

SFI thanks the Department of Jobs, Enterprise and Innovation for the opportunity to comment on the draft background document for the Successor to the Strategy for Science, Technology and Innovation. As a general comment it is important that the new strategy should emphasise the importance of a research spending plan. Primarily this should focus on the need for Ireland to increase its expenditure on RD&I activities, but may also include a plan for a multi-annual budget for research spending, which would better reflect the needs of the sector. The 1 year budgeting cycle is extremely limiting for agencies funding multi-annual projects.

The discussion on expenditure may also include an analysis of the current system of competitively allocated funding vs block grants, perhaps giving consideration to novel mechanisms of allocating any increases in block grant spend based on competitive performance. Most importantly this strategy should clearly show that most countries have increased their RD&I spending more than Ireland which means that although Ireland maintained or increased its expenditure, it is actually at a competitive disadvantage comparatively.

Given the increasingly convergent nature of research, SFI also recommends that careful consideration is given to the scope of the new strategy. The new plan should clearly articulate the role and funding structures for all relevant types of research (with regard to both discipline and technology readiness), with excellence and international benchmarking being at the heart of all planned activities.

Pillar 1 Investment in STI and key goals/targets

Key areas to be explored include:

- What should Ireland's ambition be in STI?
 - Ireland should become a global knowledge leader that places scientific and engineering research at the core of its society to power economic development and social progress.
 - Ireland's level of knowledge and innovation should become competitive with similar countries such as Denmark.
 - Ireland should restate and reiterate the importance of meeting its STI investment targets.
- Ireland is currently an innovation follower and lags other small developed countries in R&D intensity. Should we have more ambitious targets for investment?
 - Yes. More investment will enable creating human capital capacity in important areas which are currently lacking such as smart agriculture, manufacturing and energy.
 - More investment will enable increasing capacity in areas in which Ireland is currently leading, and in which existing researchers are operating at the limit. Increased investment will facilitate commercialisation of existing excellent research. Increased investment will also leverage existing capacity, facilitating winning international funding such as Horizon 2020 and increasing collaborations with industry.
- How can that level of ambition be justified? Where would we target increased funding and how could this be justified?
 - Eurostat data show that Ireland's STI system extracts top percentile innovation performance out of below average public investment in R&D. Increased public

funding will result in disproportionately large positive private sector effects e.g. innovation output.

- Most other countries have increased their RD&I investment *more* than Ireland which means that Ireland is comparatively at a competitive disadvantage. A good international benchmark for Ireland is Denmark.
- A research investment plan should be part of the new strategy. A multi-annual budget for research funding would better reflect the needs of the sector. The 1 year budgeting cycle is limiting for agencies funding multi-annual projects.
- Increased funding should be targeted through use of competitive mechanisms. These should emphasise excellence and impact by international merit review. Competitive mechanisms will maintain the existing high quality and performance in the innovation system. This will guarantee a strong return on increased investment.
- Novel mechanisms of allocating the block grant based on competitive performance should be considered.
- Increased funding should also be targeted at schemes which directly link infrastructure and people, increasing efficiency through strong coordination.
- Many authoritative sources justify increased investment including ESRI, UK BIS, ERC, McKinsey. Documentation available on request.

Pillar 2 Prioritised Approach to Public Research Funding

Key areas to be explored include:

- How can research prioritisation better serve our national objectives of a strong sustainable economy and a better society?
 - As a small country which cannot hope to maintain world leading expertise in all areas of STEM, SFI endorse research prioritisation as an overall approach.
 - Full clarity should be provided on the balance between research prioritisation areas and other areas such as research for knowledge, developing human capital, and research for policy.
 - The level of focus on societal challenges should be considered; societal challenges are a leading focus in Horizon 2020 and in other national funding systems. Also, Ireland has a large aid budget which could be complementary to the STI system.
 - Funding disruptive basic science may create new areas of opportunity; new high performing and quickly growing start-up companies typically emerge from unpredicted areas. Disruptive science by its very nature is unpredictable, so different metrics will apply to it: at minimum expect excellent publications, patents and highly trained people who will move to industry.
 - A rapid national responses to emerging areas of opportunity will be of critical importance for the future: this necessitates regular horizon scanning and international benchmarking
- How best do we identify emerging areas of opportunity and challenge i.e. horizon scanning?
 - The use of irregular meetings of prioritisation committees is inadequate due to inherently limited reaction times.
 - Selection of broad areas of prioritisation in conjunction with challenge based approaches (such as minimum co-funding in cash from industry) is preferable.

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- Learning from foresight activities and horizon scanning in other countries should be central to future identification processes.

Pillar 3 Enterprise-level R&D and Innovation Performance

Key areas to be explored include:

- A review of the outcomes of SSTI 2006-2013 shows that targets for the public research base were largely achieved or exceeded. Opportunities exist for further progress in regard to enterprise RD&I activity. How can public policy best support and more effectively optimise the impacts of enterprise RD&I investment - what actions could be taken to:
 - strengthen the number of innovation performers in the multinational sector?
 - There are no untapped research personnel of excellence in the public or private sector. Capacity building by a combination of attracting star researchers and developing junior indigenous researchers will be key to any strategy. NIBRT is a past example of where building a physical infrastructure was not matched by building up key researcher capacity and as such is currently underperforming in research.
 - broaden RD&I activity in the indigenous sector and build absorptive capacity?
 - Increased investment in the public research base will both attract MNCs and support the indigenous sector. The IP pipeline will be further filled, driving increased activity in the indigenous start-up and SME sectors. Increases in e.g. patenting activity will provide reliable indicators to MNCs of the quality of Ireland's innovation.
 - Novel funding schemes such as SFI's Strategic Partnerships Programme effectively leverage public and industry funding into research partnerships with excellence and impact, making RD&I activity in Ireland more attractive to enterprise.
 - Better promotion of SFI's Industry Fellowship scheme by EI and IDA to new companies should increase absorptive capacity.
 - Industry challenges or question / needs based funding mechanisms could be deployed which might assist particularly SME's and service based industry.
- Do we need to enhance the suite of enterprise support programmes to further drive innovation in industry and/or is there scope for consolidation of the existing range of support programmes?
 - The current suite of enterprise supports is valuable due to its portfolio/umbrella approach which ensures that there is an appropriate funding instrument in place for all scenarios.
 - It is important to have a portfolio of programmes, of varying scales, and targeting various stages of the commercialisation pipeline, in order to fully support enterprise RD&I.
- How can we incentivise firms that are R&D active to scale their research efforts?

- Novel funding schemes such as SFI's Strategic Partnerships Programme and the Centres Spokes Programme effectively leverage public and industry funding into research partnerships of excellence and impact, making RD&I activity in Ireland more attractive to enterprise.
- Existing attractors such as the R&D tax credit in conjunction with new schemes such as the knowledge development box act as strong incentives.
- Human capital availability is of paramount importance for scaling enterprise R&D activity.
- A strong and productive IP pipeline will be required to supply increased activity in this area.
- Programmes such as SFI Discover promote awareness and understanding of the importance and relevance of STEM to everyday life. These programmes build the profile and culture of STEM in Ireland and will ultimately increase the supply human capital.

Pillar 4 International Collaboration and Engagement

Key areas to be explored include:

- How can we further increase/strengthen the effectiveness of our international collaboration and engagement across all areas of STI investment in pursuit of economic and societal goals?
 - Leading on new initiatives which will be respected and emulated by other nations.
 - Continue creating partnership schemes with international funders which will both initiate new international R&I collaborations and strengthen existing R&I collaborations.
 - Novel funding schemes such as SFI's Strategic Partnerships Programme effectively leverage national public funding into international partnerships with industry. The Partnerships Programme showcases national excellence and acts as a new route for initiating MNC engagement.
 - Themed partnerships leveraging Ireland's existing expertise and advantages should be considered. Complementary strengths in other nations will act as positive multipliers, increasing the success of the partnership. Potential examples include Scotland & renewable energy and Brazil & water management.
 - Do not initiate separate schemes for different countries – this creates perverse incentives. Instead create an environment for researchers to select the most appropriate collaborations internationally and review such applications in competition with national applications. Focus on countries likely to deliver the most impact, e.g. UK (including Northern Ireland), USA, China, Brazil.
- What additional measures can be taken to maximise the engagement of industry as a partner in this regard?
- What additional measures could be taken to enhance Ireland's participation in Horizon 2020 and other EU Programmes – industry, academia, SMEs and MNCs?
 - Increased participation in roadmap creating groups (e.g. EIPs, KICs, ERA-NETs, JPIs, etc.) will ensure that European programmes align with Irish capabilities.

- Coordination of very large scale bids is being carried out by the Strategic Proposals Group; full cross departmental and cross agency support for these activities will increase the chances of success of resulting proposals.
- Are there research policy or programme developments taking place at EU level where enhanced engagement by Ireland could provide opportunities for research collaboration and ultimate economic or societal benefit?
 - Yes – increased involvement in the Joint Research Centre, and the European Institute of Technology’s Knowledge and Innovation Communities would provide valuable opportunities.

Pillar 5 Organisational/Institutional arrangements to enhance research excellence and deliver jobs

Key areas to be explored include:

- What could we do to further enhance our landscape and institutional arrangements to maximise the impact of research excellence and deliver jobs?
 - Increased development of the SFI Industry Fellowship scheme to place trained researchers in industry.
 - Focus on targeting all firms in a region including the corporate HQ of any MNC.
 - As above, aligning capital/infrastructural spend with spend on research projects is critical. Funding for infrastructure should be closely aligned with major new funding e.g. for Centres etc.
- Is there a need for a complementary market focused research centre structure in Ireland and how should that be organised?
 - Such a structure should have clearly defined objectives, metrics, and targets. A detailed cost benefit analysis should be carried out. Decisions on which sector(s) should be supported should be evidence based. Creation of such a structure should carefully consider access to skills, human resources, and HEI infrastructure bases. Of key importance is where will the centre personnel come from?
 - SFI’s Research Centres and Spokes programmes offer industry informed research of significant scale. The importance and quality of these programmes is demonstrated by recent Spokes awards with industry contributing €1m+ in cash as 50% contribution in individual awards. These centres would evolve with time. There is no untapped human research resource in public or private sector.
- How can Ireland optimise its strategic advantages of location, scale and environmental quality as a fundamental component of its research infrastructure?
 - The scale of Ireland allows the creation of national scale test-beds. Possibilities with relevant strategic advantages include Grid, Marine, ICT, and Health. When constructing new infrastructure of scale, consideration should be given to building in R&D capability into the infrastructure, e.g. in the new Children’s Hospital for example, instrumentation/sensors could be built into physical infrastructure enabling novel data analytics applications. Better integration of research and operational services in healthcare facilities would facilitate prototyping and trials. Public Private Partnerships or National Pension Reserve Fund mechanisms could be

used to support these activities. 1-2% of all infrastructure spend on each government funded project should be ring-fenced for R&D test beds, which would produce a multiplier enterprise effect.

- How can we further increase/strengthen the effectiveness of our national collaboration and engagement across all areas of STI investment in pursuit of economic and societal goals?
 - Excellence in Ireland is typically distributed across several institutions. Collaboration policy should bring together existing excellence; this will create synergistic effects in which the whole is greater than the sum of its parts.

Pillar 6 World class IP regime and dynamic systems to transfer knowledge and technology into jobs

Key areas to be explored include:

- The establishment of Knowledge Transfer Ireland has seen an important evolution in our knowledge transfer system but what more can we do to enhance further the transfer of knowledge into jobs?
- In terms of Intellectual Property policy, are there specific interventions or supports of a legislative or non-legislative nature that would improve the business environment and act as an incentive to create and sustain an innovative culture?
 - One outcome of benchmarking in the Small Advanced Economies Initiative in which SFI is involved was that Irish research outputs are competitive in terms of quality and quantity but the level of patenting is low compared to other similar nations. The reasons for why this is happening need to be fully understood before modifying existing interventions and supports. The perception is that there currently are sufficient interventions and supports, but this may not be the case.
 - Patenting is very important not just for the licence or spinout opportunities but as a hallmark to industry of innovative / disruptive science of excellence in the academic base.

Pillar 7 Government-wide goals on innovation in key sectors for job creation and societal benefit

Key areas to be explored include:

- What steps need to be taken to further the translation of investments in STI into the achievement of stated public policy goals? How can the Strategy enable research programmes to optimally support policy development and actions to address key national challenges in areas such as environment, health, etc.
 - Solutions to the national challenges typically require sustained cross departmental and cross agency support. Having the funding flowing from a central or independent source is the natural way to ensure ongoing support. Consideration should be given to such new ways of allocating public funding, perhaps consolidating agencies.
 - The new strategy should include clearly stated objectives for policy research in addition to clarity on how policy research will be funded. Should policy research

explicitly be part of the focus of one or more agencies? Should policy research be funded as a secondary component of existing funding schemes?

- What are the synergies between Government's goals in building a better society and the goal of creating jobs and economic growth?
- How can we address national challenges and also provide economic opportunities through development of new products, processes, systems?
 - For many of these deliverables, industry involvement will be critical. The limiting factor is typically a lack of funding. Initiatives such as the National Health Innovation Hub attempt to increase synergies between the triple helix of HEI-industry-government. The new strategy can best address these issues by setting out clear national objectives which are linked to a clear national spending plan. This would enable all actors to work together towards a common goal. This is best achieved by funding a central agency, e.g. SFI, and mandating that they pull together the appropriate government departments, agencies and industry.
- How can we address local and national challenges that are also regional and global challenges - how can Ireland through its research turn national challenges into global opportunities in areas such as sustainable land use, urban and rural development, and vulnerabilities to global trends and changes?
 - As a relatively small country, every region of Ireland has access to the expert research available in its HEIs. SFI data reveal collaborations with industry in every county of the Republic. Increased investment in the STI system will be accessible to every region in Ireland. Companies in regions should be targeted to educate them on the supports available.
- How can Ireland harness the opportunities presented by the major developments on observation systems, including the analysis and use of Earth Observation data by a wide array of sectors and users?
 - This is a key new area. Selected recruitment of star researchers is needed to build capacity. After that a competitive bid for a research centre could be considered.

Pillar 8 Research for knowledge and developing human capital

Key areas to be explored include:

- What more can we do to best harness the potential of our knowledge base for sustainable economic and social well-being?
 - Increasing the quantity and quality of collaborative work between STEM researchers and relevant researchers in the social sciences and humanities is important to solving societal challenges, as recognised by Horizon 2020.
- What additional steps can government take to ensure the development of human capital across the population to ensure the success of the new Strategy?
 - The single common thing that companies want most from the research base is trained people. Increased investment and linking HEI's and industry are the critical factors.
 - Incentivising strong candidates to enter teaching posts at primary, post primary and tertiary levels.

- Clearly supporting the various entry points to the research base thus enabling greater diversity of talent is essential. Supporting access to and recognition of non-traditional routes to training/development that support work/life balance, recognition of lifelong learning, the range of contributing roles (apprenticeship/Level 3 to Level 10 on NFQ).
- How can we ensure that the requisite links between research and scholarship are maintained across all RPOs?
 - Considering the scale of Ireland's higher education system, it is important that each HEI maintains (research) expertise in a number of specialist areas. Ireland is too small for each HEI to maintain broad coverage across all areas of STEM. Cooperation between HEI's should be promoted and efficiencies explored. SFI successfully engages with this structure via its Research Centres, almost all of which are multi-institutional.
 - Detailed measurement of both the scholarship outputs in addition to the research outputs will be critical in ensuring the requisite links. Detailed data will permit good accountability to the respective (scholarship and research) funding organisations. Performance targets and ongoing assessments should be integral parts of the system.
- In order to achieve a sustainable research capacity, are the outputs of our research system at doctoral and postdoctoral level the right ones in terms of volume, quality and relevant discipline?
 - HEA studies regularly show that employment rates among PhD graduates are significantly higher than employment rates among those with lower qualifications. This demonstrates that the current system outputs are of the relevant quality and in the relevant disciplines for Industry.
- How can the new Strategy support and strengthen the reforms taking place under the Higher Education Strategy and align with the new National Skills Strategy and develop capacity to enable Ireland to deal with new and emerging challenges across the full breadth of government strategies?
- How can we better leverage our research talent into the economy? How can those individuals active in research (and those seeking to be), both in the public and private sectors, be best supported to perform and progress including through optimum researchers' careers, recognition and mobility mechanisms.
 - Novel schemes such as SFI's Industry Fellowship Programme cross-pollinate expertise and encourage collaboration between public and private systems. Such schemes act as mobility and recognition mechanisms.
- How can gender equality in publicly funded research activity be further enhanced?
 - International best practice such as the Athena Swan project policy within the RPOs should continue to be supported; these systems include gender equality charters and awards for success/progress in achieving gender balance within the RPO staff, which in turn reflects into gender balance in research activity. Research funders can contribute to change in senior-level academic positions and research management by removing any existing or perceived barriers against the participation of women in publicly-funded research. Policies at evaluation stage, peer-review stage and grant management stage can encourage the participation and retention of women in

research. Unconscious bias training should be provided to all relevant staff and reviewers. SFI has re-introduced a maternity policy to cover the university costs associated with researchers taking maternity leave and to allow the extension of the related grants.

- How can the Action Plan for Jobs 2015 objective to increase the number of researchers in enterprise be fulfilled?
 - Increasing the quantity of the excellent research which is currently being carried out in the public system will serve as an attractor to research active MNCs choosing to locate here, assisting with achieving this objective (see ESRI report on location choice for R&D by MNCs). SFI's schemes to partner academic researchers with industry, e.g. Partnership, Centres, Spokes and to place trained researchers in industry, e.g. Industry Fellowship will do this and should be expanded.
- Should research and innovation performers be supported to engage citizens more actively in the innovation process to achieve optimal outreach to the public?
 - Yes. SFI CSETs and Research Centres have been supported to carry out public outreach since the inception of CSETs in 2003. These efforts should be broadened so that the majority of research funding includes planned public engagement intrinsic to the research. While it is important to create a greater knowledge profile of research and innovation amongst citizens, it is as important to reflect their needs, opinion and concern into the process. This will grow informed policy debate but also influence the confidence of the Irish public in promoting the uptake of STEM careers to our young people which in turn drives our national talent pipeline and competitiveness.
 - SFI is planning a public consultation and engagement process in order to better analyse which national challenges are of most interest to the general public. This exercise will inform SFI's investments and increase public engagement with STEM.