Comparisons were made with the procedures used in other similar organisations worldwide, including some in the US and Australia.

There are significant strengths to the review process in use by SFI, particularly:

- the emphasis on securing expert international reviewer input, and
- the high-level professional backgrounds of SFI personnel.

The assessment, and comparison with processes used in other agencies, suggests that SFI's review process is efficient, flexible and responsive. It is also impressive that, in the short time since SFI was established, it has constantly sought to make improvements in the efficiency and clarity of its processes.

In general, no major deficiencies in the system can be seen. There is every reason to believe that the SFI approach would have the same probability of funding excellent research as have major research funding agency in countries like the US, UK, Finland and Australia.

A customised web-based Award Management System (AMS) has been developed and was in pilot phase during the review. While all of the information on the peer review process was available in the SFI system, it was distributed across different files and in different formats (paper and electronic). A single award management system will allow SFI to manage the process better and to produce a range of output records to support the claim that the system is fair and efficient.

Some suggested improvements have been identified:

- SFI lacks a single policy and procedures manual (or equivalent) although all of the content of such a manual exists in various places on the organisation website or the forms used during the process. Such manuals are standard in major funding agencies and are important ways for research funding agencies to demonstrate transparency and accountability of their operations and to ensure consistency in the application of their review procedures.
- For oversight and monitoring purposes, SFI might consider requiring reviewers to sign Conflict of Interest forms prior to the review, and Nondisclosure Agreements (if and when proprietary information is presented in applications). This is done by other agencies where potentially sensitive information is involved. It may also become relevant if the funded researcher's work later becomes patentable⁴.

⁴ US Department of Energy, Office of Energy Efficiency and Renewable Energy. Peer Review Task Force. (August 2004).

6.3 Bibliometric Analysis

The study commissioned by the panel reports on the analysis of:

1. The publication record of 27 of the SFI researchers from non-Irish institutions, prior to their coming to SFI on a Principal Investigator or similar award, to determine whether excellent researchers had been attracted to SFI from abroad; and
2. The publication record of 34 of the domestic researchers actively involved in research in Irish institutions prior to receiving a Principal Investigator award.

The panel commissioned recognised experts in bibliometric analysis to undertake the work.

In the first part of the review, the numbers of publications and citations were examined and comparisons were made between the prior outputs in 1990-2001 of the researchers appointed from abroad and their peers world wide. Data were normalised and corrected, for example to exclude self citations, and used to generate internationally standardised impact indicators.

The data show that the publications by these foreign researchers have a generally high to very high impact, as measured by citations relative to global standards. The researchers in both biotechnology and ICT were seen to have a strong position in terms of highly cited publications in their field, with three quarters of them having a higher output of papers in the top 10 per cent of the most highly cited publications than would be expected from their total output of publications in the time period.

In the view of the panel members, this information, together with the view from the peer review study that the process being used by SFI is likely to select excellence, indicates that the objective of attracting world-class researchers from abroad is being achieved. The panel compared the findings from this bibliometrics study of researchers attracted to Ireland by SFI with the overall assessment of the quality of research in Ireland during the 1990s as measured by the '*Baseline Assessment of the Public Research System in Ireland in ICT and Biotechnology*', published in 2002. The baseline assessment for biotechnology showed that the key indicator for Ireland during the 1990s was around 1.4, where 1.0 represents the world average level of performance. In contrast, the figure for the biotechnology researchers brought to Ireland by SFI was over 2.8 at the end of the 1990s, just before they came to Ireland. For ICT, the corresponding figure for Ireland in the 1990s varied between 1.0 and 1.3 whereas the ICT researchers who came to Ireland to take up SFI positions averaged scores of between 1.8 and 2.8. It seems clear, therefore, that SFI has succeeded in attracting to Ireland researchers whose performance, as measured by internationally accepted criteria, is well in advance of *average* levels in Ireland in the past.

In the second part of the bibliometric review, drawing on publication and citation records in 1994 to 2003, the prior performance of domestic recipients of SFI awards is considered. The resident researchers perform creditably in terms of highly cited publications in their field, with over two thirds achieving above average representation in the top 10 per cent of the most highly cited publications given their output.

In the view of the panel members, the resident researchers funded by SFI are also being selected under the criterion of excellence through the existing SFI peer review process.

In addition, the report looked at the quality of publications of researchers in Ireland in the fields and sub-fields of research funded by SFI. This shows that the publications of researchers funded by SFI are having a high impact, both in areas that were strong pre-SFI and those that were of average or low impact pre-SFI. This implies that SFI funding is having a positive impact on the overall performance of research in Ireland in ICT and biotechnology.

It is the view of the panel members that the bibliometric data available indicate that research excellence is being funded by SFI and that the existence of SFI funding is having a positive effect on the performance of research in Ireland in its two fields.

6.4 Industry Views of SFI

In-depth face-to-face or telephone interviews with 24 companies were conducted in January/February 2005. The interviewees were from a mix of large foreign-owned multinationals, large indigenous firms and small high technology start-ups, all operating in business sectors with an interest in biotechnology and information and communications technology research.

The interviews sought to determine businesses' awareness of SFI and its activities, the extent of interaction between industry and SFI, and the main benefits of SFI funding from an industry perspective.

There is considerable support among the survey respondents for SFI's objective to improve the quantity and quality of research performed within Irish HEIs and for the strategy to focus the research on the two areas of ICT and biotechnology. Business leaders expressed most interest in the part of the SFI mission that relates to catalysing growth in the wider economy through spillovers from the research. They applauded SFI for its success in enticing world-class scientists, several from North America, to set up and lead major new research projects in Ireland. SFI investments are seen to be helping to raise Ireland's international profile with regard to science and technology and this is attracting a good deal of new interest from businesses in Ireland and internationally.

Companies involved in applications for CSET funding were broadly positive about the potential for this mechanism to bring an industrial viewpoint to Irish academic research groups and to increase networking between industry and academia.

Nonetheless, the responses suggest that business would encourage SFI to fund more applied projects and less basic science in the future and indicated that some selection of sharply defined niche areas would be welcome. Several argued that as a small country, and as something of a latecomer in the public sector research stakes, Ireland could not afford to pursue an open, response-mode approach to research funding, and that strategic issues ought to have informed decisions on mainstream funding to a greater extent.

The importance of connecting users into existing research activities, both private and public sector, not least the need to strengthen technology transfer and intellectual property management mechanisms in the public sector, was highlighted in the interviews. Some expressed concerns about the apparent lack of incentives for HEIs to be focused on producing and protecting commercialisable intellectual property. Given the real skills shortages in Ireland, concerns were also expressed that the training agenda under SFI funding would not provide people specifically geared to the needs of industry and that people with relevant up-to-date skill sets, and at least some degree of industry exposure, are the priority for industry.

Business would welcome the development of more and better mechanisms for industry-HEI engagement, including showcasing of the work of SFI and its researchers. Much of the research supported so far is not visible to industry. A roadmap or strategy for industry showing how SFI investments are expected to translate into commercial benefits, mapping investments to key segments of the economy, would also be of value.

All of the interviewees expect the SFI mission to take time to bear fruit and that one should not necessarily expect benefits to flow yet – things are still at an early stage. Most feel that there is still a considerable way to go, and that substantial additional work will need to be done if the research is to be translated into commercial benefit. They see the clock ticking and believe that the research will have to start to deliver commercialisable results over the next few years in order to retain the interest and support of the business community.

Industry would like to see strong monitoring and evaluation of SFI's progress using quantitative and qualitative indicators to gauge scientific and industrial impacts.

Panel members agree with many of the views of industry emerging from this report, particularly those relating to intellectual property, better dissemination of the results of SFI research, and monitoring and evaluation. However, industrialists must give attention to satisfying short-term requirements in addition to building a longer term vision and this duality comes through in the conflict between their welcome for the strategic role of SFI together with their wish for more applied and focused research. This is a difficult balance to strike and there are well recognised dangers in trying to link research programmes too closely to current and specific industrial requirements. The risk in such attention to shorter-term targets is that the focus of impact is narrowed and that the opportunity for creating a more widespread culture of enhanced scientific and engineering competence in application-relevant sectors is lost. When considered together with the significant industry involvement with SFI that the panel learned about during its visits it is probably fair to say that SFI are getting the balance about right.

The panel members fully share the viewpoint expressed in the industry survey that the closest attention should be given to ensuring rapid and effective communication of aspirations, needs and achievements between the worlds of industry and publicly supported research. This is a task which will require the constructive involvement of each of the agencies associated with the growth of a 'knowledge economy' in Ireland.

7 The Commercialisation Challenge

7.1 The Issues

SFI has made significant and rapid progress in setting up research groups and centres, as outlined in earlier chapters. Much of this is likely to have commercial potential in the future. However, a number of studies⁵ have identified the need to increase greatly the level of interaction between higher education institutions (HEIs) and industry and to strengthen the technology transfer functions within HEIs.

In its meetings with researchers and research groups the panel found no evidence of a lack of awareness or interest in commercialisation. There was, naturally enough, a recognition that the time-scale over which commercial output from the research work might materialise could vary greatly from project to project and that commercialisation is by and large a complex, non-linear and unpredictable process.

The following sections outline the views of the panel members on the respective roles of the different actors in the system.

7.2 Role of the Research Funders

The role of research funders, including SFI, should be a supportive and encouraging one. That is, they are the first point of contact with researchers and should use their initial interaction to emphasise the constant need for alertness in respect to the possibilities of commercialisation and to urge exchanges with the commercialisation support system which will (hopefully) be fully operational by the time their research is maturing.

7.3 Role of the Higher Education System

There are two clear functions required of the higher education institutions and of the Higher Education Authority. The first is that of 'intellectual property promotion', which involves regular interaction with research groups in the HEIs by those with the entrepreneurial experience and expertise necessary to appreciate any opportunities for commercialisation. The second is the actual commercialisation process itself, including but not solely via the transfer of Intellectual Property (IP) and knowledge to an existing company or via the formation of a new spin-off, and the creation of a supportive environment for that. These functions need to be put in place but it should be recognised that much breakthrough research does not make its way into industry by this direct and immediate path. Looking at success only in terms of startups may fail to recognise all sorts of other benefits.

Researchers themselves are, in isolation, not necessarily best placed to realise the commercial potential in their work. There is therefore a need for a support mechanism within the HEIs which assists in the process of identifying output which might have applicability, consults with the researchers on how it should be progressed and disseminates intelligence on commercialisation experiences. These identification, consultation and dissemination activities should be carried out by a dedicated and well resourced Technology Transfer Office within the HEI, geared towards supporting the researcher along the best commercialisation route. Additional expertise relevant to optimising the selection and management of the commercialisation route should be provided through this Office.

⁵ For example: *Commercialisation of Third Level Research: ICT Ireland (2004)*.

The Higher Education Authority and the institutions should have responsibility for ensuring that such a technology transfer function is in place in every HEI that has significant research activity. The focus should be on all major research groups and centres in the HEIs, no matter what their source of funding.

Clearly SFI will be a major funding source for many of them.

Most researchers have insufficient commercial or business knowledge to deal directly with the commercialisation process but they are closest to their research and many, with training, become the best guide for its fruitful development. It is quite commonplace in the US for universities to offer training in entrepreneurship and business practice, usually in their business schools, aimed at those who might be interested in starting a business. They can also provide, within their teaching, insights into the commercial environment gleaned from research into company development trajectories, including local barriers to start up and growth. The panel is not aware of similar courses in Ireland and strongly recommends that the business schools should be encouraged to consider adding such a programme to their curricula.

Clear and supportive policies for researchers engaging in commercialisation work should be in place in all higher education institutions. For example, the provision of flexible working conditions during critical periods, such as a company startup phase, will enable both the individual researcher and the HEI, with its students and other staff, to benefit from the fruits of commercialisation and to feed back the commercialisation experience gained to the wider higher education community.

7.4 Role of Enterprise Ireland

Enterprise Ireland (EI) offers a range of programmes aimed at encouraging researchers in HEIs to commercialise their research outputs. The organisation also has a long history of involvement with the HEIs and in helping to link them to industry.

EI should play an important part in the commercialisation process. It has built up technical and commercial expertise specifically in biotechnology and ICT, partly as a result of its involvement with the Programmes in Advanced Technologies. It is very desirable to maximise the contribution of this resource, particularly in facilitating linkages to industry and in promoting and assisting start-ups. Their role would appear to start once the potentially commercialisable output has been identified but, if an HEI wished, EI would also be well placed to help with the IP identification process.

The panel is aware of the gap in the Irish research support system relating to applied research which was identified in the report of the Enterprise Strategy Group⁶. This gap makes it more difficult to link industry, particularly SMEs, to the research funded through SFI. The panel supports the suggestion of establishing 'competence centres' in research and innovation which would be closely tied to industrial needs and which would help to strengthen industry links to SFI. Enterprise Ireland is, in collaboration with IDA Ireland, the logical agency to develop this proposal.

7.5 Summary

The priority is for the whole commercialisation process to be properly resourced and functioning smoothly in the shortest possible time. This will require all participants to work closely together and to accept each other's role in a constructive way.

8 Conclusions and Recommendations

8.1 Conclusions

With the establishment of SFI Ireland has set off on a bold and well-designed path to transform its research involvement. Unless this venture stumbles in its early stages, it will in time trigger an irreversible change in the expectations and capability for innovation and research in Ireland. Impressive progress has been achieved in a very short time and with, until recently, less than 25 staff. The panel members believe that SFI has responded with energy, with purpose, and with striking effect to the objectives originally set for it. The panel applauds and supports this effort, both in its vision and in the method of its enactment.

The very fact that the activities of SFI are in an early stage of development makes it premature to quantify the outputs and to demonstrate their success in the eventual arena of economic impact. The project must be seen as a long-term campaign and time will be required to provide quantified proof of its validity. What can, however, already be seen is a change in expectation and ambition, an excitement and vigour of purpose, and persuasive indications of the suitability and effectiveness of its processes.

All parties interviewed, including the researchers themselves and the associated university administrators, agree that a defining aspect of SFI is its demand for excellence in research quality through the process of rigorous peer review of proposals, and the validation of that quality internationally by the use of reviewers drawn from around the world. The culture of excellence, and not just the newly available funding, is part of what has drawn leading figures from abroad to bring their research to Ireland. The pattern of awards has confirmed also that there are many citizens of Ireland who are fully equipped and equal to the challenge of doing world-class research.

Panel members are enthusiastic about the CSET concept and the speed and vitality with which it has been implemented. It seems likely that these centres will have a strong influence on the research system and on the higher education institutions in Ireland in coming years. The extent of the already visible industrial involvement is also highly satisfactory.

With consistent support, SFI can share with other agencies in bringing about an irreversible change in the standards and expectations of research in Ireland. However, the research culture is still fragile at this point, and it could lose momentum, to a considerable cost to Ireland. Both the government and the higher education institutions must be clear as to the proper course, and clear as to how harm could come from inappropriate action or from perceived loss of commitment. The researchers that have been attracted to Ireland, or that have emerged within Ireland with this encouragement, are world-class. They have made major career commitments. Ireland must be sensitive to this, and return that commitment to them in the form of continuity of confidence in the long-term benefit of high quality strategic research. There must be a commitment to the sustenance of a research culture, to the provision of the required resources, to the development of infrastructure, and to the related activities that make a stimulating environment for research.

Universities are alert to the fact that the SFI funding that has brought and supported key academics for an initial period (such as the five year research faculty positions) is not a permanent commitment to support these people. The five-year period is intended to allow universities to lay the plans to integrate proven effective people as regular faculty and/or research fellows at their institutions. Future SFI funding, if it is deployed in a similar manner, will require flexibility for the support of new strategic areas and new people.

If one or other university is ineffective at planning for such integration, then there is consequent erosion of an evident research culture. If the universities as a whole fail to understand and accept this obligation, this may trigger a departure of leading research figures from Ireland. The universities, as well as the government, have a crucial role in sustaining this cultural transformation.

Both government and academia have recognised the necessity for investment in infrastructure – buildings, core apparatus, communications, and the like – that make it possible to operate an effective and productive research system. Ambitious and motivated researchers are disincentivised if they are required to divert themselves into a continuing struggle to establish their research environment. The panel members found in the interviews that there is a general understanding of the issues that surround infrastructure; there is, however, a consistent plea for more coordination and cross-linking between the SFI funding and funding such as PRTL infrastructure grants.

It is important that all the stakeholders, including government ministries and politicians, have realistic expectations about the pattern of commercialisation and exploitation that will result from SFI funding. In some cases the panel detected a perhaps excessive reliance on the somewhat simplistic model of technology transfer via small company startups directly emanating from SFI funds. This should not be used as the only metric of success.

While start-up innovation can certainly be expected in the environment that SFI is hoping to foster, the ideas on which commercialisation is based are not always the formally stated topic of research, but are shorter-term ideas that are conceived once creative people are placed in stimulating

environments. Long-term research can often spin out shorter-term corollaries, while the opposite is less true – short-term research does not often lead to long-term breakthroughs. But this loose relationship between long-term research and the inspiration for commercialisation means that the pattern of usage of patents and intellectual property has many shapes, and that the indirect nature of much innovation must be accepted and indeed welcomed.

The panel members consider that SFI is getting the balance about right between longer-term research and work of more immediate relevance to industry. There is significant industry involvement in the four CSETs visited as part of this review as well as a strong commitment to increasing this involvement. In organisations such as the Tyndall Institute in Cork, which has a long tradition of cooperative research with industry, there may well be scope for developing a more active intermediary role which would help companies to utilise the knowledge and concepts arising from more advanced research activities.

Finally, the panel identified a number of operational aspects of SFI where performance is satisfactory but where improvements might be made. These were discussed in chapter 5 and include issues of consistency and clarity, peer review and project monitoring. While panel members have no formal authority for the review of financial accounting or control, SFI appears to have put in place appropriate systems and procedures to safeguard the use of public money.

8.2 Recommendations

The panel commends the Irish State, for having had the vision to set up SFI, and the SFI Board, director general and staff, for their remarkable achievements over the past four years.

The panel recommends the following measures as appropriate for the Irish research system and for Ireland more broadly in its quest to evolve rapidly into a knowledge-based economy:

1. Recommendation to SFI

It is of paramount importance that SFI awards continue to be decided on the criterion of research excellence above all else.

SFI should ensure that the requirement for research excellence, confirmed through rigorous peer review, continues to be the paramount condition in grant award decisions.

Grants should continue to focus on strategic areas of science and technology relevant to Ireland. No extension beyond the two current research areas, biotechnology and ICT, should take place without there being the provision of additional funding for this purpose.

The proposal to focus on narrower topics within the broader research themes should not be allowed to jeopardise SFI's unique appeal to mobile researchers.

SFI should not be diverted into supporting peripheral activities, no matter how worthy or how great the temptation; its funding should be concentrated on excellent research, with the required ancillary activities being undertaken by other, more appropriate, agencies.

2. Recommendation to Government

It is essential to continue to take a long-term, strategic view of funding for research in Ireland.

Government should ensure that it is committed to sustaining and confirming the stability of funding for research. The panel believes that continuing support, based on research excellence, will bring increasingly identifiable benefits.

The funding agencies, with the backing of government, should ensure that this long-term funding commitment is communicated clearly to the research community, to the higher education system and to industry.

3. Recommendation to Government and its Research Funding Agencies

All relevant agencies must assume a shared responsibility for a coherent and coordinated approach to the development and consolidation of the Irish research system.

Government should orchestrate the coordination of the activities of agencies responsible for the funding of higher education research, both for infrastructure and projects, and for nurturing the higher education-industry interface. The panel believes that the funding of infrastructure and the funding of projects can be made to operate efficiently and effectively when assigned – as now – to separate bodies.

SFI, the Higher Education Authority and the other research funding bodies should work closely together to ensure a coherent and coordinated approach to the support of the research system, including a greater community interaction with SFI leadership and influence upon it.

The higher education institutions should continue to foster the move towards an intensified research culture, including substantive career development tracks for researchers, and effective knowledge transfer policies.

4. Recommendation to Higher Education Institutions, Enterprise Ireland and the Higher Education Authority

Commercialisation of SFI funded research should be supported through an integrated system built on a foundation of realistic expectations.

Higher education institutions, Enterprise Ireland and the Higher Education Authority should work together with researchers and SFI to develop a process for identifying outputs from SFI funded research with potential for commercialisation and a mechanism for linking these to industry.

Higher education institutions and the HEA should encourage business schools to extend their activities to include world class teaching and research in innovation processes and in the commercialisation of research, aimed at the needs both of academic researchers and of Irish companies.

Enterprise Ireland should move ahead quickly with plans to develop ‘competence centres’ to address industrial needs for more applied research and to help link industry to the research outputs of SFI.

5. Recommendation to Science Foundation Ireland

SFI should address a small number of operational issues which need attention.

In particular, SFI should work with the research community to ensure that there is both actual and perceived consistency and clarity in relation to issues like new grants, mid-term reviews and overheads.

Appendices

1	Membership of the Panel	42
2	Terms of Reference for Evaluation of SFI	43
3	Organisations and Individuals Consulted	44

1 Membership of the Panel

Professor Sir Richard Brook (Chairman)

Professor Brook is Director of the Leverhulme Trust in the UK. He is a materials scientist with a doctorate from MIT. He was appointed Director of the Max Planck Materials Research Institute in 1988 and in 1993 was appointed Head of the Materials Science Department in Oxford University. In 1994 he became Chief Executive of the UK Engineering and Physical Sciences Research Council (EPSRC). He is a fellow of the Royal Academy of Engineering.

Dr. David Clark

David Clark chairs the Computer Science and Telecommunication Board of the US National Academies. He received his PhD from MIT in 1973 and since then has worked at the MIT Laboratory for Computer Science, where he is in charge of the Advanced Network Architecture group. He has played a leading role in the development of the internet.

Professor David Finnegan

David Finnegan is based in the Institute of Cell and Molecular Biology, University of Edinburgh. He is a member of the European Molecular Biology Organisation and Fellow of the Royal Society of Edinburgh. David is editor of "Gene", a member of the editorial boards of "Insect Molecular Biology" and "Nucleic Acids Research" and a member of the CNRS grants committee. He is currently engaged in research including projects funded by the Wellcome Trust, EU, UK Biotechnology and Biological Sciences Research Council and Medical Research Council.

Dr. Wilhelm Krull

Wilhelm Krull has been Secretary General of the Volkswagen Foundation, Hannover, since 1996. He was DAAD-Lector at the University of Oxford (1980-84); Scientific Administrator at the Wissenschaftsrat's headquarters in Cologne (1985-87); Head of Research Policy Unit at the Wissenschaftsrat's headquarters (1987-93);

Head of Section I at the Max-Planck-Gesellschaft's headquarters in Munich (1993-95). Dr. Krull has been a member of various national and international committees, e.g. the OECD's Group on Scientific and University Research and various panels for the evaluation of European Community R&D programmes.

Professor Karin Markides

Karin Markides is Deputy Director General of Vinnova, the Swedish agency for innovation systems which finances R&D in, and fosters cooperation between, the business, higher education and public sectors. She is Director of Research at the Department of Analytical Chemistry in the University of Uppsala, Sweden, working in areas such as mass spectrometry, nanotechnology and proteomics. Prof. Markides has served on many European and international advisory groups and is a member of the Swedish Royal Academy of Sciences.

Mr. Pat Toole

Pat Toole is retired Senior Vice President of Corporate Manufacturing & Technology of IBM and former President of its systems technology division. He was a founder of the IBM Academy and holds an honorary doctorate from Notre Dame University. He has been actively involved in the American Manufacturing Association, member of the Defense Science Board and director of the American Planning Association. He has lectured in national and foreign universities including Harvard, Columbia and Cornell. He has been active in the promotion of engineering education as an advisory board member at Cornell, Syracuse and Notre Dame Universities. He holds honorary doctorates from the University of Notre Dame and from Dublin City University.

Secretariat

Michael Fitzgibbon and Jacqueline Allan of the Science and Technology Division of Forfás acted as Secretariat to the panel.

2 Terms of Reference for Evaluation of SFI

Introduction

Science Foundation Ireland (SFI) was established in 2000 with an indicative budget of €600 million for the period 2000-2006 and a mission to establish a strong research capability in biotechnology and in ICT in support of the long-term development of enterprise in Ireland.

Since 2001 SFI has gradually ramped up its annual research spending to €65 million in 2003 and over €100 million in 2004. Despite this, and because of the long-term nature of the research it is funding, it is very early to try to measure the impact it is having. Nevertheless, because of the importance of what the SFI is doing for Irish science and technology policy and for future economic development, it is desirable to make an in-depth assessment of progress to date with a view to making any necessary mid-course corrections. The parent ministry and funder of SFI – Enterprise, Trade and Employment – have therefore asked Forfás to arrange for an evaluation of what SFI has achieved to date.

Coverage of the Evaluation

The evaluation of SFI needs to cover three broad areas:

Appropriateness or Efficacy:

- Whether the objectives for SFI are still consistent with the current state of the Irish research system/science base and with national research and innovation policies
- Whether the investment in SFI is appropriate to meet its objectives and what continuing investment will be necessary to sustain it
- Whether there are sufficient and appropriate complementary measures to SFI which would allow the desired economic effects to materialise.

Effectiveness:

- Is SFI effective in meeting its objectives?
- Are its programmes and activities likely to lead to the desired outcomes?
- What are the outputs and impacts of its activities?
- What impact is SFI having on the research system as a whole?

Efficiency:

- Examine the operational efficiency of SFI in relation to a range of relevant issues (e.g. application and review procedures, monitoring).

Evaluation Output

The output of the evaluation shall be a comprehensive report covering all of the issues identified in the previous section.

Evaluation Methodology

The methodology will be determined by the international steering committee for the evaluation under the chairmanship of Professor Richard Brook.

3 Organisations and Individuals Consulted

Organisation	Representative
Department of Enterprise, Trade and Employment	<i>Ned Costello (Assistant Secretary General)</i> <i>Gillian Dennehy (Principal Officer)</i>
Chief Science Adviser	<i>Barry McSweeney</i>
Higher Education Authority	<i>Tom Boland</i> <i>Mary Kerr</i> <i>Eucharía Meehan</i>
Representatives of the Higher Education Sector	<i>Doris Alexander (Research Information Officer, Trinity College Dublin)</i> <i>Jim Browne (Registrar, NUI Galway)</i> <i>Sean Corish (Professor of Chemistry, Trinity College Dublin)</i> <i>Vincent Cunnane (Vice President of Research, University of Limerick)</i> <i>Des FitzGerald (Dean of Research, University College Dublin)</i> <i>Jane Grimson (Vice-Provost, Trinity College Dublin)</i> <i>John Hegarty (Provost, Trinity College Dublin)</i> <i>Michael Horgan (Registrar, Royal College of Surgeons)</i> <i>Conor O'Carroll (CHIU)</i> <i>Albert Pratt (Vice-President, Dublin City University)</i> <i>Ian Robertson (Dean of Research, Trinity College Dublin)</i> <i>Jason Twamley (Dean of Research, NUI Maynooth)</i> <i>Gerard Wrixon (President, University College Cork)</i>
Enterprise Strategy Group	<i>Eoin O'Driscoll (Chairman)</i>
SFI Management	<i>Bill Harris (Director General)</i> <i>Mark Keane (Director, ICT Division)</i> <i>Mattie McCabe (Director, Corporate Affairs)</i> <i>Maurice Treacy (Director, Biotechnology Division)</i> <i>John Wilkinson (Head, Office of Management, Budget & Operations)</i> <i>Eoin O'Sullivan (Special Adviser to Dr. Harris)</i>

Organisation	Representative
SFI Researchers	
	<i>Dermot Diamond (AIC, Vice President of Research, DCU)</i>
	<i>Barry Smyth (AIC, Computer Science, UCD)</i>
	<i>Alan Smeaton (AIC, Computing, DCU)</i>
	<i>Noel O'Connor (AIC, Electronic Engineering, DCU)</i>
	<i>Alex Evans (Agriculture, UCD)</i>
	<i>Pat Lonergan (Agriculture, UCD)</i>
	<i>David MacHugh (Agriculture, UCD)</i>
	<i>John Pethica (CRANN CSET, Nanoscience, Trinity College Dublin)</i>
	<i>Mike Coey (CRANN CSET, Physics, TCD)</i>
	<i>Suzi Jarvis (CRANN CSET, Physics, TCD)</i>
	<i>Igor Shvets (CRANN CSET, Physics, TCD)</i>
	<i>Donald Fitzmaurice (CRANN CSET, Chemistry, UCD)</i>
	<i>Michael Morris (CRANN CSET, Dimensional Solids Group, UCC)</i>
	<i>Paul Townsend (PSR Group, Physics, UCC)</i>
	<i>Andrew Ellis (PSR Group, Physics, UCC)</i>
	<i>Robert Manning (PSR Group, Physics, UCC)</i>
	<i>Fergus Shanahan (APC, Clinical Sciences, Cork Univ. Hospital)</i>
	<i>Liam O'Mahony (APC, BioSciences, UCC)</i>
	<i>Paul O'Toole (APC, Microbiology, UCC)</i>
	<i>Jim Greer (Tyndall National Institute, UCC)</i>
	<i>Colin Hill (BioSciences, UCC)</i>
	<i>Luke O'Neill (Biochemistry, Trinity College Dublin)</i>
	<i>Dolores Cahill (Centre for Human Proteomics, Royal College of Surgeons Ireland)</i>
	<i>Dieter Fensel (DERI CSET, NUI Galway)</i>
	<i>Ciaran Morrison (Biochemistry, NUI Galway)</i>
	<i>Ciaran Regan (Applied Neurotherapeutics, UCD)</i>
	<i>Orla Feely (Electronic Engineering, UCD)</i>
	<i>Kingston Mills (Immunology, TCD)</i>
	<i>Alan Ryder (Biomedical Engineering Science, NUI Galway)</i>
	<i>Tim O'Brien (REMEDI, NUI Galway)</i>

Organisation	Representative
Other SFI researchers and administrative staff	<p><i>Alastair Glass (Director, Tyndall National Institute, Cork)</i></p> <p><i>Frank Barry (Scientific Director REMEDI)</i></p> <p><i>Martin Polcik (Industry Researcher)</i></p> <p><i>Gerald Fitzgerald (Deputy Director APC)</i></p> <p><i>Sally Cudmore (General Manager APC)</i></p> <p><i>Linda Howard (Senior Investigator)</i></p> <p><i>Mary Murphy (Director Toxicology)</i></p> <p><i>Padraig Strappe (Director GMP Mfg.)</i></p> <p><i>Tomas Ritter (Senior Scientist)</i></p> <p><i>Ralf Zwacha (Senior Scientist)</i></p> <p><i>Ketan Mistry (Research Officer)</i></p> <p><i>Oonagh Ward (Lab. Manager)</i></p> <p><i>Catherine McPartlin (Accounts Admin.)</i></p> <p><i>Famina Gunning (Senior Researcher)</i></p> <p><i>Rod Webb (Senior Researcher)</i></p> <p><i>Paul Delaney (Senior Scientist)</i></p> <p><i>Elaine Lawton (Research Associate)</i></p> <p><i>Lorraine Draper (Research Associate)</i></p>
Collaborators	<p><i>Paul Curran, Paul Ross, Ian Dobbie, Des Cunningham, Martin Feely</i></p>
SFI post doctoral researchers	<p><i>Cathal Gurrin, Rod Shepherd, Ed Lavelle, Peter McGuirk, Deirdre Toomey, Kevin Walsh, Padraig Ross, Corrina Brereton, Michael Higgins, Anika Mostaert, Xuelin Yang, Benjamin Cuenot, Giuseppe Talli, Brian Jones, Gillian Gardiner, Giorgos Fagas, Tom Henderson, Victor Bourenkov, Paul Cotter, Denisio Togashi, Patrick Fournet, Andrew Hillman, Udo Greiser, Peter Sloane, Tyrone Bowes, Barry McGrath, Mark Lyons, Michal Zaremba, John Breslin, Laurentiu Vasiliu, Tomas Vitvar, Emer Bourke, Virginie Faure</i></p>
SFI students	<p><i>Ciaran O’Conaire, Karen Church, Lucy Dunne, Oisin Boydell, Paul Ferguson, Philip Kelly, Richard Tynan, Sarah Brady, Shen Song, Wendy McNulty, Roisin Duignan, Ray Flynn, Barry O’Donnell, Stephanos Politis, Emer Condon, Alon Ascoli, Alan Farrell, Tadhg Healy, Robin Giller, Eimear MacHale, Mary McCarthy, Emilio Bravi, JP van Pijkeren, Michelle Cronin, Scott Monaghan, Sean O’Callaghan, Lucy Deegan, Andreas Harth, Sebastien Kruk, Adrian Mocan, Matt Moran, Liam Jeffers, Anna Grabarz, Carol Cooley</i></p>