

**Interim Evaluation of Science
Foundation Ireland Research Centres
Programme**

Submitted to

Science Foundation Ireland

Prepared by

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Executive Summary

Introduction

This independent evaluation report examines the performance to date of the SFI Research Centre's Programme. The evaluation was completed by Indecon International Research Economists who were appointed by SFI to undertake the assignment following a competitive tender.

Science Foundation Ireland funds basic and applied research in the areas of science, technology, engineering and mathematics (STEM) which promotes and assists the development and competitiveness of industry, enterprise and employment in Ireland. Science Foundation Ireland's goals and ambitions are outlined in their strategic plan, 'Agenda 2020'. This plan aims to position Ireland as a global knowledge leader, a society with scientific and engineering at its core, driving economic, social and cultural development.

A key objective of Science Foundation Ireland's Agenda 2020 is to develop a set of world-leading, large-scale Research Centres that will provide major economic impact for Ireland. SFI Research Centres link scientists and engineers in partnerships across academia and industry to address crucial research questions, foster the development of new and existing Irish based technology companies, attract industry that could make an important contribution to Ireland and its economy, and expand educational and career opportunities in Ireland in science and engineering. Twelve SFI Research Centres have been established through an investment of €355 million from Government through Science Foundation Ireland and a further €190 million from industry collaborators. Seven SFI Research Centres were established in 2013 and five more in 2015. Four additional Centres were announced in 2017 and will commence operation towards the end of 2017.

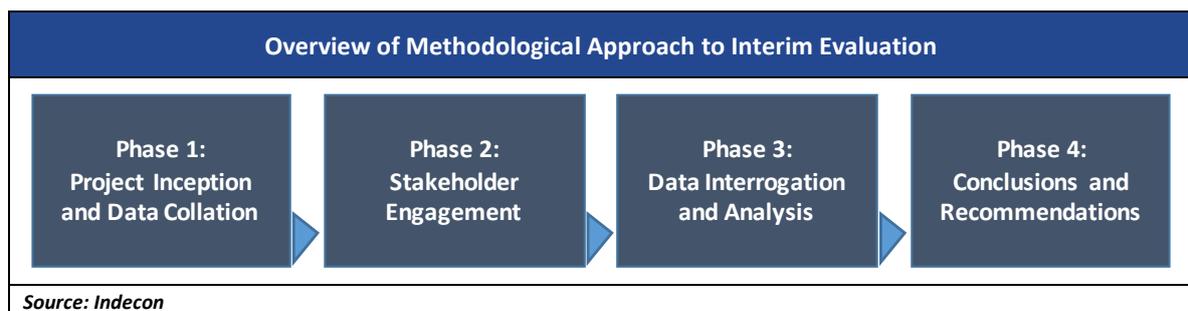
Scope and Methodology of Evaluation

This independent interim evaluation by Indecon examines the first seven established Research Centres covering the period of June 2013 – June 2016 inclusive. In this context, the programme is evaluated in terms of:

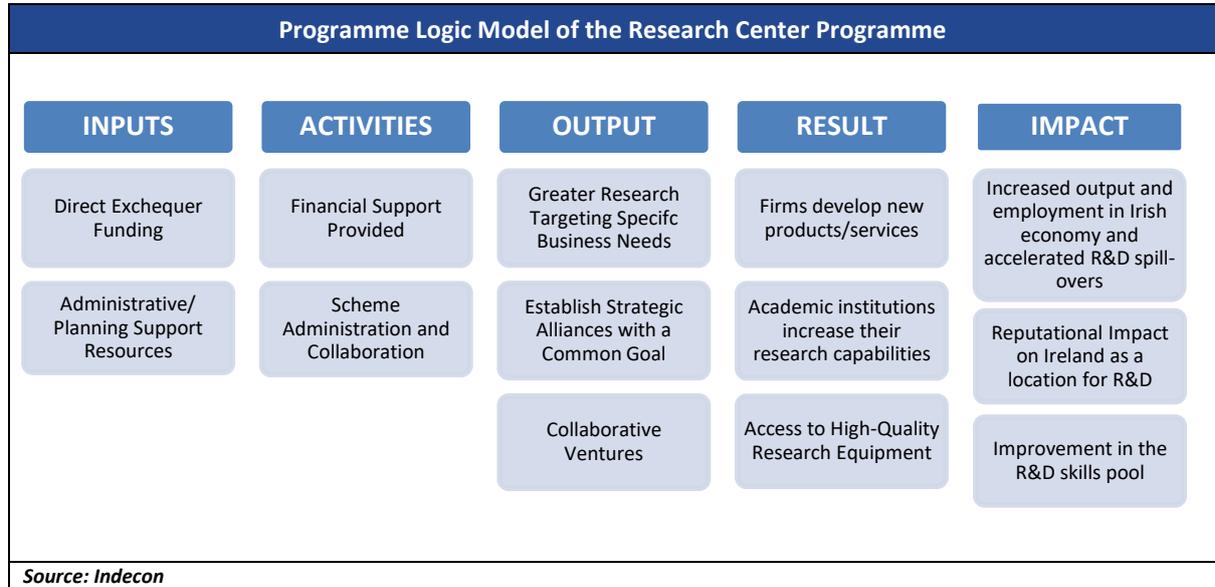
- Programme performance against its stated objectives.
- Programme return-on-investment.
- Adequacy of resources committed to the Research Centres Programme.

As an interim evaluation, the scope of the study as set out in the Invitation to Tender was restricted to a limited predominantly desk-based evaluation. Thus, the evaluation primarily consists of a review and analysis of existing reports and data on the programme. Indecon has also undertaken new empirical matching of SFI data with Annual Business Survey of Economic Impact.

The methodology applied in this assessment is consistent with international best practice, incorporating a conceptual and measurement framework.



The methodology used took account of a programme logic model so the evaluation can be seen in the context of the rationale for the Programme. This programme logic model may be of use to SFI in planning future monitoring of the Research Centres.



Policy and Programme Context

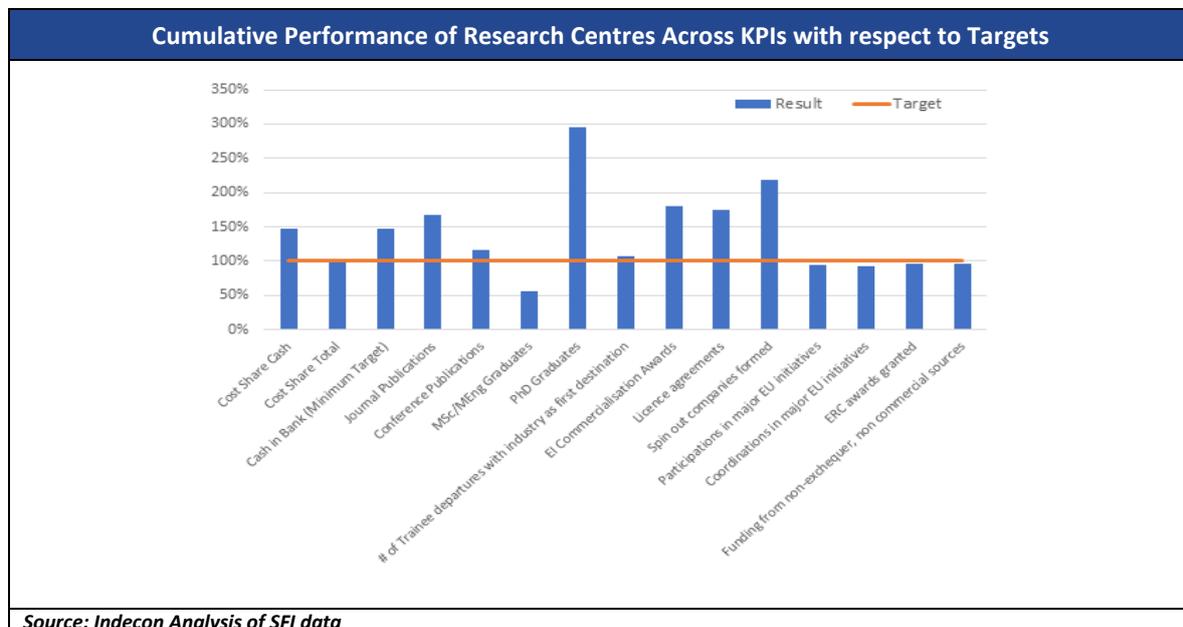
The SFI Research Centres Programme evolved from SFIs Centres Research Science, Engineering and Technology (CSETs) and the Strategic Research Clusters (SRCs). Their establishment and development reflected a number of national policies including Strategy for Science, Technology and Innovation 2006 – 2013, and Innovation 2020. The focus of the Research Centre Programme is consistent with the recommendations of a major Government Research Prioritisation Report. This recommended that Research Centres with a mandate to engage with industry must develop a distinctive industry-focused culture and that a key performance indicator for such Centres should be the percentage of leveraged funding from enterprise. It is useful for this interim evaluation to summarise where the SFI Research Centres fit in the wider RD&I policy interventions in Ireland. The next table shows the range of RD&I supports that are offered in Ireland, which are aimed at building in-company RD&I capacity; accessing RD&I skills; and promoting collaborative research. The SFI Research Centres are focused on collaborative research projects and they also have an important role in assisting companies access RD&I skills.

| Summary of Irish RD&I Policy Interventions | | | | | | | | |
|--|---|-------------------------------------|---|--|---|---|--|--|
| Building in Company RD&I Capacity | | Access to RD&I Skills for Companies | | | Collaborative on Research Projects | | | |
| Tax Incentives | RD&I Grants and Funds | Graduate | Post Graduate Research | Highly Skilled Researcher | New Product or Service Development | Industry Led Research | Stand Alone Research Initiative of Scale | Partnership with World Class Research Centres |
| RD&I Tax Credit Knowledge Development Box | IDA Ireland RD&I Programme & Feasibility Support Enterprise Ireland Business Innovation Initiative Enterprise Ireland RD&I Fund | InterTrade Ireland FUSION Programme | Irish Research Council Employment based Programme Enterprise Partnership Scheme Horizon 2020 Marie Sklodowska Curie Actions | Science Foundation Ireland Industry Fellowships Horizon 2020 Marie Sklodowska Curie Actions | Enterprise Ireland Innovation Vouchers Enterprise Ireland Innovative Partnership Programme | Enterprise Ireland and IDA Technology Centres | Science Foundation Strategic Partnership Programme | Science Foundation Ireland Research Centres Science Foundation Ireland Spokes |

Source: Adopted from Directory of Innovation Supports, Research Centres and Technology Centres 2016, Department of Jobs, Enterprise and Innovation

Programme Performance Vis-à-vis Objectives

Our analysis of the Programme performance against the objectives set as measured by the key performance indicators is summarised in the next table. This shows an impressive achievement in meeting or exceeding nearly all of the targets set. Indecon, however, believes that a number of the performance measurements and targets need to be refined in order to facilitate an accurate assessment of performance. However, Indecon’s analysis of the International Panel assessments confirms that there has been demonstrated progress towards achieving the goals of the Centres.



Our key findings on the Research Centres programme performance are summarised below.

- ❑ The seven Research Centres have established 334 collaborative research projects in the period June 2013 to June 2016, in addition to significant platform/earlier stage research. The year with the highest number of projects commencing was 2014, with 103 projects. The recent nature of the project commencements highlights the fact that the full impacts and returns are only likely to be evident in subsequent years.
- ❑ One of the primary goals of the Research Centres Programme was to increase the level of industrial and commercial investment in R&D activities through undertaking joint research projects with industry. An important indicator in this regard is the amount of private sector co-financing achieved by the Centres. The commitment of cash and in-kind funding is indicative of industry involvement. It directly leverages additional investment expenditure to further the Government's goal of achieving Business Expenditure in Research and Development (BERD). The Research Centres generally out-performed targets when it came to attracting cash funding from industry. In terms of the cumulative percentage industry cost share in terms of cash provided, the evidence presented shows that the Programme exceeded the targets set. This is important, as the Research Prioritisation Report recommended that a key performance indicator for Research Centres should be the percentage of funding leveraged by enterprise.
- ❑ International panels of experts reviewed the Research Centres in 2015 (after two years) and found that most Research Centres had demonstrated significant progress towards achieving all of the respective goals. The KPIs indicated that targets for journal publications were exceeded. However, Indecon believes there is a need to refine the performance measures in order to derive an accurate assessment of the impact of the publications and to focus on top tier journals and citations.
- ❑ In terms of knowledge transfer and skills development, the KPI data focused on the number of graduates at different levels, and the extent to which these found jobs in industry. The KPI data indicated that targets for PhD Graduates were exceeded, though the output of MSc/MEng Graduates fell short.
- ❑ In terms of public engagement and outreach, the international review panels reported that the Research Centres Programme had in more than half of the cases demonstrated outstanding impact and systematic delivery of education and public engagement.
- ❑ Cumulative funding from non-Exchequer, non-commercial sources such as the EU was slightly below the target level but the results highlight the success of the Centres in securing income of €68 million from this source. Given the possible opportunities for securing a greater share of EU research budgets in a post Brexit environment, this is an important indicator.

Programme Return on Investment

Data to enable the estimation of the return on investment of SFI Research Centres is not captured in the existing performance indicators or other data available for this interim evaluation. A comprehensive examination of the return on investment would require detailed empirical primary research with the companies interacting with the Research Centres. However, Indecon have assembled evidence which is of use in deriving interim judgements on this issue. Indecon notes that the return on the investment are likely to be only evident after a number of years and this should be considered as part of the subsequent evaluation of the Programme. Our key findings are summarised below:

- ❑ International evidence on the returns to R&D investment show high level of returns to R&D in many countries. It is useful to consider some illustrative potential returns if the returns evident in other countries are subsequently achieved by these Centres. Applying a conservative estimate of the rate of return of 15%, which is significantly lower than most international estimates thus representing a lower bound, would suggest that the expenditure by Science Foundation Ireland from 2013 to June 2016 on the first wave of seven Research Centres has the potential to result in approximately €13m per annum in terms of economic benefits. These benefits are, however, only likely to be achieved over time. The validity of this indicative estimate should be examined as part of a more

comprehensive evaluation of the SFI Research Centres based on extensive primary research and detailed econometric modelling.

- ❑ The returns on the investment in the Research Centres will be influenced by level of interaction with the internationally traded sectors in Ireland. New analysis undertaken by Indecon indicates that the Research Centres have been successful in collaborating with Irish-owned firms (45% of the total), as well as foreign-owned firms (55% of the total). Research Centres have also successfully engaged with a broad range of firms, including a significant number of SMEs. Of the firms who participate in Research Centres, one-third are large (>250 employees), though more than two in five (42%) are classed as small (<50 employees).
- ❑ One of the potential drivers of the Programme return on investment is the extent of subsequent commercialisation of the research. This in part can be seen from the levels of participation in the Enterprise Ireland Commercialisation Awards and targets for this were generally exceeded, as were the number of licenses. However, no information was available on the value of these licences or what subsequent economic activity may emerge from the licences. The number of spin-out companies achieved also exceeded the targets set.
- ❑ The international review panels found that each of the seven Research Centres had demonstrated significant or outstanding impact with the potential for further impacts.

Adequacy of Resources Committed to the Research Centre Programme

The adequacy of resources committed to the Research Centre Programme must be considered in the context of the objectives set and the overall level of investment by the state in RD&I. During the recessionary period Ireland continued to invest significant public expenditure as percentage of GDP on R&D supports. It is, however, noteworthy that Ireland's public expenditure in this area is below the levels evident in some of best R&D performing countries such as Sweden and Denmark and is also below the UK.¹ Within the overall RD&I spend, SFI has contributed €91.4m to June 2016 to the Seven Research Centres. When account is taken of industry and other contributions the evidence shows that overall €196.6m in resources has been committed to the Research Centres examined. Our interim evaluation supports the ongoing funding of the Centres but funding is not the main constraint on the existing Centres at this stage. Our key findings on the adequacy of these resources are summarised below:

- ❑ Despite recent increases in expenditure on RD&I, the RD&I performance of the enterprise base in Ireland is below selected comparator countries. The annual EU Innovation Union Scoreboard describes Ireland as an 'Innovation Follower' amongst its EU27 peer group, with an overall innovation performance close to the average for the EU Member states; this is behind the innovation leader including Denmark, Finland, Germany and Sweden.
- ❑ An issue for Ireland is whether the existing public resources committed to RD&I including the resources committed to the SFI Research Centres are adequate to achieve the objectives set in Innovation 2020 and in particular to the target of 2.5% of GNP, and to develop Ireland as an 'Innovation Leader'.
- ❑ The adequacy of resources for interventions such as the Research Centres is also influenced by the levels of business R&D expenditures which have grown significantly as a percentage of GDP in Ireland in the period 2008 – 2015. While some other countries such as Sweden and Denmark invest significantly more than Ireland in business R&D expenditures, Ireland now exceeds the levels in the UK. It is important that R&D supports continue to be structured in a way which leverages businesses investment in R&D. Achieving strong leverage with industry is one of the strengths of the Research Centres.

¹ In 2017, the European Semester Country Report for Ireland indicated a GERD as a % of GDP ranking of 25th out of 28.

- ❑ The international panels in their reviews of Research Centres judged that constraints other than funding were of key importance.
- ❑ Indecon independent assessment of the wide consultation undertaken is that there are limits in the ability of the individual Research Centres to absorb significant additional resources in the immediate future given the following:
 - The need to meet the industry co-funding targets as set down by SFI;
 - The limited number of companies in Ireland who have the scale and reach to engage in the long-run collaborative research that is core to the Research Centres model;
 - The challenge of recruiting appropriately trained and skilled research staff of a very high calibre.
- ❑ Our analysis suggests that while additional resources are not recommended at this stage reducing the level of funding to the Research Centre Programme would be a mistake.

Recommendations

Indecon recommendations are designed to support the ongoing achievements of the Research Centres Programme and to enhance the impact of the Programme. The recommendations are presented in the table below and are elaborated upon overleaf.

| Summary of Recommendations |
|---|
| 1: Ireland should continue to provide funding to support the Research Centres Programme |
| 2: Continued emphasis should be given to the transfer of skills from Research Centres to enterprise |
| 3: Performance indicators on scientific impact should be refined |
| 4: Significant additional evidence should be collected to facilitate measurement of economic returns |

1: Ireland should continue to provide funding to support the Research Centres Programme

The evidence examined in this interim evaluation indicates that the Research Centres Programme has been impressive in meeting the targets set. The seven Research Centres have initiated a significant number of collaborative research projects involving a spectrum of Irish-owned and foreign-owned firms. They have also leveraged €19m in cash from industry and €18.7m in other industry contributions in addition to €68m from other sources. In the context of the need for investment in the RD&I capacity of Ireland, we believe that the Research Centres Programme should continue to be supported and given adequate resources to ensure the long-term benefits of the support are gained. The recent report² of the independent High-Level Group on maximising the impact of EU Research and Innovation Programmes concluded that at an EU level “reducing the overall level of RD&I investment would be a mistake and a clear reversal of progress”. Indecon believes this is also valid in the context of the resources allocated to Research Centres given the performance to date of these Centres. This is particularly relevant given the need to ensure that Ireland’s R&D offering is aligned with competitors.

Indecon, however, did not as part of this interim evaluation have sufficient evidence to recommend any increase in resources for these Centres. From the wide consultation undertaken by Indecon for this review, it arose that there are significant constraints in the ability of the existing Centres to effectively absorb any significant additional Exchequer resources in the short-term, due to the need to secure co-funding from industry and the difficulties in attracting suitable skilled researchers. There may however be merit over time in considering additional Centres or an expansion of existing Centres if an identified need to address market failures is established. Any such investment should, however, be based on the findings of an independent cost benefit appraisal and should be undertaken on a case by case basis.

2: Continued emphasis should be given to the transfer of skills from Research Centres to enterprise

As outlined in the LAB-FAB-APP Report (op cited), research “**is necessary, but not sufficient to fuel innovation**”. Indecon believes that the transfer of skills from Research Centres to internationally traded businesses is one important vehicle by which research investment can translate into economic impacts and can support innovation. Indecon’s engagement with industry representative bodies highlighted the importance placed on the flow of skilled researchers from the SFI Research Centres programme. The KPIs data shows that the number of masters graduates each semester fell short of target for a number of the Research Centres, though the number of PhDs produced exceeded targets. The continued importance of a skill transfer to enterprise should be emphasised. The creation of a pool of highly skilled researchers is one of the benefits of public funding. This objective merits continued emphasis given the need to increase R&D investment by businesses and the critical role of skills in enhancing the absorptive capacity of firms to undertake such research.

3: Performance indicators on scientific impact should be refined

The Research Centres inter alia monitor scientific impact performance in terms of the number of publications and the number of conference publications. Indecon believes the existing performance measures are not adequate and should be refined. In particular we recommend that measures based on detailed bibliometric analysis should be undertaken focusing on the number of publications in the top 5% of journals by quality (journal impact factor), combined with measures based on field weighted citation indices or other citation-based metrics. These should only include publications resulting from work directly funded by the Research Centres. This recommendation is consistent with the views of a number of International Panel assessments of the Research Centres where, for example, it was indicated that “The total number of publications is not information as to the scientific quality of the Centre”. In another case the Panel indicated it was impossible to assess the impact of publications because there was very little information provided and they recommended

² LAB-FAB-APP: Investing in the European Future we Want, Report of the Independent High Level Group on Maximising the Impact of EU Research and Innovation Programmes. European Commission DG for Research and Innovation 2017

that information on impact factor for the journal should be monitored. Given that the importance of top tier journals was explicitly included in the objectives set for the Research Centre Programme we recommend that this change is implemented as soon as feasible.

4: Additional evidence should be collected to facilitate measurement of economic returns

The existing information and evidence collected by the Research Centres is not sufficient to enable a rigorous evaluation of the economic returns on the investment. In advance of a subsequent evaluation of the Centres it is important that systems are now put in place to collect the evidence to facilitate measurement of economic returns. This will need to take account of the necessity to undertake a counterfactual analysis and to provide evidence on the role of the Centres in generating licences or spin-off companies which result in measurable economic activity. A recommendation from the recent LAB-FAB-APP report concerned the need to design R&I programmes for greater impact and that they should present the results and impacts that are expected to be achieved within specified timescales. The SFI Research Centres Programme has already structured the Research Centre Programme in this way with detailed targets and measurement of performance indicators. However, in line with a commitment to have an evidence based approach to evaluating impacts there is a need for additional information to be collected to facilitate the measurement of the economic return on the investment in the Centres.

Conclusions

This interim evaluation suggests that the Research Centre Programme has met or exceeded most of the targets set. They have been successful in leveraging additional resources from industry and other sources. The Programme is aligned with the national objectives set for RD&I and the Centres have the potential to make additional contributions to the internationally traded sectors of the Irish economy. There is however a need for refinement in the performance indicators and in the collection of the evidence needed to monitor the subsequent returns of the Centre's activities. Our recommendations are designed to assist SFI in having an evidence base to measure the impacts of the Research Centre Programme.

1 Introduction, Scope and Methodology

1.1 Introduction and Background

This independent interim evaluation examines the performance to date of the SFI Research Centres Programme. The evaluation was completed by Indecon International Research Economists who were appointed by SFI to undertake the assignment following a competitive tender.

Science Foundation Ireland funds basic and applied research in the areas of science, technology, engineering and mathematics (STEM) which promotes and assists the development and competitiveness of industry, enterprise and employment in Ireland. The Foundation also promotes and supports the study of education in and engagement with STEM and promotes an awareness and understanding of the value of STEM to society and in particular to the growth of the economy.

Science Foundation Ireland's goals and ambitions are outlined in their strategic plan, 'Agenda 2020'. This plan aims to position Ireland as a global knowledge leader, a society with scientific and engineering at its core, driving economic, social and cultural development.

A key objective of Science Foundation Ireland's Agenda 2020 is to develop a set of world-leading, large-scale Research Centres that will provide major economic impact for Ireland. SFI Research Centres link scientists and engineers in partnerships across academia and industry to address crucial research questions, foster the development of new and existing Irish based technology companies, attract industry that could make an important contribution to Ireland and its economy, and expand educational and career opportunities in Ireland in science and engineering.

Sixteen SFI Research Centres have been established through an investment from Government through Science Foundation Ireland and from industry collaborators. After an extensive review for scientific excellence and impact the first seven Research Centres were established in 2013. Five Research Centres were funded in 2014 and commenced operations in early 2015. Four additional Research Centres will begin late 2017. This interim evaluation is restricted to the first seven established Centres.

These 12 SFI Research Centres are focused on strategic areas of importance to Ireland with a focus on delivering scientific excellence with economic and societal impact – Pharma, Big Data, Medical Devices, Nanotechnology/Materials, Marine Renewable Energy, Food for Health/Functional Foods, Perinatal Research, Applied Geosciences, Software, Digital Content, Telecommunications and Medical Devices.

A list of Research Centres is presented in Table 1.1, with the seven Centres which are within the scope of this interim evaluation highlighted in blue.

| Table 1.1: Science Foundation Ireland - Research Centres | |
|---|---|
| Centre | Host Institute |
| ADAPT: Centre for Digital Content and Media Innovation | UCD, DCU, DIT, TCD |
| AMBER: Advanced Materials & BioEngineering Research | TCD, RCSI, UCC |
| APC Microbiome Institute | UCC, Teagasc, CIT |
| CONNECT: Centre for Future Networks & Communications | TCD, CIT, NUIM, DIT, Tyndall, UCC, DCU, UL, UCD |
| CÚRAM: Centre for Research in Medical Devices | NUIG, UCC, UCD, RCSI, UL, TCD |
| iCRAG: Irish Centre for Research in Applied Geosciences | UCD, TCD, Teagasc, NUIG, UCC, NUIM, DIAS |
| INFANT: Irish Centre for Foetal & Neonatal Translational Research | UCC, RCSI |
| INSIGHT: The Insight Centre for Data Analytics | NUIG, DCU, UCC, UCD, NUIM, TCD, Tyndall |
| IPIC: Irish Photonic Integration Centre | DCU, CIT, Tyndall, UCC |
| Lero: The Irish Research Software Centre | DCU, NUIG, DIT, UCD, TCD, UL, UCC, NUIM |
| MaREI: Marine Renewable Energy Ireland Centre | UCC, CIT, UCD, UL, NUIG, NUIM |
| SSPC: Synthesis and Solid State Pharmaceutical Centre | DCU, AIT, UCD, UL, TCD, UCC, WIT, NUIG |
| Source: SFI. The 7 Research Centres to be analysed in this evaluation are shown as shaded. | |

The objectives of the Research Centres Programme are outlined below:

- ❑ To achieve, maintain and enhance research excellence and leadership, as measured through indicators such as publication in top-tier journals and conferences, citations, editorship of top-tier journals and giving invited lectures at top-tier conferences.
- ❑ To deliver significant economic and societal impact – research excellence with impact – which will be aligned with areas of strategic opportunity for Ireland, including the 14 National Research Priority areas and including the six broad enterprise themes (ICT, manufacturing and materials, health and medical, food, energy and services and business processes) outlined in Innovation 2020 – Ireland’s Strategy for Research and Development, Science and Technology.
- ❑ To increase the level of industrial and commercial investment in R&D activities with existing Ireland-based companies, and furthermore to attract large Foreign Direct Investments in corporate R&D laboratories.
- ❑ To spin out new, high technology start-up companies that have the potential to raise external angel or venture funding.
- ❑ To transfer technology, through licences, to Multinational Companies (MNCs) and Small and Medium Enterprises (SMEs) based in Ireland.
- ❑ To transfer knowledge, expertise and know-how to MNCs and SMEs based in Ireland.
- ❑ To undertake joint research projects with industry.
- ❑ To inspire the future generation of STEM students and train and educate a cohort of engineers and scientists at MSc/MEng/PhD and post-doctoral level that will take up high value employment in MNCs and SMEs based in Ireland.
- ❑ To attract additional non-Exchequer funding through industry sources and external research funding organisations.
- ❑ To engage the general public and equip them with the tools to confidently understand and debate science, technology and engineering research in Ireland.

1.2 Scope and Methodology of Evaluation

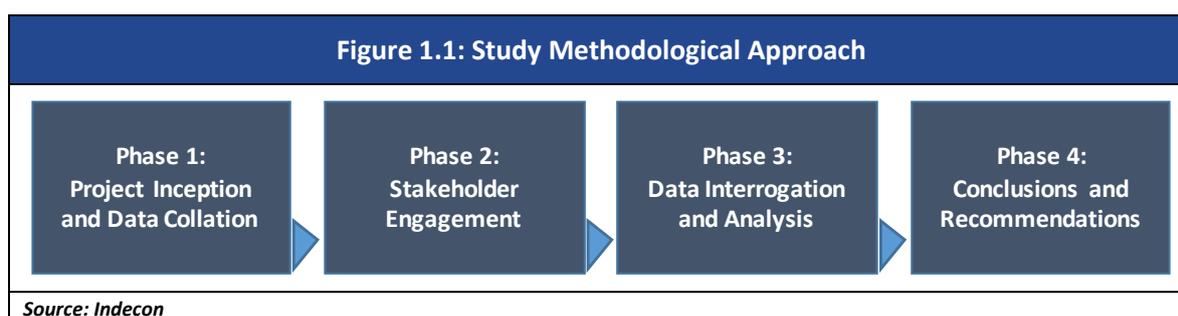
The overall aim of this interim evaluation is to assess the appropriateness and effectiveness of the Research Centres Programme. In this context, the programme is evaluated in terms of:

- ❑ Programme performance against its stated objectives.
- ❑ Programme return on investment and the related issue of value for money.
- ❑ Adequacy of resources committed to the Research Centres Programme.

As this is an interim evaluation the scope of the study was restricted to an interim economic impact analysis based on a predominantly desk-based evaluation in line with the invitation to tender. Thus, the evaluation primarily consists of a review and analysis of existing reports and data on the programme and does not discuss wider societal impacts. Indecon has undertaken new empirical matching of SFI data with Annual Business Survey of Economic Impact. A comprehensive evaluation of non-economic impacts is outside the scope of this interim review; given that social impacts take considerable time to materialise, Indecon suggests a full impact analysis will not be possible before ten years after programme inception.

Due to lack of data, this interim review report does not discuss in detail outreach and public engagement. Indecon suggests that an appropriate data collection is undertaken which ensures that outreach and public engagement can be measured in the future. This may include, for instance, tracking the use of social media to stimulate public engagement. As has been noted in the context of the International Review Panels, the use of web analytics would help understand the profile of visitors, allowing more effective engagement plans.

Figure 1.1 presents a schematic summary of the methodology and work programme applied in completing this study. The methodology applied in this assessment is consistent with international best practice, incorporating a conceptual and measurement framework.



The methodology used took account of a programme logic model so the evaluation can be seen in the context of the rationale for the programme. A Programme Logic Model outlines how the inputs and activities can lead to outputs and impacts. Reading a logic model means following the chain of reasoning, in other words the “If...then...” statements which connect the programme’s parts. For example, *inputs* are the resources needed to operate a programme. If you have access to them, they can be used to accomplish planned *activities*. If these are accomplished, then the output of product and/or service will be achieved, which will benefit participants in certain ways. If these direct benefits to participants are achieved, then certain economic or other impacts might be expected to occur.³ The main elements of the programme logic model link the high-level ‘intervention logic’ of

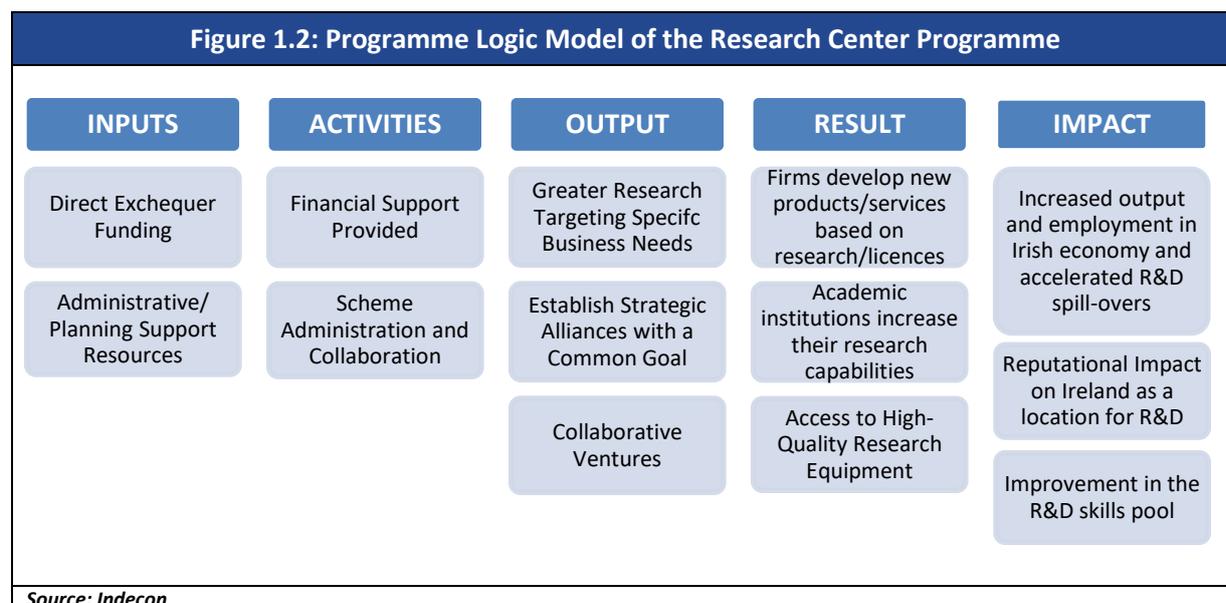
³ <http://www.smartgivers.org/uploads/logicmodelguidepdf.pdf>

the schemes to their actual operational implementation. The programme logic model builds on the following structure:

- ❑ *Input:* Resources dedicated to the programme;
- ❑ *Activity:* What the programme does with the inputs in pursuit of its objectives;
- ❑ *Output:* Intended direct outputs of programme activities;
- ❑ *Result:* The effects of the outputs on the targeted beneficiaries;
- ❑ *Impact:* Wider effects of the programme.

A programme-logic model for the Research Centres Programme developed by Indecon is presented in Figure 1.2. This model may be of use by SFI in the future in the planning of the monitoring and comprehensive evaluation of the Research Centres. The ‘inputs’ required for this programmes constitute Exchequer funding and administrative support provided by SFI and within Research Centres/HEIs for the administration and oversight (as appropriate) of the Research Centres. The inputs committed to create the Research Centre Programme (i.e., the ‘activities’) can then be offered to firms and research institutions. The outputs of the programme is reflected in the level of take-up for each of the supports, for example, the number of collaborative ventures and the scale/nature of these ventures. In this context, it is of note that recent research indicates that a large proportion of companies collaborate with higher education institutes in the area of R&D.⁴ The ‘results’ represent the direct impact on the beneficiaries. In the case of supports targeted at collaborative ventures, there are multiple direct beneficiaries: the firms that choose to collaborate with each other, and the academic institutions that also participate in the collaboration.

As with all programmes which support RD&I skills, the ‘impact’ of these programmes should lead to much greater potential for R&D spill-overs, externalities are greater as the knowledge has potential to spread across individual researchers, the academic institutions they are linked to, and the firms. These impacts are also likely to be seen in higher levels of output, employment and investment in the Irish economy.



⁴ 35% of 259 firms surveyed. National Employer Survey – Employer’s views on Irish further and Higher Education and Training Outcomes. Higher Education Authority, May 2015.

In completing this report, Indecon utilised a range of existing data on the operation of Research Centres, and of the characteristics of the firms who engage in Research Centres. These include:

- SFI Key Performance Indicators;
- Annual Business Survey of Economic Impact (ABSEI) Database;
- Half yearly Governance Reports;
- Research Centres Annual Reports
- Two-Year Progress Site Review Reports
- Report of the SFI Advisory Committee on Centre Governance.

In addition to the analysis of data, Indecon also conducted a stakeholder engagement process. This included inputs from:

- Interviews with senior management in Research Centres;
- American Chamber of Commerce Ireland’s Research, Development and Innovation Leadership Forum;
- IBEC Innovation Policy Committee;
- Enterprise Ireland; and
- IDA (Ireland).

All of the above consultations were undertaken on a confidential basis. These engagements were very helpful in understanding the context for the assessment, but the conclusions and recommendations are Indecon’s and are based on the empirical evidence examined.

1.3 Report Structure

The remainder of this report is structured as follows:

- Section 2 sets out the policy and programme context;
- Section 3 assess the Programme performance vis a vis the objectives set;
- Section 4 considers the return on investment;
- Section 5 assesses the adequacy of resources;
- Section 6 presents Indecon’s recommendations.

1.4 Acknowledgements and Disclaimer

Indecon would like to acknowledge the valuable inputs of officials from Science Foundation Ireland. Particular thanks are due to Dr Ruth Freeman, Dr Darren Morrissey, Dr Peter Clifford, Dr Kevin J Fraser, Dr Louise Maher and Dr Roisin Cheshire. We obtained valuable inputs from the Research Centres, as well as from other business stakeholders that were consulted as part of this interim review. These included officials in the American Chamber of Commerce Ireland's Research, Development and Innovation Leadership Forum, and IBEC. Thanks also due to helpful inputs from Leo Clancy in IDA (Ireland), and Gearoid Mooney of Enterprise Ireland.

The usual disclaimer applies and the views and analyses contained in this report are the sole responsibility of Indecon.

2 Policy and Programme Context

2.1 Introduction

In this section, we set out the national policy context for the introduction of the Research Centres. The SFI Research Centres Programme evolved from SFI's Centres for Science Engineering and Technology (CSETs), and the Strategic Research Clusters (SRCs). Their establishment and development is aligned with a number of national policies including the Strategy for Science, Technology and Innovation 2006 – 2013, and Innovation 2020.

The focus of the Research Centre Programme is also consistent with the recommendations of a major Government Research Prioritisation Report. The Research Prioritisation Steering Group set out a number of recommendations aimed at improving the efficiency and effectiveness of the research and innovation system, three of which are of particular relevance to the Research Centres Programme. These recommendations included⁵:

- ❑ Research Centres with a mandate to engage with industry must develop a distinctive industry-focused culture. They should have the breadth of multidisciplinary research activity and the range of expertise (including business development skills) to partner with industry. It was also recommended that a key performance indicator for such Centres should be the proportion of funding leveraged from enterprise. (Indecon notes that this recommendation was reflected in the objectives and targets set for the Research Centres Programme)
- ❑ Applications for funding under the priority areas should require at least a two-stage process. The applications should be screened based on demonstrated relevance to the priority areas, clarity of deliverables and, where appropriate, end-user engagement. Applications that pass the test of relevance to the priority area should be reviewed against the criteria of excellence and originality based on established peer review processes. (Indecon notes that SFI run a 2-step international peer review evaluation process, focusing on the excellence of science, and potential impact.)
- ❑ There should be an ongoing review of all funding programmes to ensure continued relevance and clarity of purpose, that programmes have sufficient scale and that unnecessary duplication is avoided. The reviews should ensure that the costs of the programme are commensurate with the benefits achieved. New programmes should be avoided if the objectives can be achieved through the adaptation of existing programmes. (This interim evaluation and the work of the International Panels is a recognition by SFI of the importance of such evaluations.)

Overall, the Research Centres Programme has been structured following the recommendations from the Government Research Prioritisation Report. All seven Centres are in the 14 National Research Priority Areas.

⁵ Report of the Research Prioritisation Steering Group, 2011.

2.2 R&D Support Programmes

It is useful for this evaluation to summarise where the SFI Research Centres fit in the wider RD&I policy interventions in Ireland. Table 2.1 shows the range of RD&I supports that are offered in Ireland. There are three main objectives of RD&I policy interventions, as follows: (i) building in-company RD&I capacity; (ii) accessing RD&I skills; and (iii) promoting collaborative research projects. Fostering collaborative and strategic partnerships plays a key role in Ireland's support for RD&I through the matching of R&D-focused business needs with institutions, researchers or other firms. SFI Research Centres are focused on such collaborative research as well as assisting companies to access RD&I skills.

| Table 2.1: Summary of Irish RD&I Policy Interventions | | | | | | | | |
|---|--|-------------------------------------|---|---|---|---|--|---|
| Building in Company RD&I Capacity | | Access to RD&I Skills for Companies | | | Collaborative on Research Projects | | | |
| Tax Incentives | RD&I Grants and Funds | Graduate | Post Graduate Research | Highly Skilled Researcher | New Product or Service Development | Industry Led Research | Stand Alone Research Initiative of Scale | Partnership with World Class Research Centres |
| RD&I Tax Credit | IDA Ireland RD&I Programme and Feasibility Support | InterTrade Ireland FUSION Programme | Irish Research Council Employment based Programme | Science Foundation Ireland Industry Fellowships | Enterprise Ireland Innovation Vouchers | Enterprise Ireland and IDA Technology Centres | Science Foundation Strategic Partnership Programme | Science Foundation Ireland Research Centres |
| Knowledge Development Box | Enterprise Ireland Business Innovation Initiative | | Enterprise Partnership Scheme | Horizon 2020 Marie Sklodowska Curie Actions | Enterprise Ireland Innovative Partnership Programme | | | Science Foundation Ireland Spokes |
| | Enterprise Ireland RD&I Fund | | Horizon 2020 Marie Sklodowska Curie Actions | | | | | |

Source: Adopted from Directory of Innovation Supports, Research Centres and Technology Centres 2016, Department of Jobs, Enterprise and Innovation

2.3 Summary of Findings

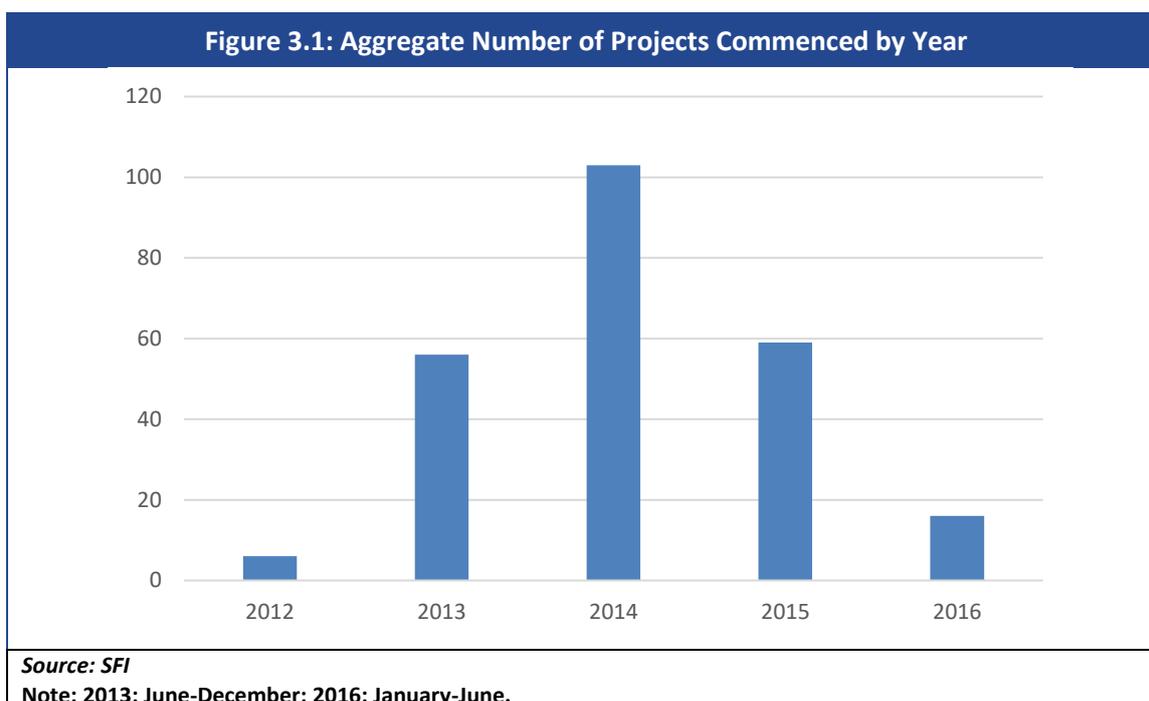
Our key findings on the national policy context for the introduction of the Research Centres Programme are summarised below:

- ❑ The SFI Research Centres Programme evolved from SFIs Centres Research Science, Engineering and Technology (CSETs) and the Strategic Research Clusters (SRCs). Their establishment and development reflected a number of national policies including Strategy for Science, Technology and Innovation 2006 – 2013, and Innovation 2020.
- ❑ The focus of the Research Centre Programme is consistent with the recommendations of a major Research Prioritisation Report. This recommended that research Centres with a mandate to engage with industry must develop a distinctive industry-focused culture and that a key performance indicator for such Centres should be the percentage of leveraged funding from enterprise.
- ❑ The SFI Research Centres are an integral part of the wider RD&I policy interventions in Ireland. The Research Centres are focused on two of the three main objectives of RD&I interventions, namely promotion of collaborative skills, and in assisting companies access RD&I skills.

3 Programme Performance Vis-à-vis Objectives

3.1 Introduction

In this chapter, we examine the evidence on the Programme performance against the objectives set as measured by the performance indicators. (KPIs) An analysis of the KPIs on the impacts of the Programme is included in the next chapter which considers the return on investments. In examining performance, it is useful as context to highlight the number of projects commenced by the Research Centres. In total, the Research Centres established 334 collaborative projects over the period, in addition to significant platform/earlier stage research.⁶ It should be noted that projects can span a number of years. The data in Figure 3.1 indicates that most of the projects commenced in 2014. This suggests that the full impacts and returns on investments are only likely to be evident in subsequent years.



As part of our review we also examined if the Research Centres Programme is consistent with, and supports, Ireland's national policy objectives. *Innovation 2020*, Ireland's strategy for research, development, science and technology, sets out the Government's commitment to supporting greater engagement in RD&I in both indigenous and foreign-owned enterprises and in both SMEs and large-scale enterprises. This strategy, which was launched in 2015, set a target for RD&I for Ireland at 2.5% of GNP. The European Union's research and innovation policy agenda states that the EU should spend 3% of gross domestic product (GDP) on RD&I, two-thirds of which should come from the private sector. The overall strategy also included a target to double private funding of publicly performed R&D to €48m per annum. In order to assess the performance of Research

⁶ At least 30% of the SFI funding is required to be spent in platform/early stage research.

Centres against this target, we compare private funding raised in the first year of the strategic period with private funding raised in the last year before the strategic period. Between June 2015 and June 2016, the seven Research Centres attracted €9.6m of cash funding, which represented an increase of 159% on the €3.7m received in the period June 2013 – June 2014. While it is still too early to say if the target of doubling the private funding of publicly performed R&D to €48m per annum will be achieved by 2020, the evidence to mid-2016 suggests that Research Centres will contribute to meeting this target.

3.2 Key Performance Indicators (KPIs)

SFI identified 15 key performance indicators to align with the objectives of the Research Centres programme and with SFI's Agenda 2020. Research Centres were then asked to develop a set of targets against these KPIs for each calendar year of operation of the Research Centre. These targets were then agreed in discussion with SFI and were subject to periodic updating following developments such as the securing of an SFI Spokes award or on the advice of external evaluation panels. There are 15 KPIs against which the Research Centres were asked to set annual targets. The Research Centres report twice a year on progress against their target KPIs. The key performance indicators used to evaluate performance against the objectives set are presented in the table below.

| Table 3.1: Science Foundation Ireland Research Centres - KPIs | | |
|---|------|---|
| Objective | KPIs | |
| Objective 1: Industry Partnerships | 1 | % Industry Cost Share (cash) |
| | 2 | % Industry Cost Share (total) |
| | 3 | Cash in Bank |
| Objective 2: Excellence in Science | 4 | Journal Publications |
| | 5 | Conference Publications |
| Objective 3: Skills | 6 | MSc/MEng Graduates |
| | 7 | # PhD Graduates |
| | 8 | % Trainee departures with industry as first destination |
| Objective 4: Impacts | 9 | # EI commercialisation awards |
| | 10 | # licence agreements |
| | 11 | # spin out companies formed |
| Objective 5: Leveraged Funding | 12 | # participations in major EU initiatives |
| | 13 | # coordinations in major EU initiatives |
| | 14 | # ERC awards granted |
| | 15 | Funding from non-exchequer, non-commercial sources |
| <i>Source: SFI/Indecon</i> | | |

3.3 Industry Partnerships

The Research Centres Programme has a number of objectives which directly relate to the need to establish industry partnerships. In particular:

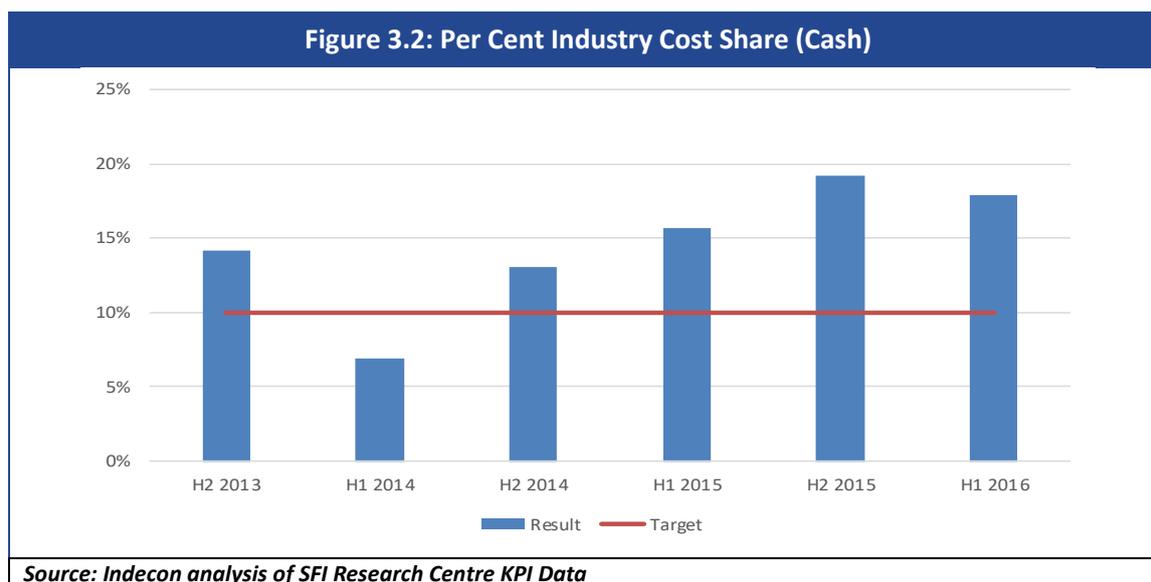
- To increase the level of industrial and commercial investment in R&D activities with existing Ireland-based companies, and furthermore to attract large Foreign Direct Investments in corporate R&D laboratories;
- To spin out new, high-technology start-up companies that have the potential to raise external angel or venture funding;
- To transfer technology, through licences, to Multinational Companies (MNCs) and Small and Medium Enterprises (SMEs) based in Ireland;
- To transfer knowledge, expertise and know-how to MNCs and SMEs based in Ireland; and
- To undertake joint research projects with industry.

There are three KPIs which have been used by SFI to measure the extent of industry partnerships. These focus on the percentage of the cost share of collaborative projects born by industry, whether in terms of cash, or in terms of cash plus in-kind. Indecon believes these performance indicators are of significance. Further refinement of these could usefully focus on directly measuring progress towards achieving the objectives such as increasing the level of industrial and commercial investment and the extent and value of technology transfers. This would facilitate the measurement of the return on investment.

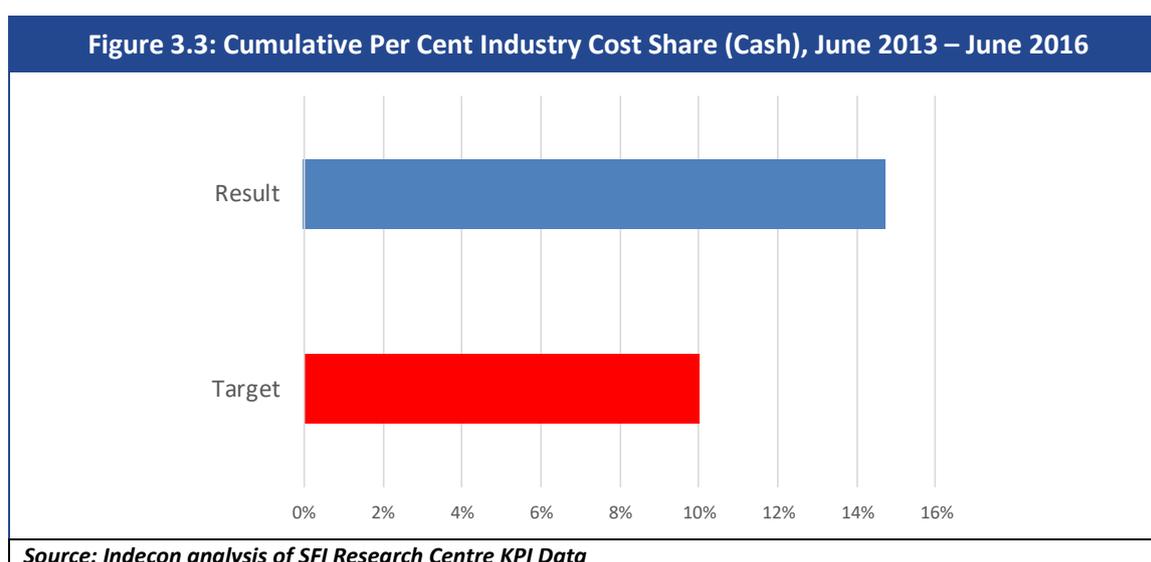
KPI 1 - % Industry Cost Share (cash)

The SFI Research Centres are mandated to maintain a minimum cost share of not less than 10% cash and not less than 30% in total (cash and in-kind) for each individual calendar year of the award. The Research Centre budget is defined as comprising three parts: an SFI contribution (direct costs), an industry cash contribution (direct costs) and an industry in-kind contribution.

The Research Centres generally out-performed targets when it came to attracting cash funding from industry. The aggregate performance of the programme against targets in terms of cash share contributed by industry is shown in Figure 3.2. The industry cost share for the seven Research Centres is plotted along the 10% target. In every half-year except the first-half of 2014, the aggregate result exceeded the target and at most two Research Centres missed the biannual target on an individual basis. It should be noted that the average result for the full year 2014 was 10%, thus meeting the yearly target for that year. In some cases, the success of Centres in securing funding from industry has been very successful. For example, one of the International Panels noted that **“The funding from the industrial partners has been quite remarkable”**. The average cost share appears to be on an increasing path since 2014 in cumulative terms.



In terms of the cumulative percentage industry cost share in terms of cash provided, the evidence presented in Figure 3.3 shows that the Programme exceeded the targets set. This is important as the Research Prioritisation Report recommended that a key performance indicator for Research Centres should be the percentage of funding leveraged by enterprise.



KPI 2 - % Industry Share (total)

The Research Centres initially fell short of target in terms of the percentage of cash plus in-kind contributions from industry, though this target was met in the periods from June 2014 to June 2016. The per cent total industry contribution – cash and in-kind – is shown in Figure 3.4.

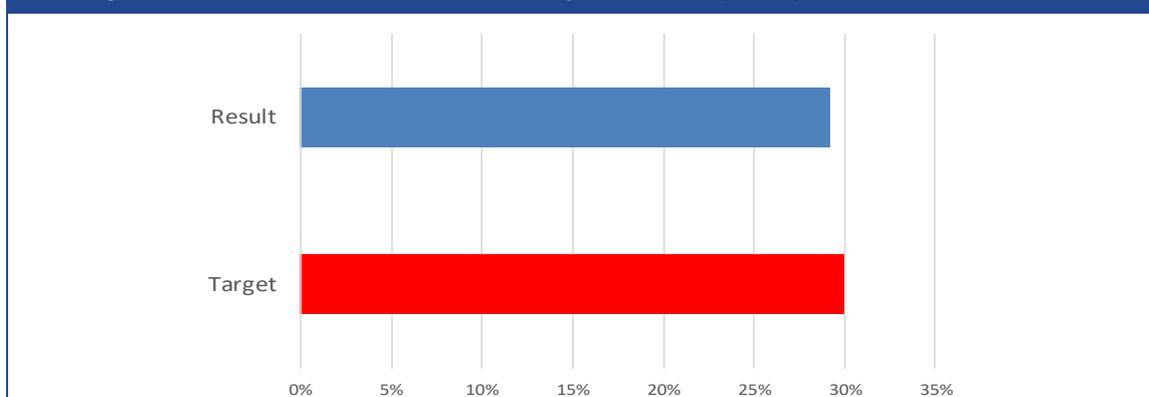
Figure 3.4: Per Cent Industry Cost Share (Total), June 2013 – June 2016



Source: Indecon analysis of SFI Research Centre KPI Data

The total cumulative contribution by industry as a share of resources was slightly below the target set of 30%. However, Indecon believes that the results show an impressive outcome in leveraging overall funding from the enterprise sector.

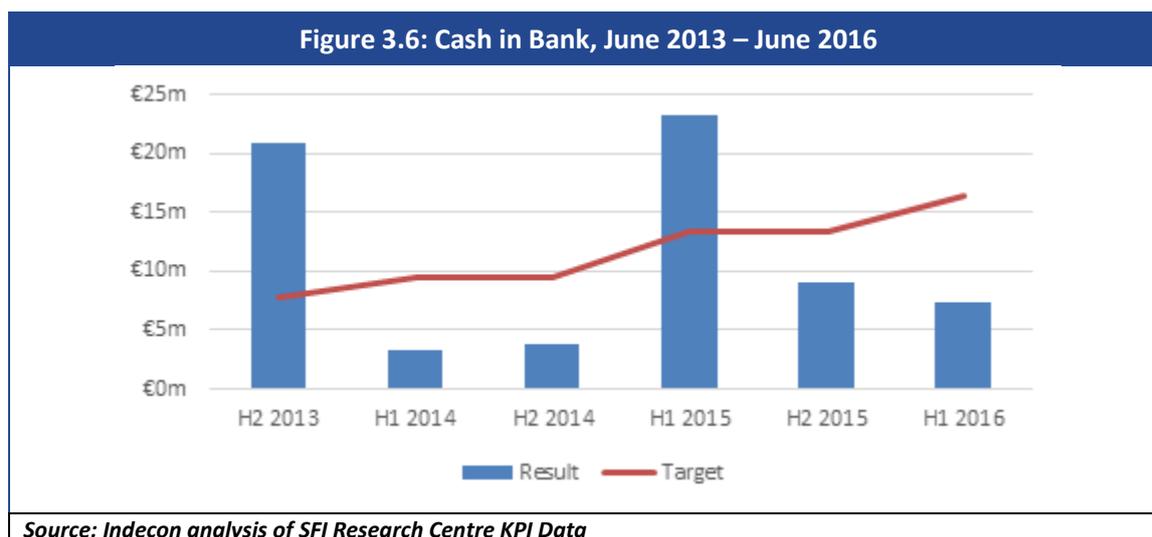
Figure 3.5: Cumulative Per Cent Industry Cost Share (Total), June 2013 – June 2016



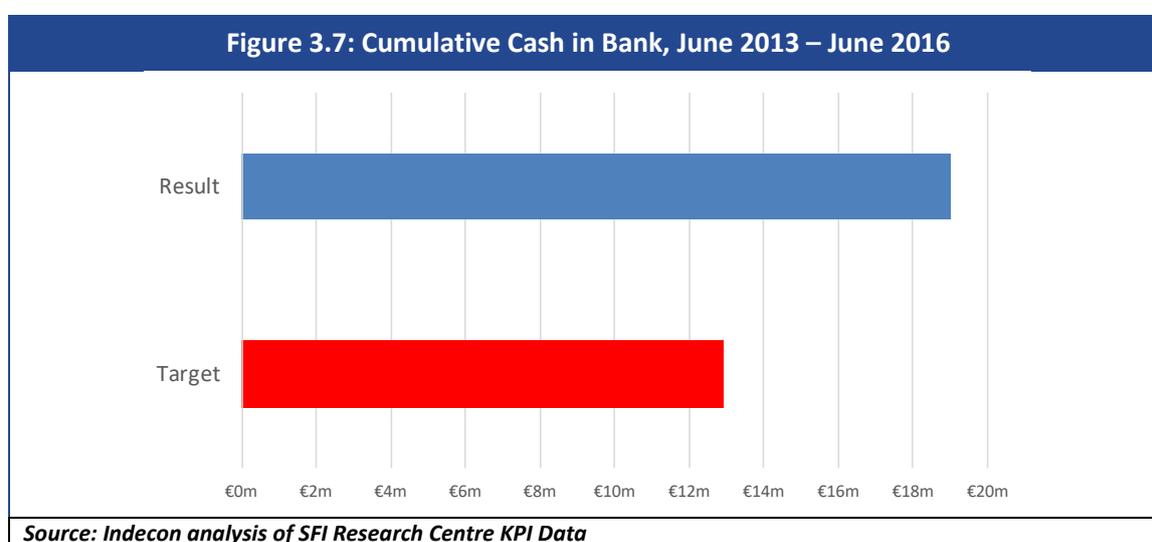
Source: Indecon analysis of SFI Research Centre KPI Data

KPI 3 – Cash in Bank

The “Cash in Bank” KPI refers to cash paid to the Research Centre by their industry partners during the reporting period. It does not refer to committed cash, invoiced cash or pro-rata cash amounts. Contributions, whether in cash or in-kind, from Irish Exchequer sources are not included. As can be seen in Figure 3.6, there was some year-to-year variance in the results.



In aggregate, the Research Centres Programme exceeded the target for achieving actual cash payments.



3.4 Achieving Excellence in Science

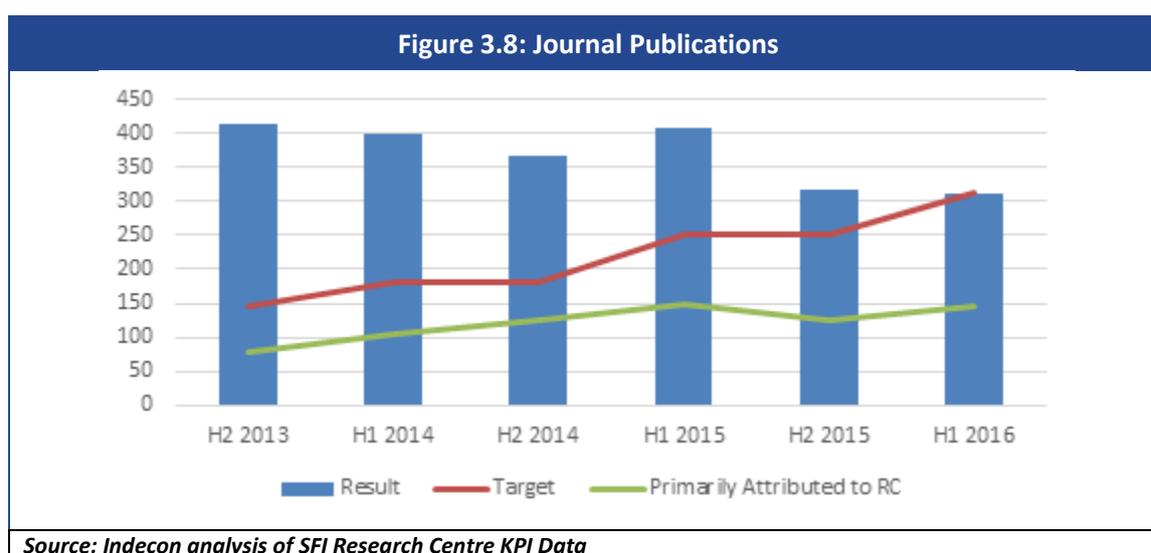
A key objective of the Research Centres Programme is to deliver a high level of research excellence, namely to achieve, maintain and enhance research excellence and leadership, as measured through indicators such as publication in top-tier journals and conferences, citations, editorship of top-tier journals, and giving invited lectures at top-tier conferences.

Two KPIs used by SFI relate to this objective. The first KPI is the number of journal publications with a publication date within the reporting period. This includes both original and review articles, where either the primary or the secondary attribution is a Research Centre. The second KPI is the number of Refereed Conferences or Meeting Proceedings with a publication date within the reporting period and where either the primary or the secondary attribution is a Research Centre. Indecon believes

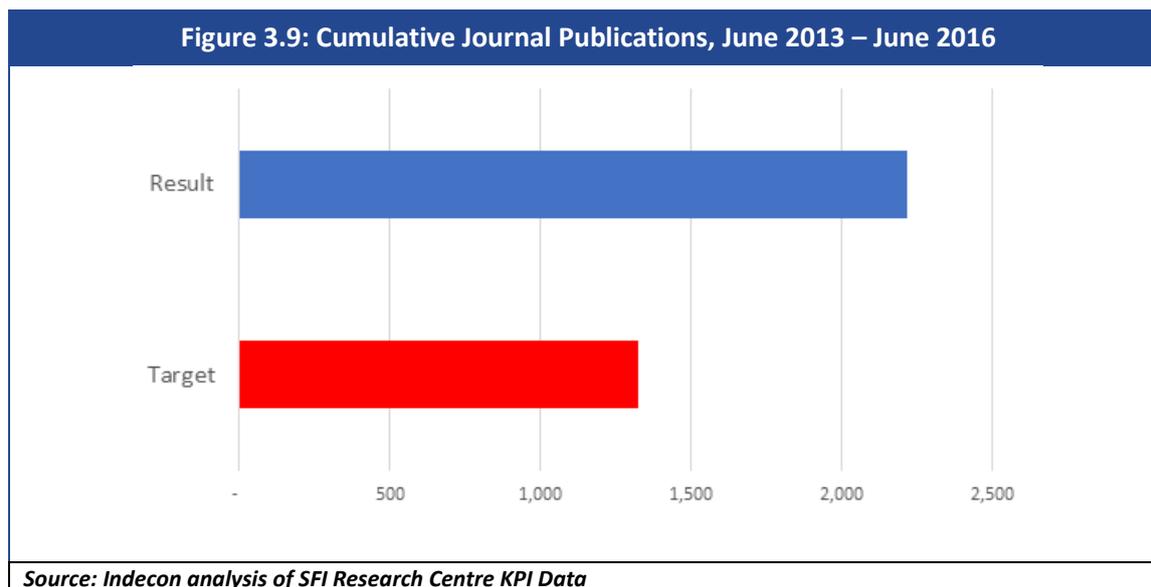
that while of some use in measuring overall activity, the number of journal articles does not address the need to measure impact and to differentiate between top tier journals or levels of citations. The original objectives set for achieving excellence in science explicitly referred to measurement such as publications in top tier journals and citations but this was not reflected in the KPIs used. This is discussed further in our recommendations.

KPI 4 - Journal Publications

The number of journal publications across the Research Centres is shown in Figure 3.8 compared with the objectives sets. The figure plots the number of journal publications primarily attributed to the Research Centres. While no targets were set for this latter measure, it is instructive to take into account the extent to which the publications achieved directly relate to the research financed by the SFI. Overall, the results show that the Programme met or exceeded the targets in every period but the number of journal articles has been decreasing.

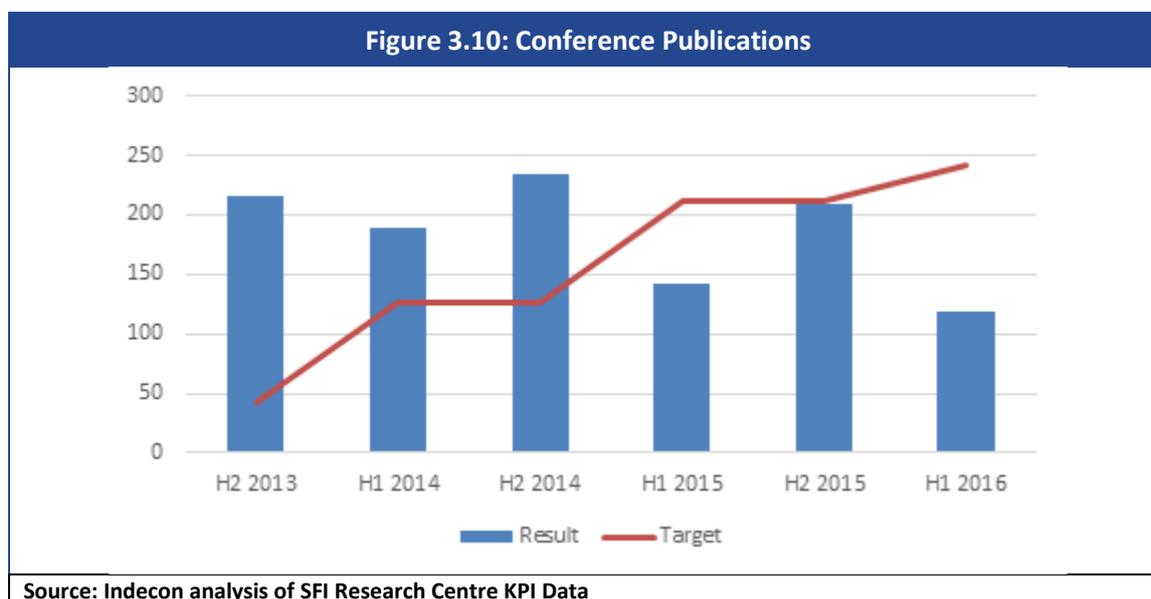


Data on the cumulative performance in terms of number of journal publications is presented in Figure 3.9. The results show that the number of journal publications achieved exceeded the targets set.

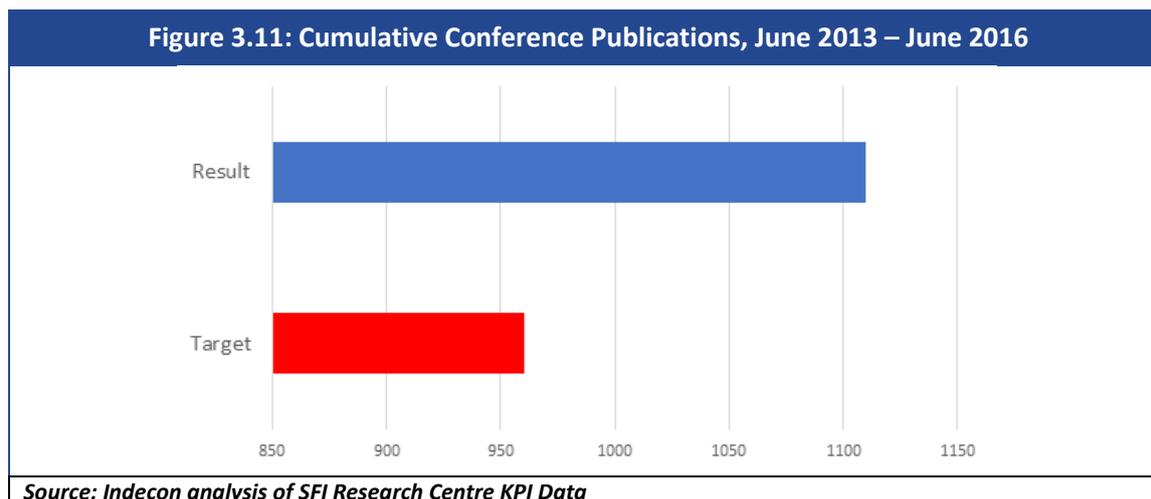


KPI 5 – Conference Publications

The performance in terms of the number of conference publications followed a similar pattern as with respect to the number of journal publications.



The cumulative number of conference publications has exceeded the targets set (see figure overleaf).



International Panel Reviews

Given the constraints on the existing performance indicators for excellence in science, Indecon has examined the assessments undertaken by the International Panels concerning the progress of the projects within each Research Centres (further details on these international reviews, and on the composition of the review panels, are included in the review panel reports prepared for SFI).

Overall, the reports are positive in terms of scientific impact. The reports conclude that the results compared with objectives outlined in the 2012 Research Centres programme broadly fulfils what one could expect in such a relatively short period of time. Also of note is the International Panel assessment that Ireland's reputation is deemed to be enhanced by the research undertaken in the Research Centres.

Table 3.3 reports a summary of the assessment of the International Panels on progress of each of the projects within the seven Research Centres in relation to projects' scientific programmes (it should be noted that some Centres have undertaken more than one project and each project has been individually evaluated by the Panels). Under this aspect, the majority of projects were judged to have demonstrated significant progress towards achieving all of the respective goals. In 19% of projects, outstanding progress was demonstrated. In the case of a minority (10%) of projects evaluation by the panels, progress and direction was seen to be lacking in one or two aspects that need to be addressed.

| Table 3.2: International Panel Reviews – Summary of Panel Assessments of Project Scientific Programmes | |
|--|--|
| Description | % of Projects Evaluated by International Panels |
| The scientific programme has demonstrated little progress towards achieving the goals of the Research Centre or has moved in a direction that is not optimal | 0% |
| The scientific programme has demonstrated progress towards achieving some of the goals of the Research Centre, progress towards other goals is less than expected | 0% |
| The scientific programme has demonstrated progress towards achieving most of the goals of the Research Centre but progress and direction lacking in one or two aspects that need to be addressed | 10% |
| The scientific programme has demonstrated significant progress towards achieving all of the goals of the Research Centre | 71% |
| The scientific programme has demonstrated outstanding progress in all respects | 19% |
| <i>Source: Indecon analysis of individual International Panel Reports</i> | |

3.5 Education and Outreach

The Research Centres Programme has an education objective which relates to the training of and teaching to younger cohorts. The objective of this Programme is to inspire the future generation of STEM students and train and educate a cohort of engineers and scientists at MSc/MEng, PhD and post-doctoral level that will take up high-value employment in MNCs and SMEs based in Ireland.

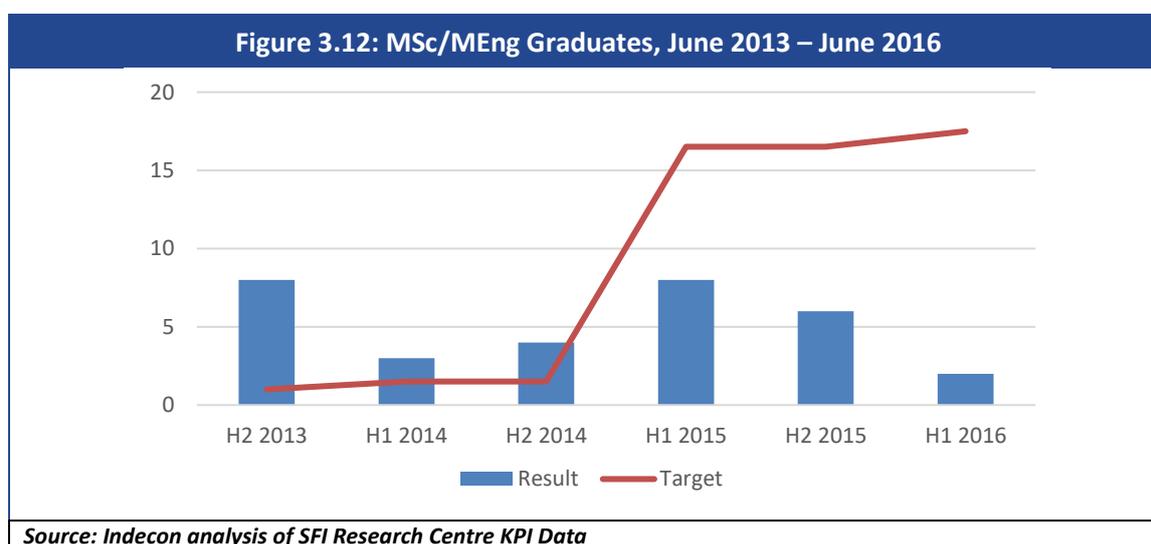
The SFI's EPE programme seeks to promote the awareness and engagement of the Irish public with science, technology, engineering and maths (STEM). The mission of this programme is to "catalyse, inspire and guide the best in STEM education and public engagement" by supporting and developing the education and outreach STEM sector in Ireland; by investing in developing and extending capacity in this area; and also by exploring and encouraging novel means of public engagement and communications. Each Centre has a range of education and public engagement programmes, including activities such as student placements, lab tours, web-based mentoring programmes, games/videos/competitions, school visits/workshops, as well as other activities.

Three KPIs directly relate to this objective. The first two KPIs measure the number of degrees awarded at the postgraduate level. The third KPI relates to the ability of Research Centres to enable young cohorts to take up industry jobs directly after the training provided. Consultation with business representative bodies undertaken by Indecon as part of this study highlighted the importance of the flow of skilled graduates as an important potential benefit to industry of the Research Centres Programme. This is also aligned with one of the main objectives of National RD&I Interventions, namely to enhance the ability of companies to access RD&I skills.

The first KPI is the number of Master (MSc and MEng) Graduations awarded in the period. This includes both graduates whose primary attribution is the Research Centre and graduates whose secondary attribution is the Research Centre but the primary attribution is from other sources of funding. The second KPI is the number of PhD Degrees awarded, with primary or secondary attribution from the Research Centre. The third KPI in this group is the percentage of trainee departures with industry as first destination.

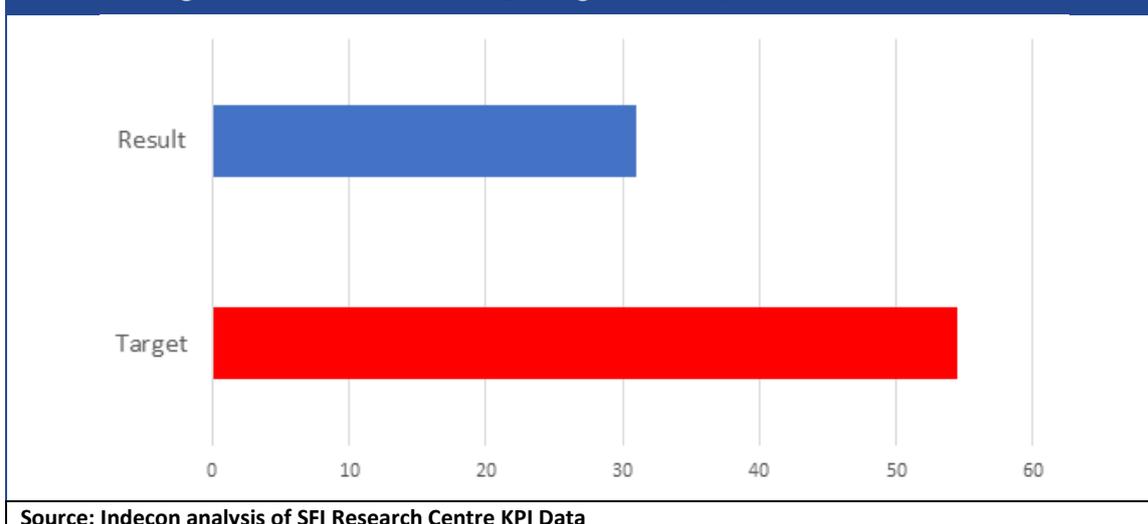
KPI 6 – Number of MSc/MEng Graduates

Research Centres have delivered between two and eight Master Graduates each semester. This, however, is a very small number given the number of internationally traded businesses operating in the Irish economy. Of note is there was an increase in the overall target in the first half of 2015, and one Research Centre tripled its target between June 2014 and June 2015.



Of more relevance than the annual targets concern the number of Masters degree graduates compared to the cumulative targets set. These are presented in the next figure and show that results were below the targeted levels. The figures may reflect a willingness of master graduates to pursue PhDs. It may therefore be more appropriate to consider a combined estimate for both master level and PhD graduates.

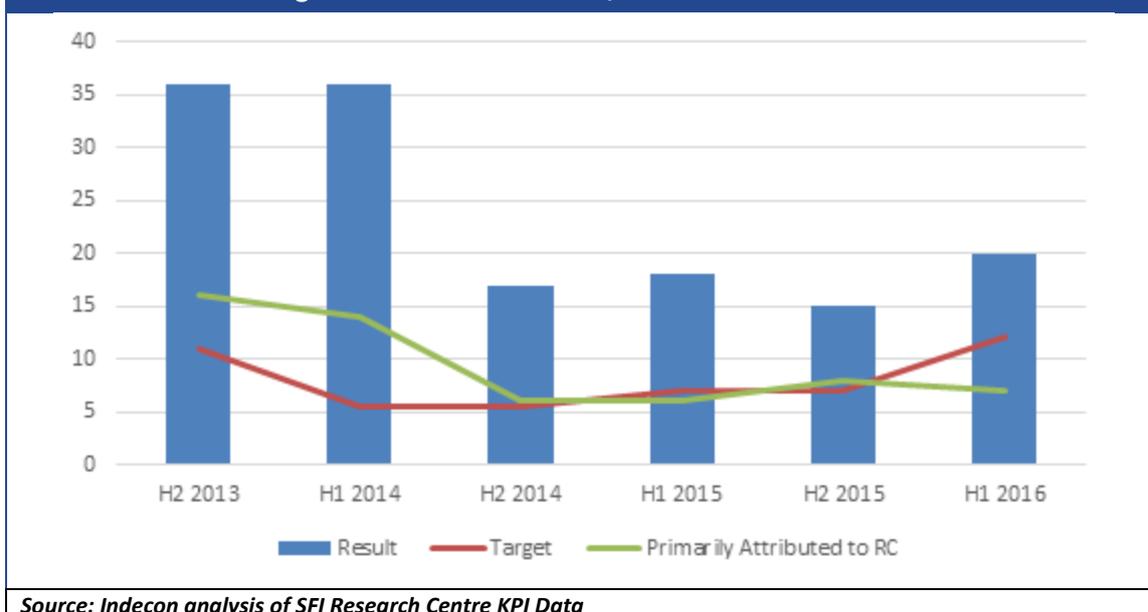
Figure 3.13: Cumulative MSc/MEng Graduates, June 2013 – June 2016



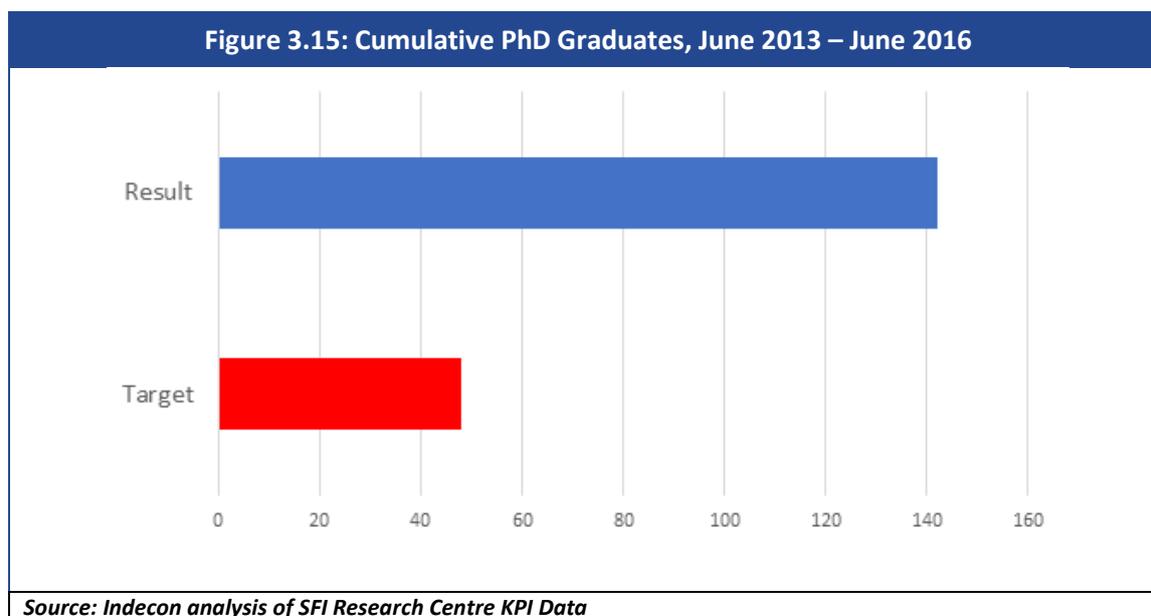
KPI 7 – Number of PhD Graduates

The number of PhDs awarded in aggregate by Research Centres was between 15 and 36 each semester. This is higher than the aggregate target in each period. All Research Centres met the cumulative target in the first half of 2016.

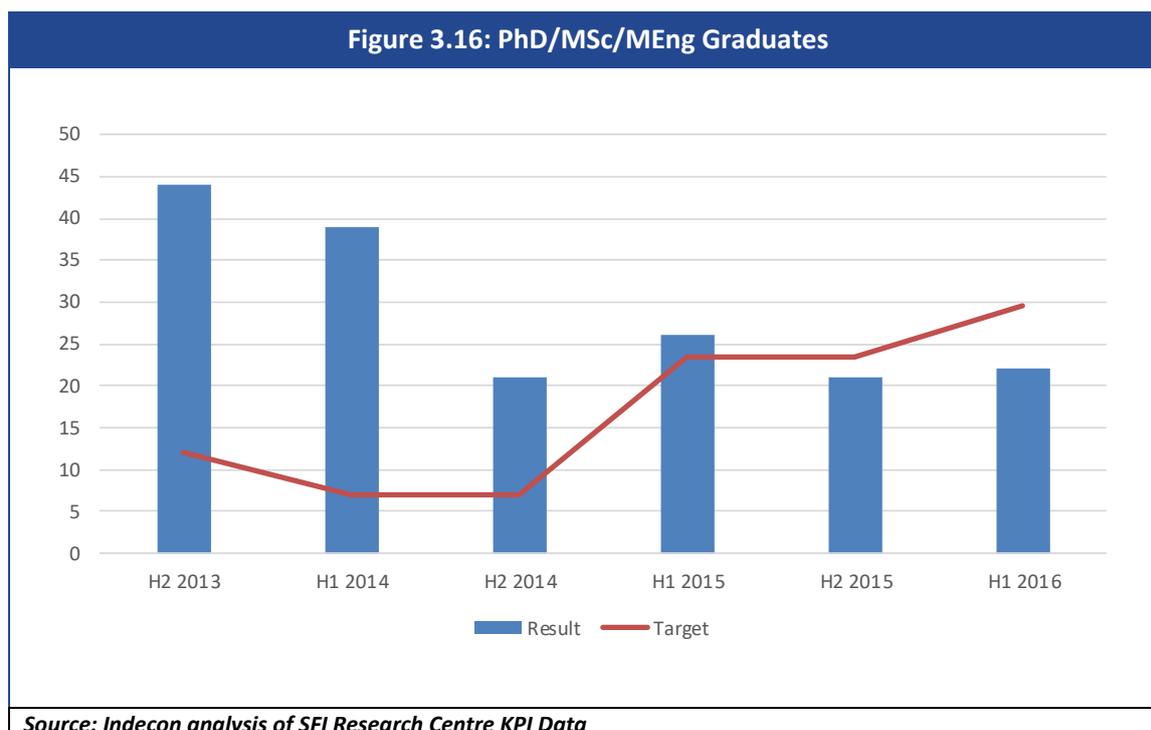
Figure 3.14: PhD Graduates, June 2013 – June 2016



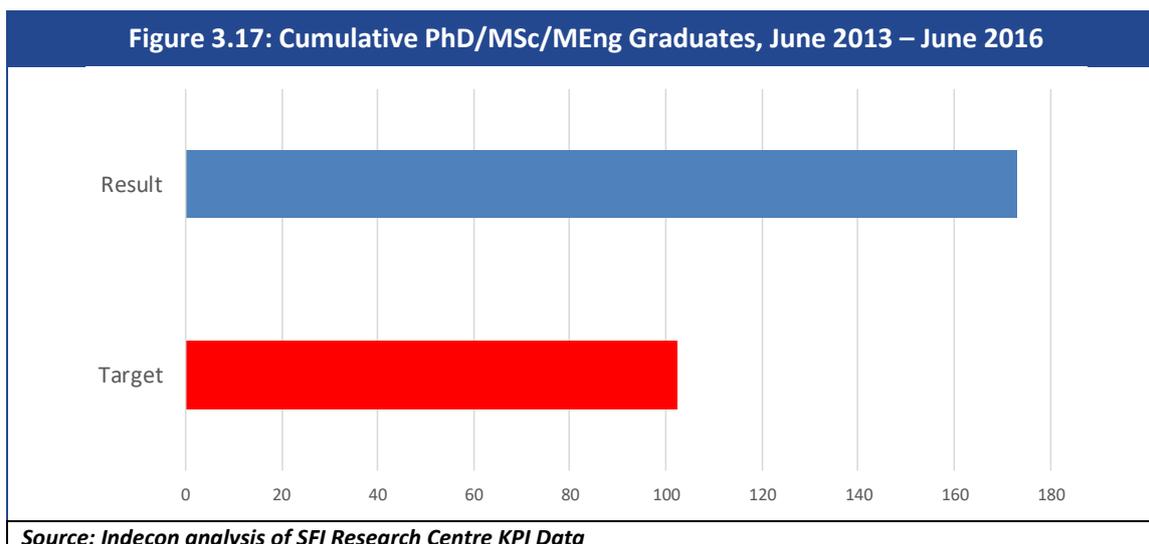
The cumulative data on PhD graduates shows that this greatly exceeded the targets set. These graduates are a potential important source of RD&I skills for companies and this may require additional focus over time in order to maximise the economic impacts of the Centres.



It is also useful to consider the aggregate performance of PhD and Masters graduates initiatives as presented below. While in earlier years results significantly exceeded the low targets set, this has been more challenging in 2015 and 2016.

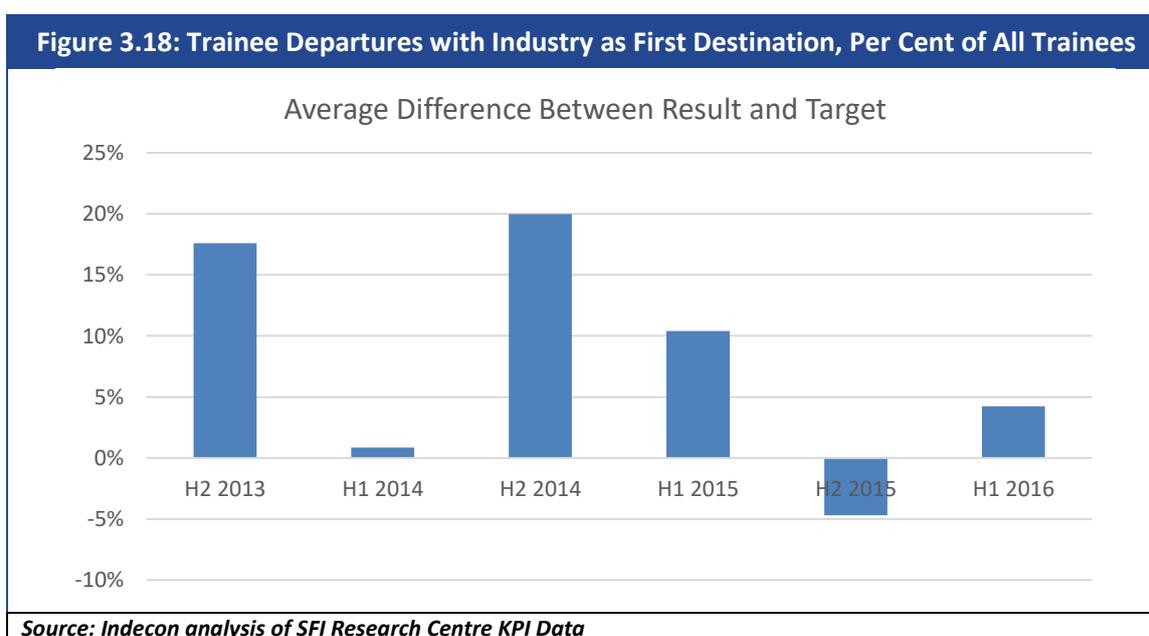


The cumulative PhD/Masters graduate placements show this exceeded the targets set.



KPI 8 – Percentage trainee departures with industry as first destination

The percentage of trainees with industry as their first destination after their period at the Research Centres varies between 6% and 100% of individual Research Centres' trainees in each semester. Individual targets range between 15% and 60% in the period June 2013 – June 2016, depending on both the Research Centre and the time period. The figure below reports the average difference between result and target of individual Research Centres' percentage trainee departures with industry as first destination, for each time period. As of June 2016, five Research Centres' cumulative percentage of trainees with direct departure to industry exceeded the targets set.



International Panel Reviews

The progress with respect to the Education and Public Engagement (EPE) programme was examined by the International Panels. The assessments were positive and in particular the commitment and enthusiasm of the researchers in participating in EPE activities was noted. While Research Centres performance on their EPE plans was more than satisfactory, the panels also concluded that more senior researchers should be involved in the design of the message to be delivered to the public through the EPE programme, to ensure the public is engaged with a deeper message that explains the major projects of the Research Centres, rather than just advertising science. In some cases, however, there was the perception that the portion of Research Centres' budget allocated to EPE activities was too low.

The table below summarises the overall assessment of the Research Centres regarding progress towards EPE objectives. A majority of activities had demonstrated 'outstanding' impact and systematic delivery of EPE activity, and 36% has demonstrated 'significant' impact and systematic delivery of EPE activity. In 7% of cases, there are some issues raised that needed to be addressed.

| Table 3.3: International Panel Reviews – Summary of Panel Assessments of Project Progress Against EPE Action Plan | |
|---|--|
| Description | % of Projects Evaluated by International Panels |
| The programme has demonstrated little or no systematic delivery of EPE activity | 0% |
| The programme has demonstrated limited systematic delivery of EPE activity | 0% |
| The programme has demonstrated some systematic delivery of EPE activity but there are some issues that need to be addressed | 7% |
| The programme has demonstrated significant impact and systematic delivery of EPE activity | 36% |
| The programme has demonstrated outstanding impact and systematic delivery of EPE activity | 57% |
| <i>Source: Indecon analysis of individual International Panel Reports</i> | |

3.6 Leveraged Funding Impact

Among the Research Centres Programme objectives is the leveraging of funding not only from the industry, but also from other non-industry sources. This is summarised in the Programme objective to attract additional non-Exchequer funding through industry sources and external research-funding organisations. Given the possible opportunities for securing a greater share of EU research budgets in a post Brexit environment, this is an important issue.

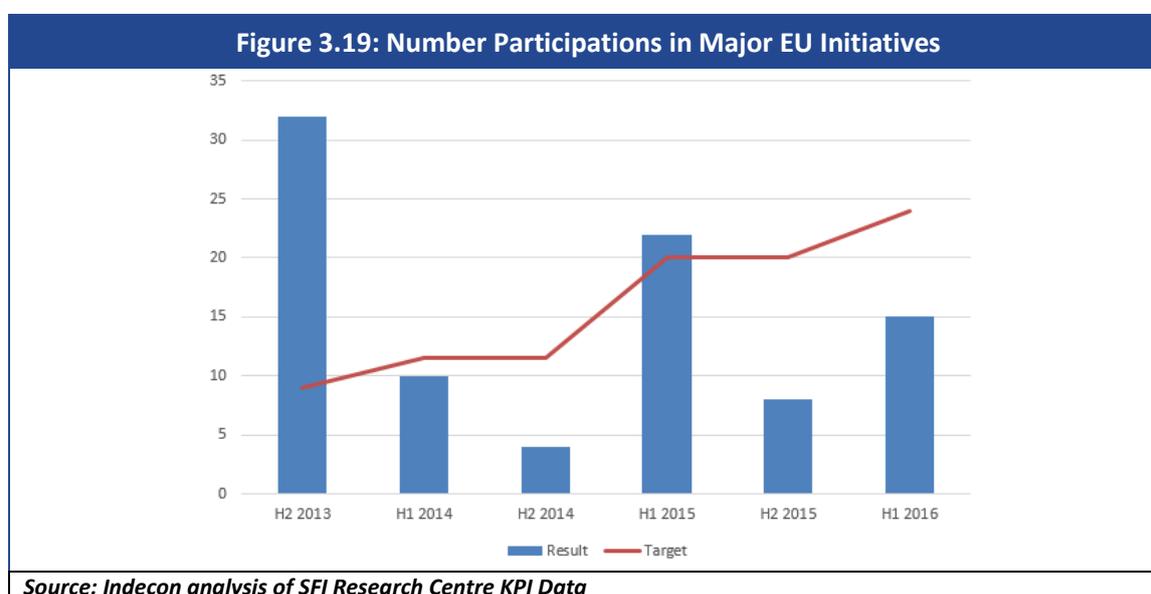
Four KPIs are grouped under this heading. The first three relate to EU funding; the fourth concerns funding from non-exchequer, non-commercial sources.

The first KPI measures the total number of participations in EU awards, regardless of the type of award, provided the funding body is the EU and the position held by the Research Centre on the award is either “Collaborator” or “PI” (Principal Investigator) or “co-PI”. The second KPI is the number of participations as coordinator in EU funding calls, regardless of the type of award, provided the funding body is the EU and the position held by the Research Centre on the award is “Coordinator”. The third KPI is a subset of the second and is the number of awards funded by the European Research Council (ERC) where the position held by the Research Centre on the award is “Coordinator”.

The fourth KPI analysed in this section is the level of funding from non-exchequer, non-commercial sources. This is the sum of the total amount of funding for the project and the amount of funding allocated to the PI, where the funding body is from a public, non-industry source including charities such as Wellcome Trust. The position held by Research Centres on the Award must be either “Collaborator”, “PI” or “co-PI”.

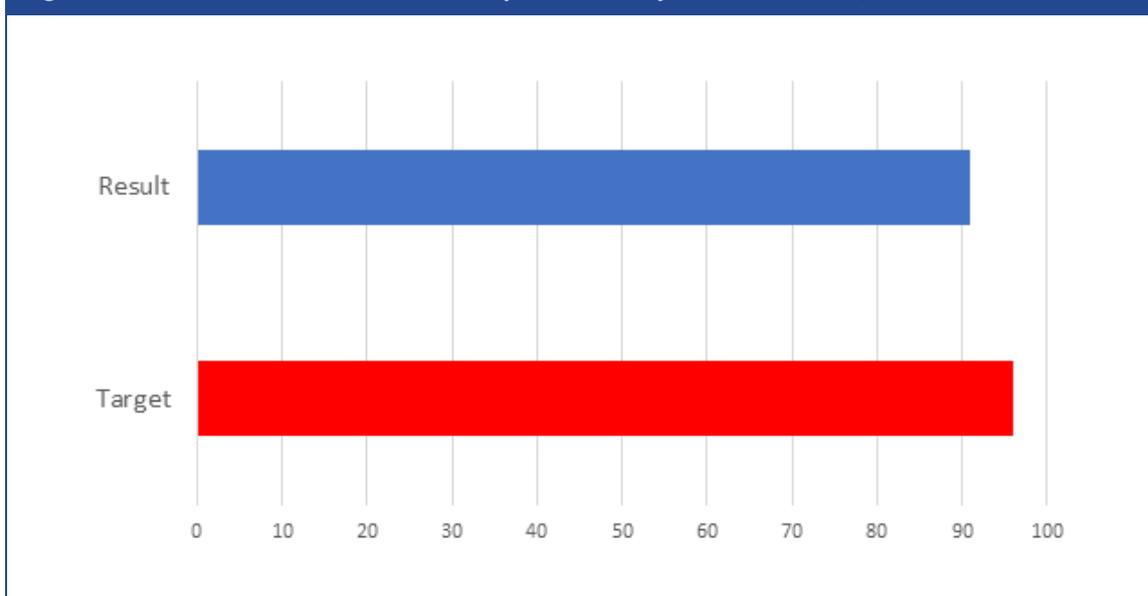
KPI 12 – Number participations in major EU initiatives

The number of participation of the Research Centres in EU funding calls, as “Collaborator”, “PI” or “co-PI”, is shown in the figure below.



The cumulative performance of the Research Centres participation in major EU initiatives is presented in Figure 3.20 and shows that performance was broadly aligned with the targets set. However, perhaps more important as an indicator is the extent of funding secured and the scale of the initiatives. This is in part captured by another KPI discussed later in this section.

Figure 3.20: Cumulative Number Participation in Major EU Initiatives, June 2013 – June 2016



Source: Indecon analysis of SFI Research Centre KPI Data

KPI 13 – Number coordination's in major EU initiatives

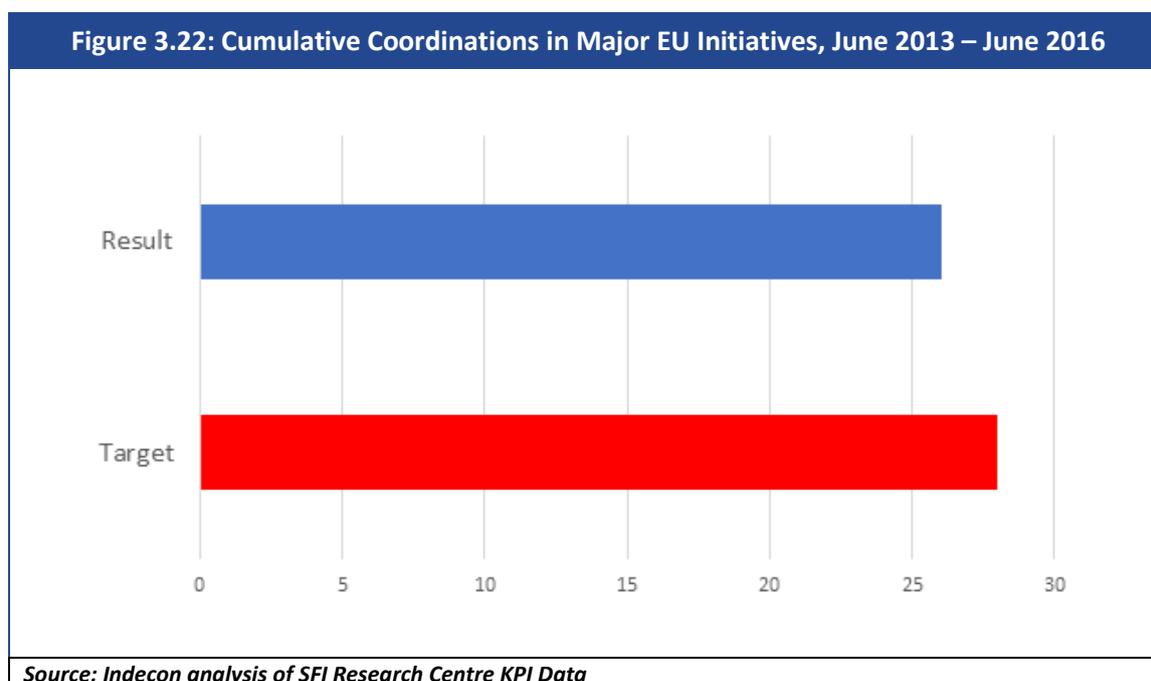
The number of EU funding calls in which Research Centres acted as coordinator is shown below.

Figure 3.21: Coordinations in Major EU Initiatives



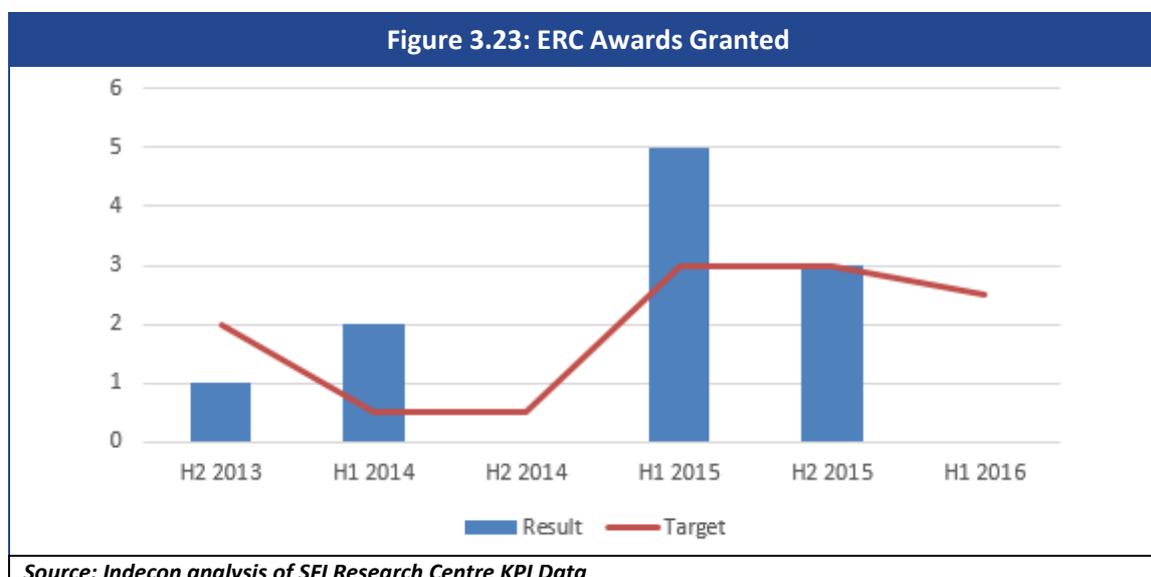
Source: Indecon analysis of SFI Research Centre KPI Data

The cumulative performance in terms of co-ordination in major EU initiatives shows that this was slightly below the target set.

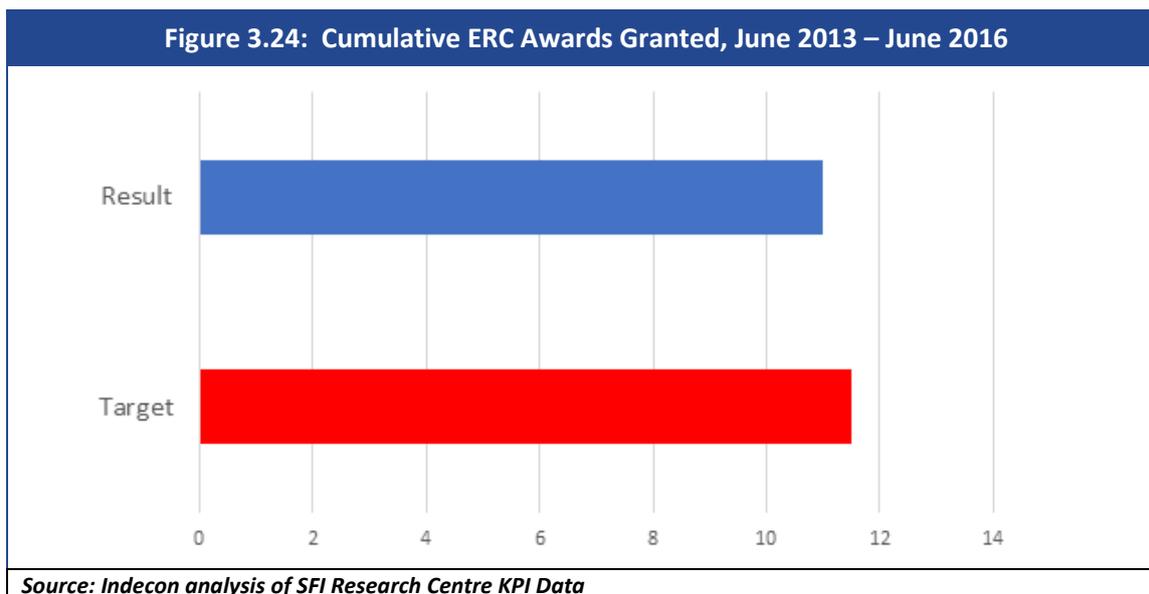


KPI 14 – Number ERC awards granted

A subset of EU funding calls where Research Centres were coordinators is the awards funded by the European Research Council. The number of ERC awards were between zero and five awards per semester.

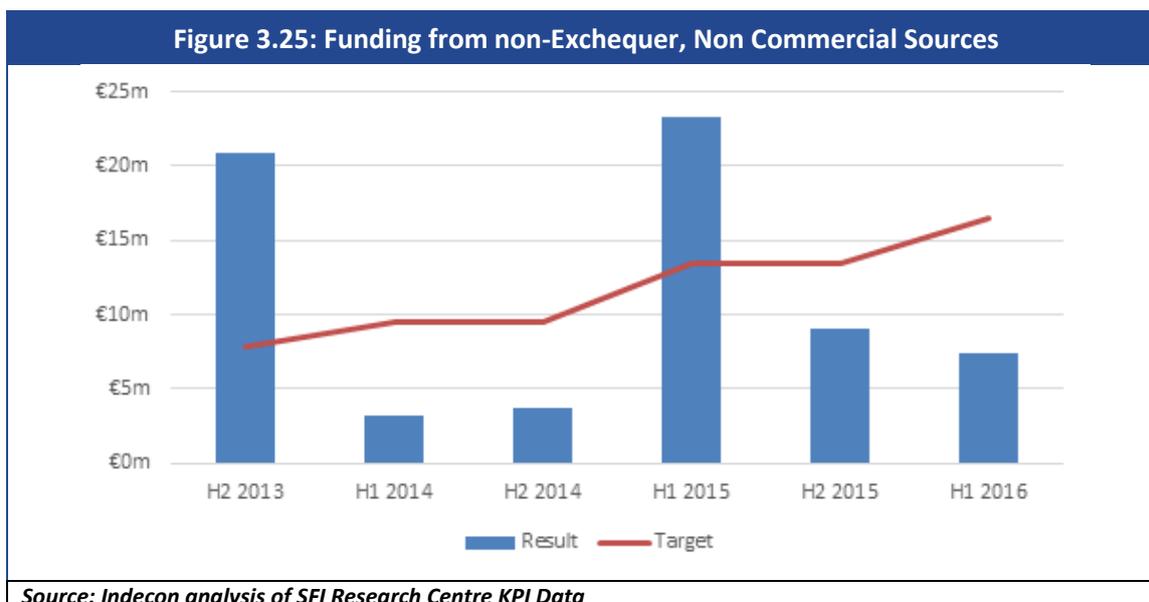


The cumulative number of ERC awards granted was slightly below the target set.



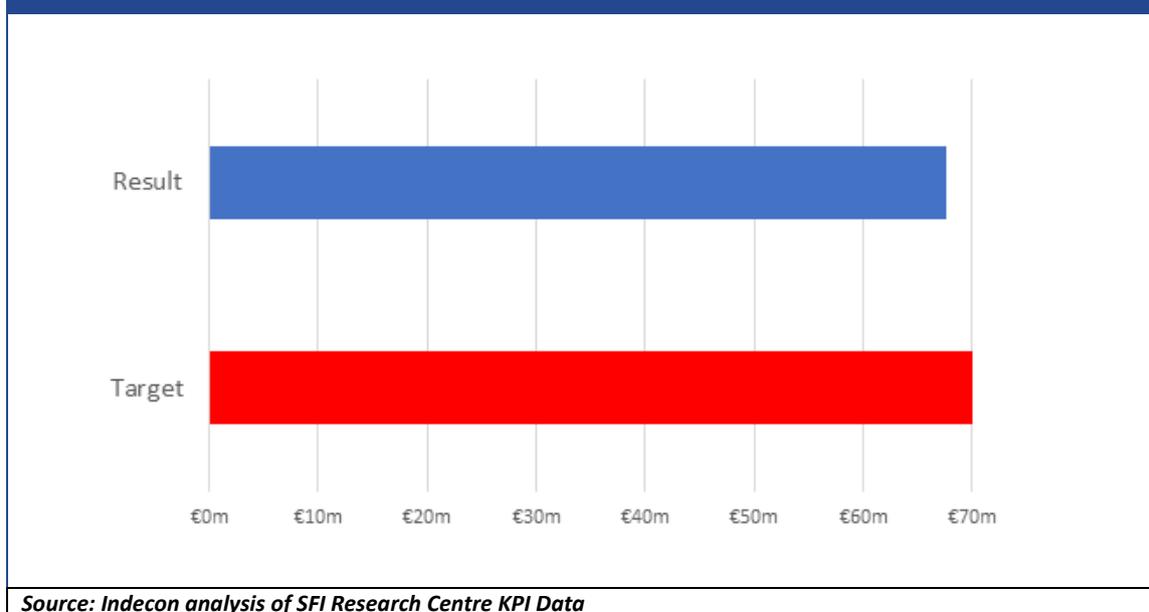
KPI 15 – Funding from non-exchequer, non-commercial sources

While the previous indicators reflect the number of awards from external funding bodies, this last KPI measures the total amounts received. This is shown in the figure below. The level of funding from non-exchequer, non-commercial sources has ranged between €2.3m and €23m each semester. In cumulative terms for this period, the aggregate income of €68m highlights the importance of this funding source.



The cumulative figures for non-Exchequer funding shows that the Programme has secured high levels of non-Exchequer funding although slightly below the cumulative targets.

Figure 3.26: Cumulative Funding from non-Exchequer, Non Commercial Sources, June 2013 – June 2016



3.7 Summary of Findings

Our key findings on the Programme performance are summarised below.

- ❑ The seven Research Centres have established 334 collaborative research projects in the period June 2013 to June 2016. The year with the highest number of projects commencing was 2014, with 103 projects. The recent nature of the project commencements highlights the fact that the full impacts and returns are only likely to be evident in subsequent years.
- ❑ One of the primary goals of the Research Centres Programme was to increase the level of industrial and commercial investment in R&D activities through undertaking joint research projects with industry. An important indicator in this regard is the amount of private sector co-financing achieved by the Centres. The commitment of cash and in-kind funding is indicative of industry involvement. It directly leverages additional investment expenditure to further the Government's goal of achieving Business Expenditure in Research and Development (BERD). Our evaluation shows strong progress on this objective.
- ❑ A central objective of the Programme is to achieve excellence in science. The international panels of experts found that most Research Centres had demonstrated significant progress towards achieving all of the respective goals, while the KPIs indicated that targets for journal publications were generally exceeded. However, Indecon believes there is a need to refine the performance measures in order to derive an accurate assessment of the impact of the publications and to focus on top tier journals and citations.
- ❑ In terms of education and outreach, the KPI data focussed on the number of graduates at different levels, and the extent to which these found jobs in industry. The KPI data indicated that targets for PhD Graduates were exceeded, though the output of MSc/MEng Graduates fell short. In terms of broader outreach, the international review panels reported that the

Research Centres Programme had in more than half of the cases demonstrated outstanding impact and systematic delivery of education and public engagement.

- ❑ Cumulative funding from non-Exchequer, non-commercial sources such as the EU was slightly below the target level but the results highlight the success of the Centres in securing income of €68 million from this source. Given the possible opportunities for securing a greater share of EU research budgets in a post Brexit environment, this is an important indicator.
- ❑ A comprehensive evaluation of non-economic impacts is outside the scope of this interim review. Given that social impacts take considerable time to materialise, Indecon is of the view that a full impact analysis will not be possible prior to a period of ten years following programme inception.

4 Programme Return on Investment

4.1 Introduction

This section considers the issue of the Programme return on investment. The level of return is a key measure of value for money of the resources committed to the Programme. Data to enable the estimation of the return on investment of SFI Research Centres or value for money is not captured in the existing performance indicators or other data available for this interim evaluation. A comprehensive examination of the return on investment would require detailed empirical primary research with the companies interacting with the Research Centres as well as data on the levels of commercial investment arising from the research, the performance of spin-off companies and the value of licences. Indecon would also note that rigorous methods would require counterfactual econometric modelling and extensive primary research which are outside the scope of this interim evaluation. Also of note is that the returns on the investment are likely to be only evident after a number of years and this should be considered as part of the subsequent evaluation of the Programme. However, Indecon have assembled evidence which is of use in deriving interim judgements on this issue.

In considering the likely returns on the investment in SFI Research Centres it is useful to examine international evidence on the returns to R&D investment. Hill, Mairesse, and Mohnen (2009)⁷ examined econometric other research measuring both economic and private returns to R&D, and covering 50 years of economic research. The table below reports on a number of the studies which have been completed which estimate the private and social returns to R&D.

| Table 4.1: Sample of Recent Papers Estimating Rate of Return on R&D Investment | | |
|---|--|---|
| Private Rate of Return Estimate on R&D | | |
| Study | Sample | Estimated Return |
| Bernstein and Nadiri (1990) | US, 35 firms | 9% to 20% |
| Mohnen-Lepine (1991) | Canada, 12 mfg industries 1975, 77, 79, 81-83 | 5% to 275% |
| Mohnen-Nadiri-Prucha (1986) | 1965-77 | 11% (US) 15% (Japan) 13% (Germany) |
| Bernstein-Mohnen (1998) | 11 industries | 44% (US) 47% (Japan) |
| Mohnen (1992) | OECD 5 countries | 6% to 9% |
| Nadiri-Kim (1996) | 7 countries | 14% to 16% |
| Social Rate of Return Estimate on R&D | | |
| Mansfield et al. (1977) | 17 industrial innovations | Median social ROR: 56% Median private ROR: 25% |
| Tewksbury et al. (1980) | 20 innovations | Median social ROR: 99% Median private ROR: 27% |
| Mohnen (1990) | Canadian Manufacturing | 29% |
| Mohnen (1992) | OECD 5 countries | 4% to 18% |
| Coe-Helpman (1995) | 22 countries | 32% |
| Source: Hill, Mairesse, and Mohnen (2009) | | |

⁷ Chapter prepared for the Handbook of the Economics of Innovation, B. H. Hall and N. Rosenberg (editors)

A recent study completed in 2014⁸ for the UK finds that private economics returns are on average 30%, with a median of 20-25%, while social economic returns are estimated at 60-90%. Both capital and current investments in R&D by the public sector are thought to be important in generating innovation. The report suggests that returns increase when the funding is channelled through competitive UK Research Councils schemes (the equivalent of SFI in Ireland). In terms of timing, the report suggests that private R&D investments depreciate at a rate of around 20% per year, while public investments are usually assumed to depreciate at much slower rates, if at all.

A study commissioned by the European Commission and completed in March 2017⁹ reviewed numerous studies that have addressed the rate of return on public research investment. According to most studies, rates of return have a median value between 20% and 50%. Other studies adopting a macro-economic modelling approach have also estimated positive impacts of 10-20%.

The results show high level of returns to R&D in many countries suggesting excellent value for money of the resources invested. While it is too early in the Research Centres Programme to judge the economic impacts of the investment and existing data does not capture the information needed to evaluate such returns, it is useful to consider some illustrative potential returns. Applying a conservative estimate of the rate of return of 15%, which is lower than most international estimates thus a lower bound estimate of actual return, would suggest that the expenditure by Science Foundation Ireland from 2013 to June 2016 on the first wave of seven Research Centres of €90m has the potential to result in approximately €13m per annum in terms of economic benefits. The return on investment will be influenced by the performance of the Research Centres. Positive evidence on the performance against the objectives set were discussed in Section 3 of this report. These benefits are, however, only likely to be achieved over time. The validity of this indicative estimate should be examined as part of a more comprehensive evaluation of the SFI Research Centres based on extensive primary research and detailed econometric modelling.

4.2 Interaction of Research Centres with Internationally Traded Sectors

The returns on R&D investments will also be influenced by the level of interaction with the internationally traded sectors in Ireland. As part of our analysis Indecon has also examined new evidence which sheds light on the likelihood of economic returns being achieved. To assist in this evaluation Indecon conducted new research linking the ABSEI database with participant firm identification numbers to understand in detail the characteristics of these firms. It should be noted that the ABSEI database only captures a subset of firms who actually participated in the Research Centres (approximately 50%), so these figures should be read in this light.

The Research Centres have been successful in collaborating with a wide range of companies, including Irish/foreign-owned and small/large. Turning first to firm ownership, both foreign-owned MNCs and Irish-owned companies participate in SFI Research Centres. Irish firm's make up 45% of firms who participate in collaborative research with a Research Centre, while foreign-owned are the majority at 55%. Of firms who participate in Research Centres, one-third are large (>250 employees), though more than two in five (42%) are classed as small (<50 employees).

⁸ "Rates of return to investment in science & Innovation: A report prepared for the Department of Business Industry and Skills by Frontier Economics", 2014.

⁹ European Commission, "The economic Rationale for public and R&I funding and its impact", 2017.

| Table 4.2: Science Foundation Ireland Research Centres - Company Ownership | | |
|---|-------------------------|-------------------------|
| Ownership | # of Respondents | % of Respondents |
| Irish | 52 | 45% |
| Foreign | 63 | 55% |
| Total | 115 | 100% |
| <i>Source: DJEI ABSEI Database</i> | | |

The table below shows that the spread of Research Centre firms covers a range of sectors. Unsurprisingly, there is a strong weighting for firms operating in the modern manufacturing and ICT sectors. Almost 20% of firms who responded were in the chemicals sector, 13% in computer consultancy, and 10% in several sectors such as medical devices and business services.

| Table 4.3: Science Foundation Ireland Research Centres – Sectoral Distribution | | |
|---|-----------------------------------|---------------------------|
| Sector | % of Research Centre Firms | Overall Employment |
| Agriculture, Fishing, Forestry, Mining & Quarrying | 2% | 1% |
| Food, Drink & Tobacco | 5% | 15% |
| Electrical equipment | 3% | 2% |
| Machinery and Equipment | 2% | 4% |
| Construction, Energy, Water, & Waste | 2% | 2% |
| Other Traditional Manufacturing | 6% | 11% |
| Chemicals | 19% | 8% |
| Computer, electronic and optical products | 10% | 6% |
| Medical Device Manufacturing | 10% | 8% |
| Computer Programming | 6% | 9% |
| Computer Consultancy | 13% | 9% |
| Other Information, Communication and Computer | 9% | 4% |
| Business Services | 9% | 7% |
| Financial Services | 3% | 5% |
| Other Business, Financial & Other Services | 2% | 2% |
| Total | 100% | 100% |
| <i>Source: DJEI ABSEI Database</i> | | |

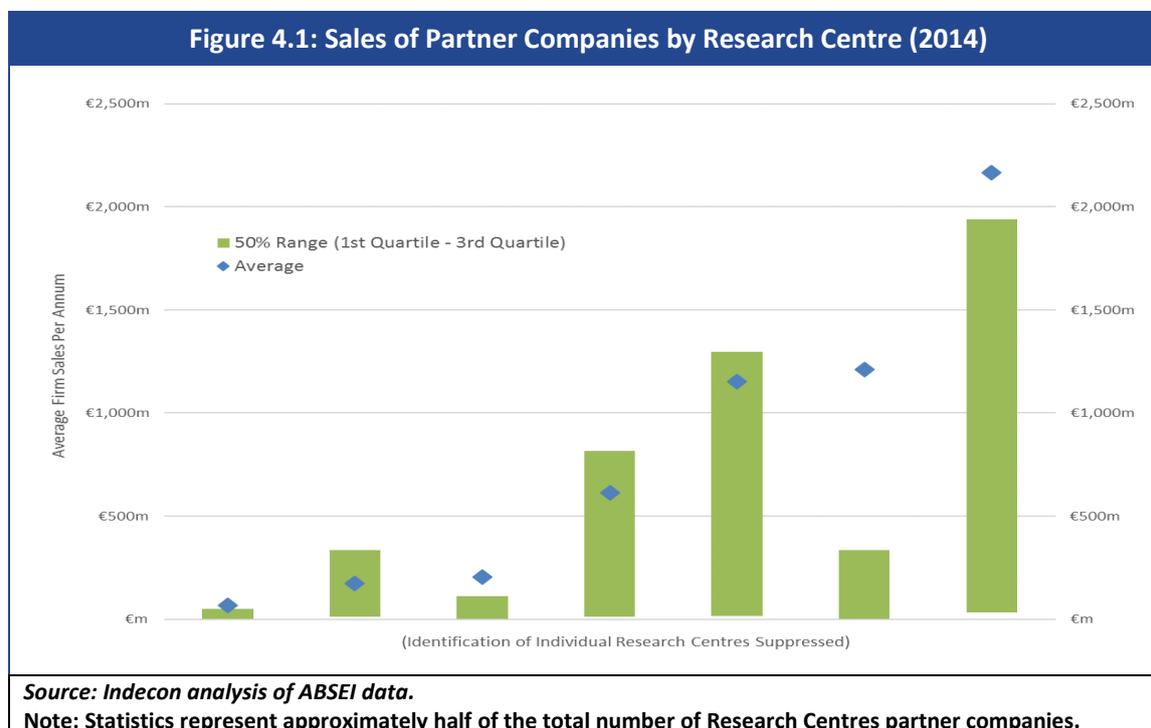
The returns to the Irish economy of investment in Research Centres are likely to be seen in terms of output and employment in the Irish economy. Firms that engage with Research Centres are typically much bigger than non-participating firms. Table 4.4 below shows the average sales of firms who participate in Research Centres versus average sales of firms who did not participate in Research Centres in terms of sales in 2015. It shows that the average IDA client firm has sales of €276m a year, but that this is substantially higher (€988m a year) for firms which participate in Research Centres.

Table 4.4: Average Sales Activities of Research Centre versus non- Research Centre companies Statistics, 2015

| Sales (€k) | IDA | Enterprise Ireland |
|---------------------|---------|--------------------|
| Non-Research Centre | 227,824 | 15,952 |
| Research Centre | 987,935 | 68,519 |
| Total | 276,435 | 16,925 |

Source: Indecon analysis of ABSEI data.
Note: Statistics of SFI companies represent 50% of the total number of Research Centres partner companies.

There is a large distribution between Centres in terms of the typical size of firm that they engage with. This suggests that the Research Centres Programme engages with a diverse range of firms including SMEs. Figure 4.1 shows statistics on the distribution of sales in 2014; each bar represents the distribution of companies in each of the seven Research Centres. The green bar represents the boundaries between the 1st Quartile Sales level for each Research Centre, and the 3rd Quartile Sales level. As such, it captures the range of sales of the central 50% of firms which participate in each Research Centre. The average sales per firm is also illustrated. The graph is intended to give a sense of the spread of the size of firms (as measured by annual turnover) that participate in Research Centres.



The difference in scale in firms who participate in Research Centres compared to those that do not is also evidenced by differences in average employment. The average employment of these firms among IDA clients is 667, more than three times the average number in the rest of the population of IDA client firms. Similarly, the average employment level in Enterprise Ireland-client firms who participate in Research Centres is 193, compared to 58 for non-Research Centre firms.

Table 4.5: Average Employment of Research Centre versus non- Research Centre companies Statistics, 2015

| Average Employment (Number) | IDA | Enterprise Ireland |
|------------------------------------|------------|---------------------------|
| Non-Research Centre | 201 | 58 |
| Research Centre | 667 | 193 |
| Total | 231 | 61 |

Source: Indecon analysis of ABSEI data.
Note: Statistics of SFI companies represent 50% of the total number of Research Centres partner companies.

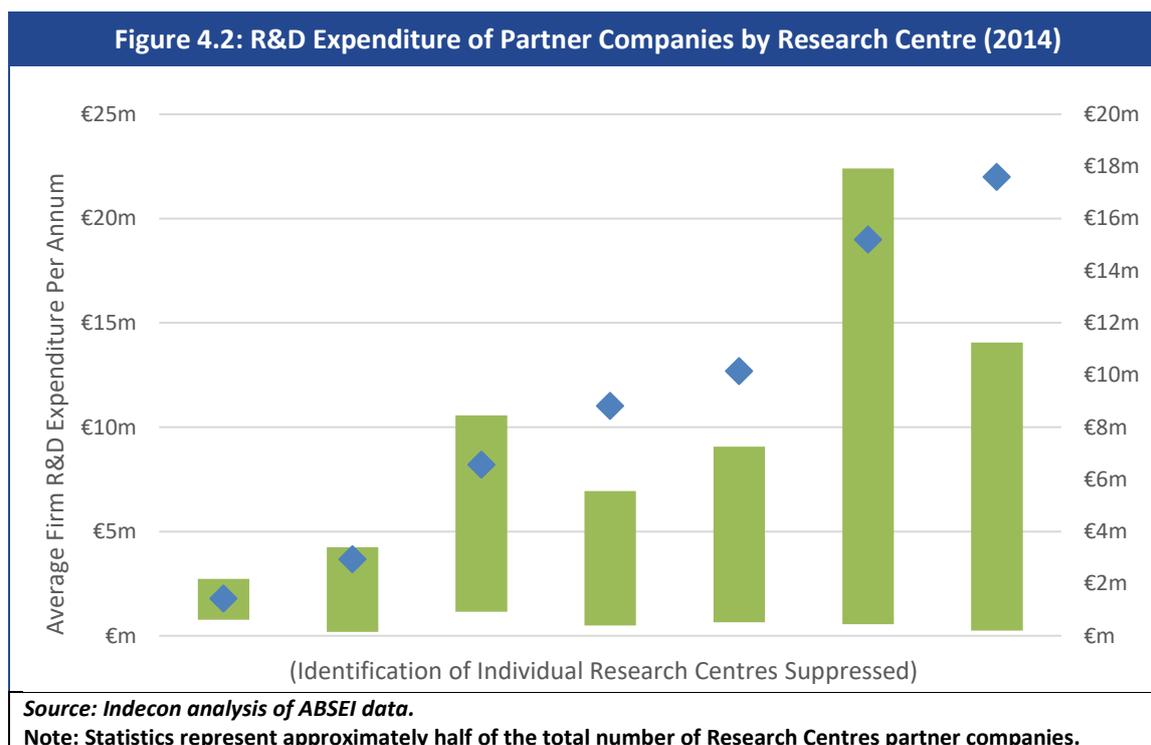
Not surprisingly firms that participate in Research Centres also tend to conduct more R&D. The table below shows that the average annual R&D expenditure of IDA-client firms who engage with a Research Centre is €13.8m, more than double the average of firms who don't engage with a Research Centre. A similar picture can be seen for Enterprise Ireland supported firms, with firms who engage with a Research Centre showing average R&D expenditure of almost €1m per annum, compared to just over half that level for other firms.

Table 4.6: R&D Expenditure - Research Centre versus non- Research Centre companies Statistics, 2015

| R&D Expenditure (€k) | IDA | Enterprise Ireland |
|--|------------|---------------------------|
| Non-Research Centre | 6,715 | 488 |
| Research Centre | 13,871 | 870 |
| Total | 7,555 | 497 |
| | | |
| R&D Expenditure per Person Employed (€) | IDA | Enterprise Ireland |
| Non-Research Centre | 33.5 | 8.4 |
| Research Centre | 20.8 | 4.5 |
| Total | 32.7 | 8.2 |

Source: Indecon analysis of ABSEI data.
Note: Statistics of SFI companies represent 50% of the total number of Research Centres partner companies.

In Figure 4.2 R&D expenditure for the Research Centres partner companies (the identities of which are suppressed to ensure data confidentiality) shows R&D spend in 2014. The average spend on R&D ranges from just over €1m per annum to €18m per annum.



Another important aspect relating to R&D expenditure is the extent to which R&D activity is conducted in-house or is out-sourced. This may give an indication as to the extent to which research conducted in a Research Centre complements other investments being made internally. The table shows both the in-house R&D employment for Research Centre and non-Research Centre firms. The figures show that, on average, the in-house R&D employment is significantly higher for firms that are engaged in Research Centres, with the difference being more pronounced for IDA-client firms than Enterprise Ireland client firms.

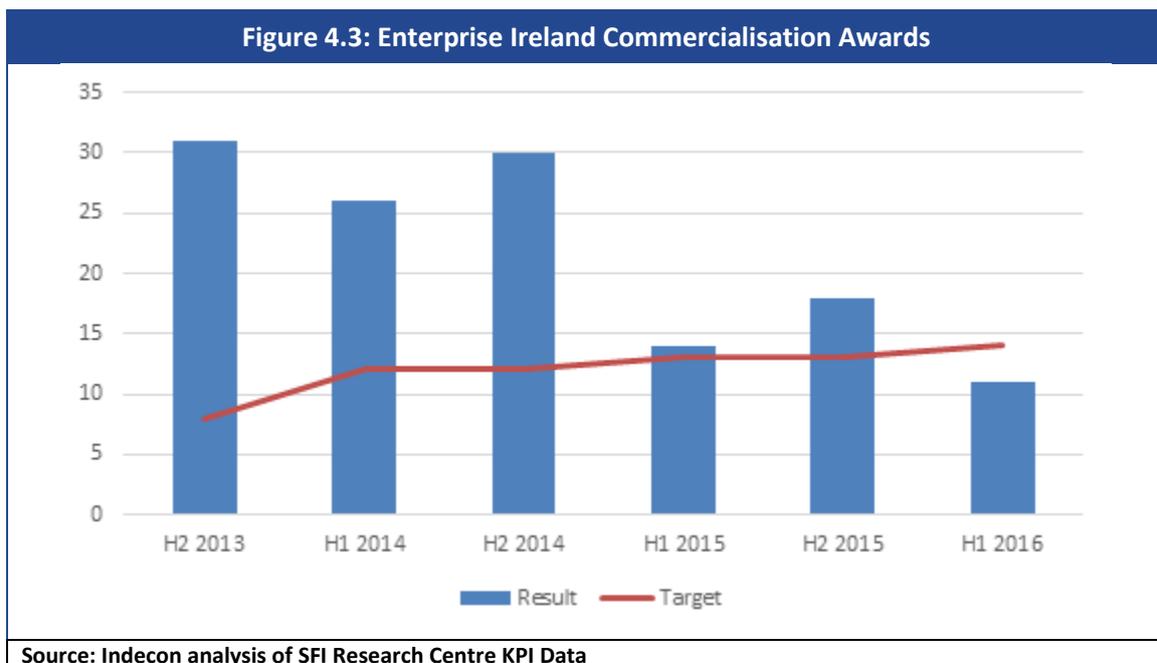
| In-House R&D Employment (Number) | IDA | Enterprise Ireland |
|---|------------|---------------------------|
| Non-Research Centre | 35 | 6 |
| Research Centre | 101 | 10 |
| Total | 43 | 6 |
| | | |
| In-House R&D Employment (% of Total) | IDA | Enterprise Ireland |
| Non-Research Centre | 17.5% | 10.7% |
| Research Centre | 15.2% | 5.4% |
| Total | 18.7% | 10.4% |

Source: Indecon analysis of ABSEI data.
Note: Statistics of SFI companies represent 50% of the total number of Research Centres partner companies.

4.3 SFI Evidence on Potential Returns as Measured by Impact KPIs

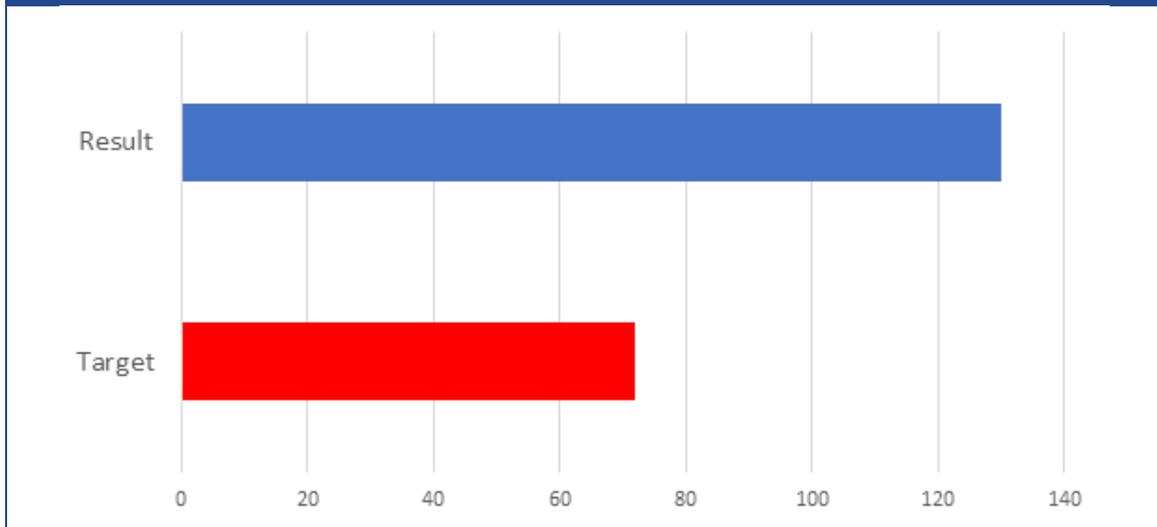
Indecon considered SFI evidence on potential return on the investment in SFI Centres and the related issue of value for money by examining the impact indicators. The first of the SFI impact indicators for the Research Centres is the number of commercialisation awards received from Enterprise Ireland. The other two KPIs are the number of licence agreements and the number of spin out companies formed. Both these KPIs measure innovation and commercialisation activities. The former relates to licenced technology which is a result of the research undertaken in the Centres, either as primary or secondary attribution. The latter is the number of companies formed which employ the technology or other research output created within the Research Centres, again whether on primary or secondary attribution.

An important measure of the potential impacts and hence the likely return on investment is the success of SFI Research Centres in achieving EI commercialisation awards. The data is presented in the next figure.



While the figure shows some yearly variance, it is clear that the Programme has cumulatively significantly exceeded its target on this measure.

Figure 4.4: Cumulative Enterprise Ireland Commercialisation Awards, June 2013 – June 2016



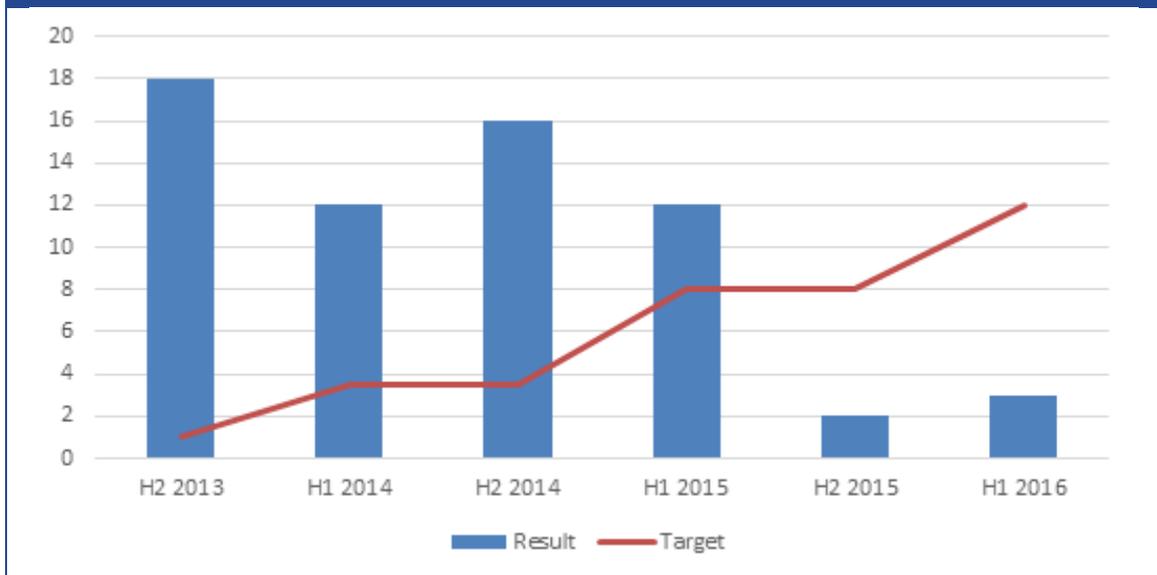
Source: Indecon analysis of SFI Research Centre KPI Data

KPI 10 – Number licence agreements

The aggregate number of licence agreements released each semester has decreased from 18 licences in the second half of 2013 to 3 licences in the first half of 2016. Targets were set to increase from one licence agreement in the first half of 2013 to 12 licence agreements in the second half of 2016. Aggregate licence agreements exceeded the aggregate target before June 2015.

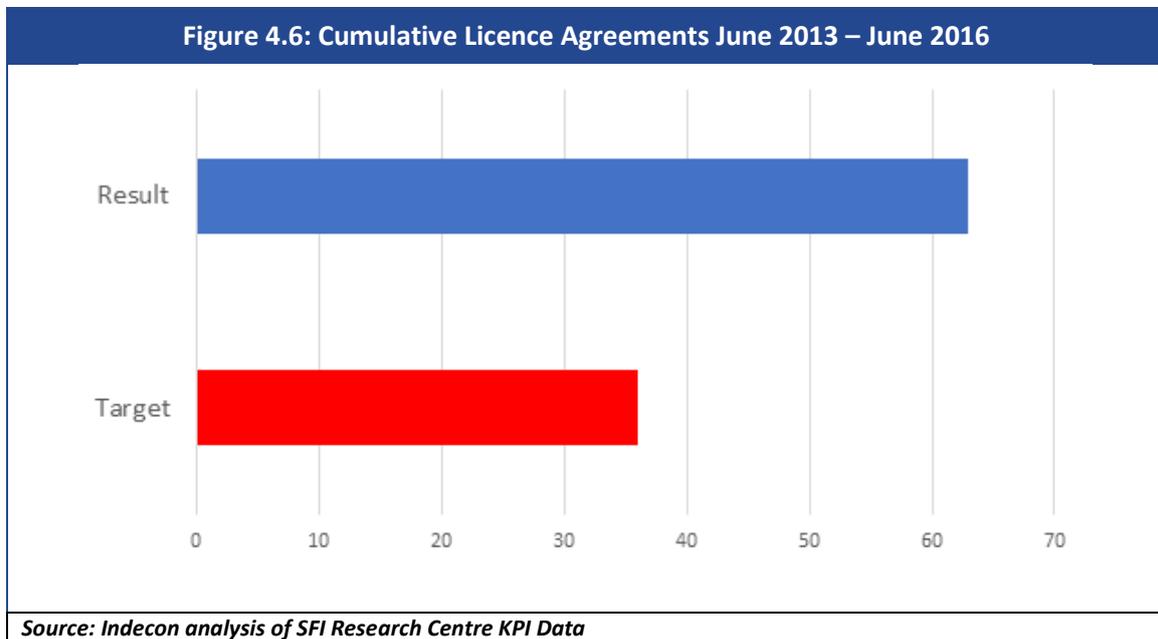
Data on the results for licence agreements compared to the targets set is presented below.

Figure 4.5: Licence Agreements



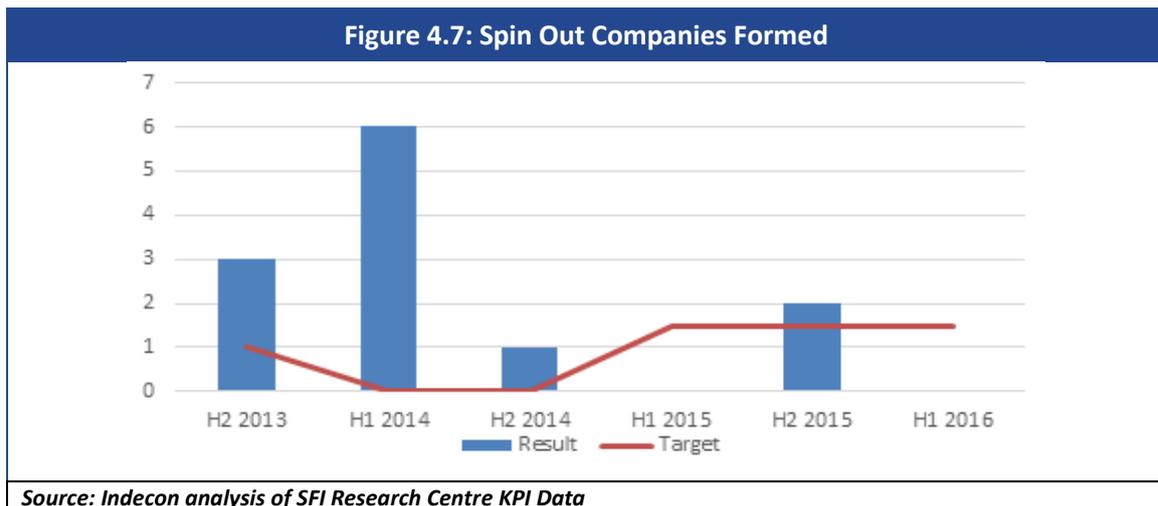
Source: Indecon analysis of SFI Research Centre KPI Data

While there is inevitable yearly variance in performance of licence agreements, of more importance is the number of licence agreements secured over the period. The cumulative number of licence agreements secured have exceeded the targets set. This is suggestive of significant potential economic impacts but further information on the value and subsequent use of these licences would be needed to inform an assessment of the likely economic returns.

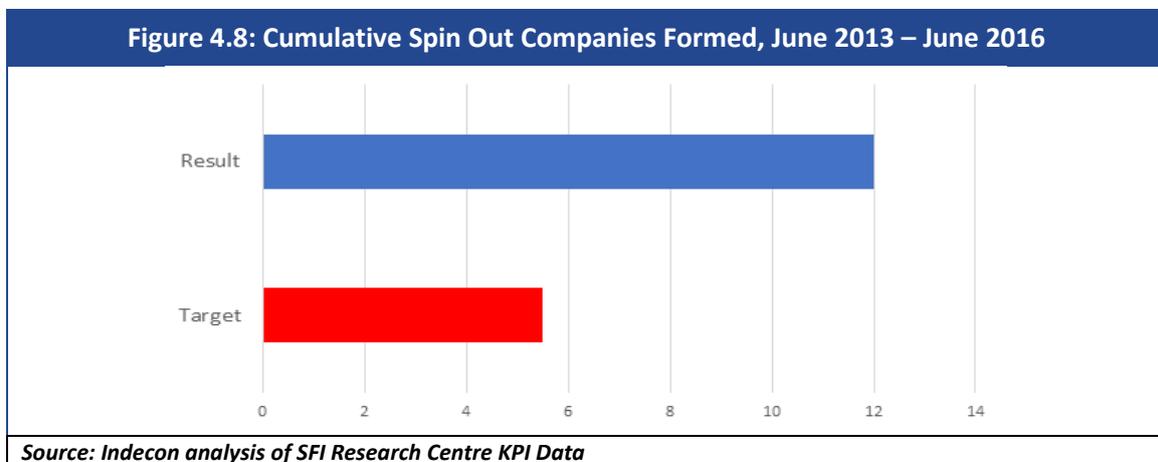


KPI 11 – Number spin-out companies formed

The target levels agreed between the SFI and the Research Centres for the number of spin-out companies was very low considering the level of funding, with a cumulative total of only 5.5 companies between June 2013 and June 2016 across all Research Centres. The total number of spin-out companies formed each semester as a result of the activities of the Research Centres has declined, from a total of 7 spin-out companies formed in the year 2014 to only two companies formed in 2015. However, more important in the cumulative performance results discussed below.



The total number of spin out companies formed have exceeded the targets set. A key issue is how these companies perform over time in terms of the value of output, investment, R&D and employment. It is important that systems are put in place to monitor these outcomes.



International Panels Reviews

Seven International Panels assessed the seven Research Centre's impacts, including collaboration with partners in the private sector; routes to commercialisation (invention disclosures, patent applications, licencing agreements, spin-out creation); industry contribution; and collaboration and engagement with the public. The impact assessments also examined the following areas:

- Societal impacts and international engagement;
- Impacts on public policy, services and regulation;
- Health and wellbeing impacts;
- Environmental impacts;
- Impacts on professional services; and
- Impacts on human capacity.

Despite the early stage, the Panels felt that the Research Centres were making good progress towards producing the impacts targeted for the programme. On environmental impact, there was positive and negative feedback, suggesting that progress towards this goal could be increased in some Research Centres.

The Panels suggested that KPIs be developed to further demonstrate progress on impact in a convincing way with reliable statistics as well as case studies. Statistics proposed include the following:

- Net jobs created in the region of investment or intervention;
- Net value of jobs created;
- Inward investment as a result of Research Centres' activities.

Indecon would be supportive of these proposals as this information is part of the evidence base needed (but not currently available) to assess the economic return on the investment. Care is needed to ensure that the above economic indicators are accurately collected and estimated, and SFI may need specialist assistance to assemble this evidence. The table below provides a summary of the views of the international panels on Research Centres' impact. Half of the activities of the Research Centres were judged to have demonstrated outstanding impact and potential for further impact. The other half were believed to have demonstrated significant further impact and potential for impact.

| Table 4.8: International Panel Reviews – Summary of Panel Assessments of Progress on Project Impact | |
|--|--|
| Description | % of Projects Evaluated by International Panels |
| The programme has demonstrated little or no potential for impact | 0% |
| The programme has demonstrated limited potential for impact | 0% |
| The programme has demonstrated some impact and potential for impact in most aspects, one or more issues need to be addressed | 0% |
| The programme has demonstrated significant impact and potential for impact in all respects | 50% |
| The programme has demonstrated outstanding impact and potential for further impact in all respects | 50% |
| <i>Source: Indecon analysis of individual International Panel Reports</i> | |

4.4 Summary of Findings

Our key findings on the programme return on investments are summarised below:

- ❑ International evidence on the returns to R&D investment show high level of returns to R&D in many countries. It is useful to consider some illustrative potential returns if the returns evident in other countries are subsequently achieved by these Centres. Applying a conservative estimate of the rate of return of 15%, which is lower than most international estimates thus representing a lower bound, would suggest that the expenditure by Science Foundation Ireland from 2013 to June 2016 on the first wave of seven Research Centres has the potential to result in approximately €13m per annum in terms of economic benefits. These benefits are, however, only likely to be achieved over time. The validity of this indicative estimate should be examined as part of a more comprehensive evaluation of the SFI Research Centres based on extensive primary research and detailed econometric modelling.
- ❑ The return on the investment in the Research Centres will be influenced by level of interaction with the internationally traded sectors in Ireland. New analysis undertaken by Indecon indicates that the Research Centres have been successful in collaborating with Irish-owned firms (45% of the total), as well as foreign-owned firms (55% of the total). Research Centres have also successfully engaged with a broad range of firms, including a significant number of SMEs. Of the firms who participate in Research Centres, one-third are large (>250 employees), though more than two in five (42%) are classed as small (<50 employees).
- ❑ One of the potential drivers of the Programme return on investment is the extent of subsequent commercialisation of the research. This in part can be seen from the levels of participation in the Enterprise Ireland Commercialisation Awards and targets for this were generally exceeded, as were the number of licenses. However, no information was available on the value of these licences or what subsequent economic activity may emerge from the licences. The number of spin-out companies achieved also exceeded the targets set.
- ❑ The international review panels found that each of the seven Research Centres had demonstrated significant or outstanding impact, with the potential for further impacts.
- ❑ A full account of the programme return on investment would involve measuring non-economic, societal impact. Indecon acknowledges that this is an important objective of Research Centres which takes time to materialise. Indecon would suggest conducting a full impact analysis ten years after programme inception.

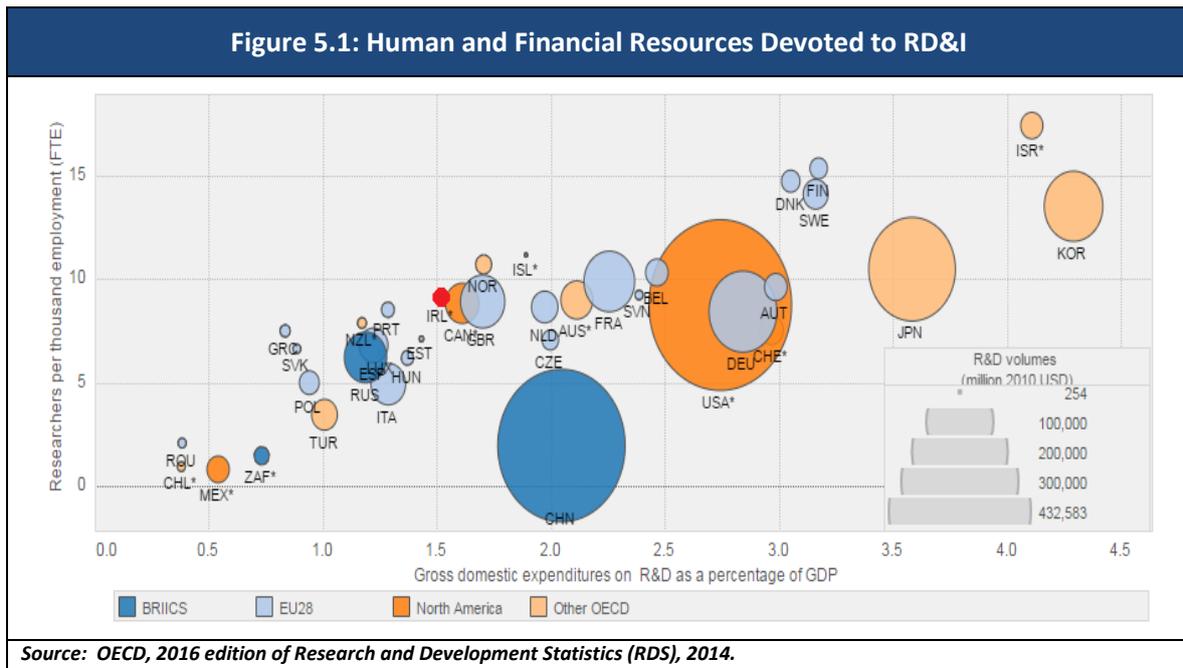
5 Adequacy of Resources Committed to the Research Centres Programme

5.1 Introduction

In line with the terms of reference and scope of this interim evaluation the study was restricted to a predominantly desk-based evaluation. Within these constraints it is useful to consider the implications of the existing information in forming a judgement on the adequacy of resources committed to the Research Centres programme. To put this in context it is useful also to consider the RD&I challenge for Ireland and the overall level of national resources allocated to RD&I.

5.2 Resources Allocated to RD&I in Ireland

Ireland in the last decade has invested significant additional resources in RD&I.¹⁰ Business Expenditure on RD&I (BERD) has increased from €1.10 billion in 2003 to over €2 billion by 2013. BERD has also increased as a percentage of GNP over that timeframe. Despite recent increases in business expenditure on RD&I, the RD&I performance of the enterprise base in Ireland is still below selected comparator countries. The annual EU Innovation Union Scoreboard provides an annual comparative assessment of the research and innovation performance of EU Member States, and the relative strengths and weaknesses of their research and innovation systems. The 2016 Scoreboard describes Ireland as an ‘Innovation Follower’ amongst its EU27 peer group, with an overall innovation performance close to the average for the EU Member states; and identifies Denmark, Finland, Germany and Sweden as ‘Innovation Leaders’. Figure 5.1 shows the extent to which these ‘Innovation Leaders’ utilise research personnel (vertical axis) and expenditure (horizontal axis) resources relative to ‘Innovation Followers’ like Ireland, which shows the extent of the gap Ireland faces to develop.



¹⁰ Evaluations of State Supports for Enterprise, Department of Jobs, Enterprise and Innovation

The challenge for Ireland in increasing the contribution of knowledge-based capital to support economic growth was considered in a report undertaken by the OECD. The OECD paper¹¹ emphasised the progress that Ireland's 'relatively young' innovation system had made. In particular, it pointed to the expansion in the number and range of publicly-funded Research Centres. These were seen as playing a key role in encouraging linkages and spillovers in the innovation system.

However, the report also noted that many firms in Ireland did not have access to Research Technology Organisations (RTOs). The advantages of RTOs, according to the OECD, is that they can focus on providing firms with technological and other knowledge related solutions, raise a substantial amount of their funding privately and have a shorter-term focus of 2 to 3 years than more academically focused Centres. RTOs can also act as bridge from HEIs to the private sector and play an important role in supporting SMEs in future innovation activities. In particular they can provide consultancy and technological expertise tailored to firm needs and nearer to market activities. It is important that RTO staff have the incentives to produce industry-focused research, and that performance and promotion would be based on commercially-related outputs rather than academic ones. The report also states that RTOs also need more operational freedom, for example, over employment contracts than current HEI Centres, a restriction also referenced in meetings with individual Research Centres conducted by Indecon for the purposes of this review.

The report concluded that, notwithstanding that the research Centre landscape was still evolving, it does not seem that this gap is being filled in Ireland. The new, larger SFI Research Centres fulfil a different and important role of longer-term strategic research, and that as a result that academic performance metrics remain dominant. Enterprise Ireland's new technology Centres are relatively small and project based and therefore not likely to build the critical mass and continuity that an RTO can bring. The report concluded that the Government should move to setting up a pilot RTO.

An issue for Ireland is whether the existing resources committed to RD&I including the resources committed to the SFI Research Centres are adequate to contribute to the objectives set in Innovation 2020 and in particular to the target of 2.5% of GNP. It is useful therefore to examine the evidence on the overall levels of public R&D expenditure as a percentage of GDP in Ireland compared to other countries. We include Ireland and an EU average and also include UK, Sweden and Denmark. The UK is relevant as one of Ireland's largest export markets and as a key location for foreign investment. Sweden and Denmark are included due to their success in R&D and innovation. The figures in Table 5.1 show that even during recessionary period Ireland continued to invest significant public expenditure as percentage of GDP on R&D supports. It is, however, noteworthy that Ireland's public expenditure in this area is below levels evident in some of best R&D performing countries such as Sweden and Denmark and is also below the UK.

¹¹ From Bricks to Brains: Increasing the Contribution of Knowledge-Based Capital to Growth in Ireland

| Table 5.1: Public R&D expenditures as % of GDP | | | | | | | | |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| EU | 0.6% | 0.7% | 0.7% | 0.7% | 0.7% | 0.7% | 0.7% | 0.7% |
| Denmark | 0.7% | 0.8% | 0.9% | 1.0% | 1.0% | 1.0% | 1.1% | 1.1% |
| Ireland | 0.4% | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% | 0.4% | 0.4% |
| Sweden | 0.9% | 0.9% | 1.0% | 1.0% | 1.0% | 1.1% | 1.0% | 1.0% |
| United Kingdom | 0.6% | 0.6% | 0.7% | 0.6% | 0.6% | 0.6% | 0.6% | 0.6% |

Source: European Innovation Scoreboard 2016

Also relevant are the levels of business R&D expenditures. Of note is that this has grown significantly as a percentage of GDP in Ireland in the period 2008 – 2015. While some other countries such as Sweden and Denmark invest significantly more than Ireland in business R&D expenditures, Ireland now exceeds the levels evident in the UK. It is, important that R&D supports continue to be structured in a way which leverages businesses investment in R&D. Achieving strong leverage with industry is one of the strengths of the Research Centres.

| Table 5.2: Business R&D expenditures as % of GDP | | | | | | | | |
|--|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| EU | 1.13% | 1.17% | 1.20% | 1.19% | 1.25% | 1.28% | 1.29% | 1.30% |
| Denmark | 1.76% | 1.94% | 2.14% | 1.97% | 1.98% | 1.97% | 1.96% | 1.95% |
| Ireland | 0.81% | 0.90% | 1.11% | 1.11% | 1.09% | 1.12% | 1.13% | 1.11% |
| Sweden | 2.38% | 2.59% | 2.45% | 2.21% | 2.24% | 2.22% | 2.28% | 2.12% |
| United Kingdom | 1.06% | 1.05% | 1.05% | 1.03% | 1.08% | 1.03% | 1.06% | 1.09% |

Source: European Innovation Scoreboard 2016

5.3 Funding Model and Resources Committed to Research Centre

A previous 2012 report on the Sustainability of Research Centres by the Advisory Council for Science, Technology and Innovation considered the evolving mix and profile of the Irish Research Centres portfolio¹² and the potential funding models that may be best suited for sustaining Research Centres. This report concluded that Government should support a smaller number of Research Centres than existed at the time, and to re-divert some funding towards resolving Centre sustainability issues and the development of new Centres.

¹² In this context, the term 'Research Centres' includes SFI Research Centres, fifteen EI/IDA Technology Centres, and a group of sector-specific Centres, more specifically Teagasc (agriculture & food research), Tyndall Institute (information and communications technology research) and NIBRT (bioprocessing research and training).

It was also recommended that funders of State-supported Centres assign a diversified set of funding sources and levels for each of their respective Centres, including private and other non-exchequer funding. As demonstrated in this interim evaluation this has been a feature of the SFI Research Centres.

Against the background of the level of funding allocated to RD&I nationally and the planned funding model for the Research Centre, it is useful to examine the amount of (annualised) expenditure on the Research Centres Programme for the seven Research Centres covered in this interim evaluation.

| Table 5.3: Public Resources Allocated to Seven SFI Research Centres | | |
|--|--------------------------|---------------|
| Research Centre | 2013 H2 – 2016 H1 | 2015 |
| AMBER | €12.9m | €3.7m |
| APC | €15.5m | €4.4m |
| Infant | €5.1m | €1.9m |
| Insight | €27.9m | €9.6m |
| IPIC | €8.7m | €3.1m |
| MaREI | €8.9m | €2.1m |
| SSPC | €12.4m | €4.2m |
| Total | €91.4m | €29.0m |

Source: Indecon Analysis of SFI Data

| Table 5.4: Public Resources Allocated to Seven SFI Research Centres | | |
|--|--------------------------|---------------|
| Research Centre | 2013 H2 – 2016 H1 | 2015 |
| AMBER | €12.9m | €3.7m |
| APC | €15.5m | €4.4m |
| Infant | €5.1m | €1.9m |
| Insight | €27.9m | €9.6m |
| IPIC | €8.7m | €3.1m |
| MaREI | €8.9m | €2.1m |
| SSPC | €12.4m | €4.2m |
| Total | €91.4m | €29.0m |

Source: Indecon Analysis of SFI Data

| Table 5.5: Public Resources Allocated to Seven SFI Research Centres | | |
|--|------------------------------|---------------|
| Research Centre | June 2013 – June 2016 | 2015 |
| AMBER | €12.9m | €3.7m |
| APC | €15.5m | €4.4m |
| Infant | €5.1m | €1.9m |
| Insight | €27.9m | €9.6m |
| IPIC | €8.7m | €3.1m |
| MaREI | €8.9m | €2.1m |
| SSPC | €12.4m | €4.2m |
| Total | €91.4m | €29.0m |

Source: Indecon Analysis of SFI Data

The resources committed to the Research Centre Programme on an annual basis are presented in the following table. This indicates public resources committed to the seven Research Centres of €29 million. This represented approximately 18% of all SFI resources or 3.8% of Government's overall budget for R&D.

| Table 5.6: Resources Committed to SFI Research Centres Compared to Overall SFI Budget and Overall Government Expenditure on R&D in 2015 | |
|--|-------|
| Government's Budget for Research and Development (GBARD) | €763m |
| Public Resources Committed to SFI | €162m |
| Public Resources Committed to Research Centres (seven) | €29m |

Source: SFI and Department of Enterprise and Innovation

It is also important to take account of the leverage from enterprise. This shows that total resources committed since 2013 to be nearly €130 million, and this excludes non-Exchequer, non-commercial sources.

| Table 5.7: Total Resources Allocated to SFI Research Centres, June 2013 – June 2016 | | | | |
|--|---------------------|-------------------------|----------------------|-------------------------|
| Research Centre | Total Budget | Public Resources | Cash Received | In-Kind Received |
| AMBER | €21.5m | €12.9m | €3.7m | €4.9m |
| APC | €23.9m | €15.5m | €6.4m | €2.0m |
| Infant | €7.6m | €5.1m | €1.2m | €1.3m |
| Insight | €33.3m | €27.9m | €2.6m | €2.8m |
| IPIC | €12.1m | €8.7m | €1.6m | €1.8m |
| MaREI | €12.2m | €8.9m | €1.2m | €2.1m |
| SSPC | €18.5m | €12.4m | €2.3m | €3.8m |
| Total | €129.1m | €91.4m | €19.0m | €18.7m |

Source: Indecon Analysis of SFI Data

In evaluating the adequacy of resources, it is important to consider funds from all sources. This is presented in Table 5.6 and shows that to date nearly €200m has been invested in the Centres. Within the constraints of this level of resources it is noteworthy that this has enabled the Centres to meet or exceed nearly all of the targets set.

| Table 5.8: Resources Allocated to SFI Research Centres, June 2013 – June 2016 | | | | | |
|--|----------------|-----------------------------------|----------------------|-------------------------|-------------------------------------|
| Research Centre | Total | SFI Research Centre/Spokes | Cash Received | In-Kind Received | Non-Exchequer/Non-Commercial |
| AMBER | €42.9m | €12.9m | €3.7m | €4.9m | €21.4m |
| APC | €28.6m | €15.5m | €6.4m | €2.0m | €4.7m |
| Infant | €12.2m | €5.1m | €1.2m | €1.3m | €4.6m |
| Insight | €48.9m | €27.9m | €2.6m | €2.8m | €15.7m |
| IPIC | €18.5m | €8.7m | €1.6m | €1.8m | €6.4m |
| MaREI | €20.0m | €8.9m | €1.2m | €2.1m | €7.8m |
| SSPC | €25.5m | €12.4m | €2.3m | €3.8m | €7.0m |
| Total | €196.6m | €91.4m | €19.0m | €18.7m | €67.6m |

Source: Indecon Analysis of SFI Data

The existing funding has enabled the Centres to employ a large number of highly skilled researchers. The data in Table 5.7 indicates that there were approximately 1,174 researchers employed in the Centres.

| Table 5.9: Employment of Researchers in the Seven Research Centres | | | |
|---|---|---------------------------------------|--|
| Research Centre | Host Institution | Number of Researchers Employed | Note |
| AMBER: Advanced Materials & BioEngineering Research | TCD, RCSI, UCC | 48 | Includes Investigators and Scientific Advisory Board Only |
| APC Microbiome Institute | UCC, Teagasc, CIT | 145 | Includes postgraduate students (M.Sc and Ph.D), post-doctoral fellows, and research assistants |
| INFANT: Irish Centre for Foetal & Neonatal Translational Research | UCC, RCSI | 99 | Includes Principle Investigators, Funded Investigators, Senior Researchers, Operations Team, Research Support Team and Postgraduate Students |
| INSIGHT: The Insight Centre for Data Analytics | NUIG, DCU, UCC, UCD, NUIM, TCD, Tyndall | 368 | Researchers, PhD Students, Research Assistants, Research Fellows, Post-Docs, |
| IPIC: Irish Photonic Integration Centre | DCU, CIT, Tyndall, UCC | 160 | PhD students principal investigators and funded investigators |
| MaREI: Marine Renewable Energy Ireland Centre | UCC, CIT, UCD, UL, NUIG, NUIM | 187 | Post-Docs, PhD students, Research Fellows, Funded Investigators, etc. |
| SSPC: Synthesis and Solid State Pharmaceutical Centre | DCU, AIT, UCD, UL, TCD, UCC, WIT, NUIG | 167 | Post-Docs, PhD students, Research Fellows, Funded Investigators, etc. |
| Total | | 1,174 | |
| <i>Source: Research Centres</i> | | | |

To put this in context, the table below shows the employment of researchers across the business, Governmental and Higher Education sectors. It shows that aggregate employment of researchers¹³ in Ireland is in line with the average of the countries listed at 0.6% of population. Ireland has 29,000 researchers, of which 18,000 are employed in business, just under 1,000 are employed in Governmental organisations, while the remainder (10,200) are employed in Higher Education Institutes.

¹³ This figure includes technicians, but does not include support staff.

| Table 5.10: Employment of Researches as a percentage of Population (2015) | | | | |
|---|-------------------|---------------------|------------|------------------|
| | Total Researchers | Business enterprise | Government | Higher education |
| Austria | 0.8% | 0.6% | 0.0% | 0.2% |
| Belgium | 0.7% | 0.4% | 0.1% | 0.2% |
| Chile | 0.1% | 0.0% | 0.0% | 0.0% |
| Czech Republic | 0.6% | 0.3% | 0.1% | 0.2% |
| Denmark | 1.1% | 0.6% | 0.0% | 0.4% |
| Estonia | 0.4% | 0.1% | 0.1% | 0.2% |
| Finland | 0.9% | 0.5% | 0.1% | 0.3% |
| Germany | 0.8% | 0.5% | 0.1% | 0.2% |
| Greece | 0.5% | 0.1% | 0.1% | 0.3% |
| Hungary | 0.4% | 0.2% | 0.1% | 0.1% |
| Iceland | 0.9% | 0.5% | 0.1% | 0.3% |
| Ireland | 0.6% | 0.4% | 0.0% | 0.2% |
| Italy | 0.4% | 0.2% | 0.1% | 0.1% |
| Japan | 0.7% | 0.5% | 0.0% | 0.2% |
| Korea | 0.9% | 0.6% | 0.1% | 0.1% |
| Luxembourg | 1.0% | 0.5% | 0.2% | 0.2% |
| Netherlands | 0.8% | 0.5% | 0.1% | 0.2% |
| Norway | 0.8% | 0.4% | 0.1% | 0.3% |
| Poland | 0.3% | 0.1% | 0.1% | 0.1% |
| Portugal | 0.5% | 0.2% | 0.0% | 0.3% |
| Slovak Republic | 0.3% | 0.1% | 0.1% | 0.2% |
| Slovenia | 0.7% | 0.4% | 0.1% | 0.1% |
| Spain | 0.4% | 0.2% | 0.1% | 0.2% |
| Sweden | 0.9% | 0.6% | 0.0% | 0.2% |
| United Kingdom | 0.7% | 0.3% | 0.0% | 0.3% |
| Average | 0.6% | 0.4% | 0.1% | 0.2% |

Source: OECD

Indecon, believes that the number of researchers per capita is not the best indicator of the adequacy of investment in this area given the significance of Ireland's internationally traded sector and the importance of FDI. The evidence in Table 5.9 suggest the need for investment over time in researchers if Ireland is to be aligned with best performing economies. This however is a wider issue than the number of researchers in the Research Centres.

| Table 5.11: Number of Researchers Employed per Billion Euro of GDP (US\$) | | | | |
|--|--------------------------|----------------------------|-------------------|-------------------------|
| | Total Researchers | Business enterprise | Government | Higher education |
| Austria | 185 | 130 | 7 | 47 |
| Belgium | 167 | 93 | 14 | 59 |
| Chile | 40 | 11 | 4 | 19 |
| Czech Republic | 207 | 113 | 40 | 53 |
| Denmark | 231 | 141 | 7 | 83 |
| Estonia | 162 | 49 | 23 | 88 |
| Finland | 239 | 141 | 21 | 74 |
| Germany | 173 | 107 | 28 | 38 |
| Greece | 197 | 32 | 53 | 111 |
| Hungary | 153 | 88 | 34 | 32 |
| Iceland | 196 | 107 | 18 | 71 |
| Ireland (GNP) | 131 | 81 | 4 | 45 |
| Italy | 122 | 63 | 19 | 37 |
| Japan | 184 | 125 | 13 | 44 |
| Korea | 247 | 181 | 21 | 41 |
| Luxembourg | 106 | 59 | 25 | 22 |
| Netherlands | 163 | 102 | 19 | 43 |
| Norway | 137 | 71 | 22 | 44 |
| Poland | 114 | 44 | 23 | 47 |
| Portugal | 173 | 65 | 7 | 99 |
| Slovak Republic | 112 | 28 | 28 | 56 |
| Slovenia | 239 | 155 | 41 | 43 |
| Spain | 132 | 58 | 26 | 48 |
| Sweden | 189 | 132 | 9 | 48 |
| United Kingdom | 165 | 82 | 6 | 75 |
| Average | 167 | 90 | 21 | 55 |
| <i>Source: Indecon analysis based on OECD Data</i> | | | | |

5.4 International Panels Assessment of Adequacy of Resources

In terms of the international panel reports, the table below reports findings which were made on individual Research Centre funding levels¹⁴. Overall, the international panels judged that the level of funding of the Centres was adequate for their purposes, and constraints other than funding were of key importance. Indecon would point out that, in our opinion, there are constraints on the ability of the individual Research Centres to absorb more resources given the following:

- ❑ The need to meet the industry co-funding targets as set down by SFI;
- ❑ The limited number of companies in Ireland who have the scale and reach to engage in the long-run collaborative research that is core to the Research Centres model;
- ❑ Access to appropriately trained and skilled research staff of a very high calibre.

Figure 5.2: Selected International Panel Comments on Funding Levels

| |
|--|
| <i>"It is evident that growth of () is becoming limited not by the possibilities for new funding, but mostly by its ability to take on new projects without chocking the existing investigators."</i> |
| <i>"Although the budget does not need to change, it is expected that the research should change as time goes on and not necessarily follow the exact plan in the original proposal."</i> |
| <i>"There are a variety of funding sources, limited only by the number and time of investigators and their funding."</i> |
| <i>"The reviewers do not believe the budget should be reduced..... More important than the value of the budget, is the autonomy in which it may be spent."</i> |
| <i>There is "no need to modify the budget in a significant manner."</i> |
| <i>Should the budget be modified to reflect changes in research plan? "Not so far."</i> |
| Source: Indecon analysis of individual International Panel Reports |

¹⁴ The identity of individual Centres is not reported.

The international panels also considered the issue of funding (as of June 2015) and recommended continued funding of each of the seven Research Centres. Only in one case did one of the panels identify the need to address key issues, though even in that case it was recommended to continue funding. A majority of projects were judged of high quality in nearly all respects, and 36% of projects were judged outstanding in all respects and deserving highest priority for continued funding.

| Table 5.12: Summary and Recommendations of International Panels Two-Year Review Reports | |
|--|--|
| Description | % of Projects Evaluated by International Panels |
| Project funding should be withdrawn | 0% |
| Project has serious deficiencies; funding should be reviewed | 0% |
| Strong project lacking in some aspects; key issues need to be addressed | 7% |
| High quality project in nearly all respects; recommend continued funding | 57% |
| Outstanding project in all respects; deserves highest priority for continued funding | 36% |
| <i>Source: Indecon analysis of individual International Panel Reports</i> | |

5.5 Summary of Findings

Our key findings on the adequacy of the resources committed to the Research Centres Programme are summarised below:

- ❑ Despite recent increases in expenditure on RD&I, the RD&I performance of the enterprise base in Ireland is still below selected comparator countries. The annual EU Innovation Union Scoreboard describes Ireland as an ‘Innovation Follower’ amongst its EU27 peer group, with an overall innovation performance close to the average for the EU Member states; This is behind the Innovation Leaders including, Denmark, Finland, Germany and Sweden.
- ❑ An issue for Ireland is whether the existing resources committed to RD&I including the resources committed to the SFI Research Centres are adequate to achieve the objectives set in Innovation 2020 and in particular to the target of 2.5% of GNP, and to develop Ireland as an ‘Innovation Leader’. Our examination of the evidence on the overall levels of public R&D expenditure as a percentage of GDP in Ireland compared to other countries show that even during recessionary period Ireland continued to invest significant public expenditure as percentage of GDP on R&D supports. It is, however, noteworthy that Ireland’s public expenditure in this area is below levels evident in some of best R&D performing countries such as Sweden and Denmark and is also below the UK.
- ❑ The adequacy of resources for interventions such as the Research Centres is also influenced by the levels of business R&D expenditures which have grown significantly as a percentage of GDP in Ireland in the period 2008 – 2015. While some other countries such as Sweden and Denmark invest significantly more than Ireland in business R&D expenditures, Ireland now exceeds the levels in the UK. It is important that R&D supports continue to be structured in a way which leverages businesses investment in R&D. Achieving strong leverage with industry is one of the strengths of the Research Centres.

- The international panels judged that constraints other than funding were of key importance. Indecon would point out that there are limits in the ability of the individual Research Centres to effectively absorb significant additional resources in the immediate future given the following:
 - The need to meet the industry co-funding targets as set down by SFI;
 - The limited number of companies in Ireland who have the scale and reach to engage in the long-run collaborative research that is core to the Research Centres model;
 - The challenge of recruiting appropriately trained and skilled research staff of a very high calibre.

- Our analysis suggests that while additional resources are not recommended at this stage reducing the levels of funding to the Research Centre Programme would be a mistake.

6 Recommendations

6.1 Introduction

This report provided an interim evaluation of the SFI Research Centres Programme. The Research Centres are one of a number of RD&I policy interventions in Ireland, aimed at promoting collaborative research projects and accessing RD&I skills.

The Research Centres Programme has been in operation for a relatively short period of time, with many of the collaborative agreements only commencing in 2014. Since the inception of the programme, the SFI Research Centres have put in place governance and advisory structures necessary to ensure oversight of these Centres. To date the Centres have established relationships with a broad mix of companies, including SMEs and MNCs; and firms which represent a broad mix of Irish industrial activity. There has been a high level of achievements in terms of measured performance against the objectives set and the International Panel assessments have indicated demonstrated impacts to date.

6.2 Recommendations

Indecon recommendations are designed to support the ongoing achievements of the Research Centres Programme and to enhance the impact of the Programme. The recommendations are presented in Table 6.1 below.

Table 6.1: Summary of Recommendations

- | |
|---|
| <p>1: Ireland should continue to provide funding to support the Research Centres Programme</p> <p>2: Continued emphasis should be given to the transfer of skills from Research Centres to enterprise</p> <p>3: Performance Indicators on Scientific Impact should be refined</p> <p>4: Significant Additional Evidence should be collected to facilitate measurement of Economic Returns</p> |
|---|

1: Ireland should continue to provide funding to support the Research Centres Programme

The evidence examined in this interim evaluation indicates that the Research Centres Programme has been impressive in meeting the targets set. The seven Research Centres have initiated a significant number of collaborative research projects involving a spectrum of Irish-owned and foreign-owned firms. They have also leveraged €19m in cash from industry and €18.7m in other industry contributions in addition to €68m from other sources.

In the context of the need for investment in the RD&I capacity of Ireland, we believe that the Research Centres Programme should continue to be supported and given adequate resources to ensure the long-term benefits of the support are gained. The recent report¹⁵ of the independent High-Level Group on maximising the impact of EU Research and Innovation Programmes concluded

¹⁵ LAB-FAB-APP: Investing in the European Future we Want, Report of the Independent High Level Group on Maximising the Impact of EU Research and Innovation Programmes. European Commission DG for Research and Innovation 2017

that at an EU level “reducing the overall level of R&I investment would be a mistake and a clear reversal of progress”. Indecon believes this is also valid in the context of the resources allocated to Research Centres given the performance to date of these Centres. This is particularly relevant given the need to ensure that Ireland’s R&D offering is aligned with competitors.

Indecon, however, did not as part of this interim evaluation have sufficient evidence to recommend any increase in resources for these Centres. We note that there are significant constraints in the ability of the existing Centres to effectively absorb any significant additional Exchequer resources in the short-term due to the need to secure co-funding from industry and the difficulties in attracting suitable skilled researchers. There may however be merit over time in considering an expansion of existing Centres if an identified need to address market failures is established. Any such investment should, however, be based on the findings of an independent cost benefit appraisal and should be undertaken on a case by case basis.

2: Continued Emphasis should be Given to the Transfer of Skills from Research Centres to Enterprise

As outlined in the LAB-FAB-APP Report (op cited), research “**is necessary, but not sufficient to fuel innovation**”. Indecon believes that the transfer of skills from Research Centres to internationally traded businesses is one important vehicle by which research investment can translate into economic impacts and can support innovation. Indecon’s engagement with industry representative bodies highlighted the importance placed on the flow of skilled researchers from the SFI Research Centres programme. The KPIs data shows that the number of Masters Graduates each semester fell short of target for a number of the Research Centres, though the number of PhDs produced exceeded targets. The continued importance of a skill transfer to enterprise should be emphasised. The creation of a pool of highly skilled researchers is one of the benefits of public funding. This objective merits continued emphasis, given the need to increase R&D investment by businesses and the critical role of skills in enhancing the absorptive capacity of firms to undertake such research.

3: Performance Indicators on Scientific impact should be refined

The Research Centres inter alia monitor scientific impact performance in terms of the number of publications and the number of conference publications. Indecon believes the existing performance measures are not adequate and should be refined. In particular we recommend that measures based on detailed bibliometric analysis should be undertaken focusing on the number of publications in the top 5% of journals by quality (journal impact factor), combined with measures based on field weighted citation indices or other citation-based metrics. These should only include publications resulting from work directly funded by the Research Centres. This recommendation is consistent with the views of a number of International Panel assessments of the Research Centres where, for example, it was indicated that “The total number of publications is not information as to the scientific quality of the Centre”. In another case the Panel indicated it was impossible to assess the impact of publications because there was very little information provided and they recommended that information on impact factor for the journal should be monitored. Given that the importance of top tier journals was explicitly included in the objectives set for the Research Centre Programme we recommend that this change is implemented as soon as feasible.

4: Significant additional evidence should be collected to facilitate measurement of economic returns

The existing information and evidence collected by the Research Centres are not sufficient to enable a rigorous evaluation of the economic returns on the investment. In advance of a subsequent evaluation of the Centres it is important that systems are now put in place to collect the evidence to facilitate measurement of economy returns. This will need to take account of the necessity to undertake a counterfactual analysis and to provide evidence on the role of the Centres in generating licences or spin off companies which result in measurable economic activity.

A recommendation from the recent LAB-FAB-APP report concerned the need to design R&I programmes for greater impact and that they should present the results and impacts that are expected to be achieved within specified timescales. The SFI Research Centres Programme has already structured the Research Centre Programme in this way with detailed targets and measurement of performance indicators. However, in line with a commitment to have an evidence based approach to evaluating impacts there is a need for significant additional information to be collected to facilitate the measurement of the economic return on the investment in the Centres.

Conclusions

This interim evaluation suggests that the Research Centre Programme has met or exceeded most of the targets set. They have been successful in leveraging additional resources from industry and other sources including the EU. The Programme is aligned with the national objectives set for RD&I and the Centres have the potential to make additional contributions to the internationally traded sectors of the Irish economy. There is however a need for refinement in the performance indicators and in the collection of the evidence needed to monitor the subsequent returns of the Centre's activities. Our recommendations are designed to assist the SFI in having an evidence base to measure the impacts of the Research Centre Programme.