Consultation on successor to the
Strategy for Science, Technology and Innovation 2006 -2013
Response from the Technological University for Dublin Alliance (TU4Dublin)

The Technological University for Dublin Alliance (TU4Dublin), comprising the Dublin Institute of Technology (DIT), the Institute of Technology Tallaght (ITT) and the Institute of Technology Blanchardstown (ITB), welcome the consultation on a successor to the Strategy for Science, Technology and Innovation (SSTI) 2006 -2013. As members of a consortium preparing a bid for designation as a Technological University, fulfilling one of the central elements of the National Strategy for Higher Education to 2030, this is an important opportunity to contribute to the debate on the appropriate composition of the research and innovation ecosystem. During the period that the SSTI strategy will cover, the three TU4Dublin member institutions will merge, first, to create an enlarged DIT and then seek to become one of Ireland's first Technological Universities. Technological Universities make a direct contribution to science, technology and innovation and it is vital that SSTI 2 duly recognises and supports the unique mission envisaged for Technological Universities as outlined in successive strategic documents and in proposed legislation.

The entire HE sector has a crucial responsibility to bring the benefits of research and innovation to society. In the following, we set out the principles underpinning this approach from a Technological University perspective and respond to the specific questions posed under each pillar of the proposed strategy.

The Technological University and SSTI 2

The National Strategy for Higher Education to 2030 promotes the development of a unique type of university, the Technological University (TU), described as *"... a higher education institution that operates at the highest academic level in an environment that is specifically focused on technology and its application".* [1] The Technological University offers an opportunity for a new model of interaction between knowledge producers and end users in industry and the wider society.

Technological Universities (TUs) are practice-based, research-based higher education institutions with a systematic focus on preparation of graduates for professional roles. Technological Universities are distinguished by their applied research focus, oriented to national innovation strategy and characterised by strong links to enterprise, industry and other research units. [2] Technological Universities will undertake high quality research and innovation activities in distinct fields of science and technology, benchmarked against the highest international standards and with direct social and economic impacts for the surrounding

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[1] Report of the Strategy Group. (2011). National Strategy for Higher Education to 2030, p.103.
[2] Marginson, S. (2011). Criteria for Technological University Designation. Department of Education and Skills, p.8.

region.[3] They will have a particular responsibility to support local and regional small and medium-sized enterprises through applied, problem oriented research and discovery, with *"effective knowledge transfer alongside the provision of consulting/problem solving services that are particularly relevant to the region".[4]*

Technological Universities add a key new dimension to Ireland's research and innovation system. They realise a central goal of internationalising the higher education system through global engagement with world leaders in the innovation space. They add new impetus and capacity to enterprise-driven research and strengthen human capital development through closer ties to industry, supported by relevant partnerships in professional and practice-led education.

Technological Universities fulfill key elements of science, technology and innovation strategy by:
- Providing agile research and innovation capacity responsive to the needs of industry and enterprise;
- Concentrating research, innovation and graduate education in key areas of prioritized need;
- Producing use-inspired, impactful research through an emphasis on problem-solving, and social and technological development and innovation that advances human knowledge and makes a real difference to people's life experience;
- Supporting and building Ireland's talent pool with highly skilled and practice-oriented graduates;
- Creating further opportunities and greater access for Ireland's SME sector to research infrastructure and resources;
- Ensuring further success in knowledge transfer, commercialization of research results, supporting business development and job creation.

Technological Universities will play a direct role in enhancing levels of HE-industry partnership, fostering enterprise-inspired research development and promoting better and more coordinated services to industry. Their enterprise-focused educational programmes, supported by the close links forged with regional business, enterprise, professions and related stakeholders, will enhance innovation performance. Research and graduate education in the Technological University will include practice-led, professional, and industrial doctorate structures alongside more traditional PI-led approaches,[5] aided by work-based placements, entrepreneurship education and engagement of industry expertise in university programmes.

The Technological University for Dublin partners have committed to the establishment of an Enterprise Agency to grow, support and encourage an enterprising culture across the organization and to draw together this experience with external partners to create a charged and purposeful university capable of engaging effectively to support economic and social development.[6] Entrepreneurship will be embedded in all programmes, and the success of the various direct interventions to support entrepreneurs, start-ups and knowledge-intensive small and medium enterprises across the three institutions, will be built on and will become a major focus of the new institution.

The distinctive vision for higher education promoted by the Technological University for Dublin Alliance will be a critical element in Dublin's and Ireland's development. The TU4Dublin will produce a new type of university graduate with core skills in their chosen area of study, the technical and relational capabilities sought by employers and the innovative, creative and entrepreneurial qualities that will enable them to make a real impact on the economic and social challenges facing Dublin, Ireland and the world.

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[3] General Scheme Technological Universities Bill. (2012). Retrieved from https://www.education.ie/en/The-Education-System/Legislation/General-Scheme-Technological-Universities-Bill-2014.pdf

[4] HEA. (2012). *Towards a Future Higher Education Landscape*. Dublin: Higher Education Authority, p.14.

[5] HEA. (2012). *Towards a Future Higher Education Landscape*. Dublin: Higher Education Authority.

[6] TU4D Implementation Plan. (2014). Dublin Technological University Alliance, p.26.

Pillar 1 Investment in STI and key goals/targets

What should Ireland's ambition be in STI?

Ireland's ambition for Science Technology and Innovation should be to have the best possible truly open innovation ecosystem we can sustain; one that is SMART[7], balanced, sustainable and inclusive, able to deliver high levels of employment, productivity and social improvement. Ireland should aim to be the R&D destination of choice for international investment and be in the top 1% of international research performers in its strongest research fields, in the top 10% of those fields in which it has a special strength and in the top 30% for those other fields in which it is active.

The system requires an appropriate balance between blue skies research, creating the knowledge pool of tomorrow, and applied research that is closer to market. To achieve this, investment must be diversified to support more cross-cutting research efforts and avoid over-concentration on narrow fields of focus. We need to move from relatively closed innovation systems to truly open innovation systems in line with Open Innovation 2.[8] The innovation system must be characterized by strategic vision, empowerment and engagement of all relevant sectors. Investing excessively in a small number of large centres of excellence risks narrowing the pool of creative ideas as the research leadership is vested in fewer like-minded persons and ultimately limits the ideas component of strategic innovation and the potential for disruptive innovation.

Investment is required to:
- Ensure that Irish talent is nurtured by the continued development of it through Ireland's higher education system, building on the competitive advantage of having the youngest population in Europe;
- Support the upgrading of existing research infrastructure, physical, electronic, service[9], technical, intellectual and cultural and devise a solution to sustain the large capital investments in buildings and infrastructure made through PRTLI and SFI;
- Develop an innovative enterprise culture with the talent and ability to exploit the opportunities of a technologically-oriented, dynamic knowledge economy.

It is also vital that investment in research and innovation supports the balanced development of the economic, social and cultural wealth of communities across the country. Community, social and economic development should be as feasible in the regions as it is in larger urban centres.

Ireland is currently an innovation follower and lags other small developed countries in R&D intensity. Should we have more ambitious targets for investment?

Currently Ireland invests ca. 1.4 to 1.6 % of GDP in RD&I, which is significantly behind many comparator countries. In 2012 300 companies accounted for ca.70% of total R&D expenditure. Foreign-owned firms accounted for 66.6% of the expenditure and 54% of foreign owned firms are not R&D active. Amongst Irish owned R&D active firms, 72% of R&D expenditure is focused on sectors that are not significant exporters.

Industry and business in Ireland has been more traditionally engaged in manufacturing and servicing than in leading-edge research, development and innovation, with the consequent risk that manufacturing and services are more easily relocated than are knowledge intensive manufacturing and services rooted in locally generated knowledge, expertise and technology.

The capacity of SMEs to actively engage in knowledge transfer activities is typically limited by constraints in their human and financial resources. Manufacturing SMEs in the high-tech sectors typically have

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[7] SMART = Strategic, Measurable, Actionable, Realisable, and Time bound
[8] http://www.openinnovation.net/featured/open-innovation-2-0-3/
[9] Service Infrastructure largely comprises the systems and services associated with running the RDI system. For example standardising working days per annum, IT infrastructure, record collection, reporting and statistics.

proportionately higher R&D budgets, often related to short product life-cycles. They would benefit from closer links to academia with more accessible pathways to innovation and development, and it is important to encourage SMEs to absorb new and external knowledge for faster innovation.

In this context, it is vital to sustain the research infrastructure represented by PRTLI Research Institutes, and promote the access to research capacity provided by Technology Gateways whilst supporting initiatives such as employment-based and enterprise partnership schemes for research and innovation that enhance market-focused activity.

How can that level of ambition be justified? Where would we target increased funding and how could this be justified?

Ireland's spend on higher education research and development (HERD), which increased strongly during the period of economic growth to a high of €750m in 2008, has, as noted in the Consultation Paper (p.16), declined to an estimated €649m in 2013, as a result of the economic crisis. Ireland now lags behind leading small innovative economies with consequent challenges in responding to demographic change and maintaining a competitive research performance. Technological Universities represent a focal point for the strategic development of Ireland's higher education system. However, this strategic development needs to be adequately resourced, both to support the associated development costs and to boost new research and innovation capacity.

The current funding system is imbalanced, as it over-emphasises a few large scale centres of excellence whilst the remainder of the higher education system and the regions they serve struggle in terms of RD&I investment. The proposed new Technological Universities have a regional distribution that can, with the right investment, help to re-focus development patterns towards areas of greater need. Significant investment in the already established PRTLI Research Institutes and fledgling Technology Gateways can create regional technology hubs of appropriate scale, able to support and provide immediate access for local SME development. With the appropriate support, Technology Gateways can act as valuable portals to research capacity within the Technological University and to others centres of expertise such as EI/IDA-funded Technology Centres.

Pillar 2 Prioritised Approach to Public Research Funding

How can research prioritisation better serve our national objectives of a strong sustainable economy and a better society?

Research prioritisation and smart specialisation has been central to the achievements of national research strategy. However, the concentration of resources in NRPE areas (more than 90%) has been to the detriment of an RDI pipeline beyond a 5-year timeframe, at the expense of preparing and developing future research ground that may present opportunities for Ireland. There is an important role for fundamental research in STEM in order to ensure the foundations for future scientific discovery and innovation. SSTI policy also needs to be more broadly based to incorporate the three broad discipline groupings, Arts & Humanities, Social Sciences and STEM, each of which make a distinctive contribution to the flourishing of society and the economy.[10] Moreover, the need to engender greater and deeper interactions between disciplines is essential to meeting the challenges that confront Irish and international society.[11]

The current NRPE areas provide little accommodation for the Arts Humanities and Social Science (AHSS) domains and do not fully recognize the added value they bring. Investment in AHSS Arts and Humanities

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[10] Expert Group on Future Funding for Higher Education. (2015). The Role, Value and Scale of Higher Education in Ireland. Department of Education and Skills.
[11] Ibid.

has the potential to produce significant impact in the regions and is essential to the development of education, tourism and culture, all of which have been identified by government as significant opportunities for the Irish economy.

Greater involvement of social and humanities researchers in science and technology programmes, as envisaged under Horizon 2020, can also bring new perspectives and support innovation. AHSS researchers can add value through better understanding the needs of end-users and informing the direction and development of technologies in ways that have not been envisaged by scientists.

Pillar 3 Enterprise-level R&D and Innovation Performance

What actions could be taken to strengthen the number of innovation performers in the multinational sector?

Most interactions between research institutions and companies involve large firms, often foreign owned. This is due to the fact that such collaborations are considered to be more durable than with SMEs. It is notable that ca. €1.2 billion is spent by companies operating in Ireland on R&D outside of the state; this represents a major opportunity for Irish research provider organisations. We need to understand why these spends go abroad and what must be done to bring them home. Often, it is because the research is applied, falls within the upper Technology Readiness Levels (TRL) bands, not generally addressed in university research centres and requires performance to a certified standard e.g. ISO or GLP. A notable example of successful technology transfer involved an ISO accredited DIT research centre working with an Irish SME to achieve validation for a new automotive product for a leading OEM. This wouldn't have happened without an underlying understanding of the sectors requirements for traceability and rapid responses to developmental challenges.[12]

Establishment of research laboratories operating under ISO or equivalent standards has already proven very successful in DIT. Further successes could attract a significant proportion of MNC research to Ireland, deepening industry connections and confidence in the Irish research system, and create a more effective open innovation system.

Enterprise Ireland Technology Gateways are already established, and have completed over 1000 innovation projects for business involving over 450 companies, providing real impact for Irish industry, particularly the SME sector. Continued and enhanced investment in the physical and human infrastructure of Technology Gateways has the capacity to raise their output to a higher level providing regionally based, strategically focused research laboratory facilities open to support near-to-market R&D for product development, technology adoption or adaptation, and business and process enhancement.

What actions could be taken to broaden RD&I activity in the indigenous sector and build absorptive capacity?

The new Technological Universities and Institutes of Technology have a critical role to play as regional RPOs and market-focused research centres in the national RD&I ecosystem due to their applied research focus, regional location and accessibility to the SME sector. The greatest potential for sustainable economic growth lies with the indigenous regional SME sector. Enterprise Ireland funded Technology Gateways act as portals into regionally distributed centres of excellence, including PRTLI Research Institutes, strategically focused on prioritized areas technology development of national importance and provide ready access for SMEs to expertise and capability they cannot justify having themselves.

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[12] CREST (DIT) working with TE Labs (SME) to pass Volvo (OEM) requirements for C&F Automotive (MNC)

Greater investment is needed in regional RPOs to increase their research capacity and capability in a sustainable manner in order to:

- Develop enhanced mechanisms and systems to better engage regional companies including SMEs in R&D activity;

- Better educate companies, particularly Irish owned SMEs who collectively are the largest employment group, on export opportunities that can be addressed proactively through R&D;

- Provide enhanced access for SMEs to RPOs;

- Improve the connectivity between the Technological Universities and the larger research centres funded through EI, IDA and SFI;

- Strengthen the Enterprise Ireland Local Enterprise Offices (LEO) and forge stronger links between them and RPOs who can provide local regional supports in terms of access to R&D expertise and facilities.

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?

Building the capacity of the Technological Universities and their constituent research infrastructures is essential if they are have the necessary bandwidth to provide sustainable high level services to industry. Enterprise Ireland does not currently address capacity building but rather is focused on bridging capabilities between Institutes of Technology and local industry and the development of on-going regional strategies involving Institutes of Technology.[13]

While Institutes of Technology have completed more Innovation Voucher projects than all other institutions and account for 53% of the Voucher Budget in recent years, twice that awarded to the university sector, IoTI members were only awarded 34% of Innovation Partnerships compared to universities. The question is why? Research capacity and capability in this sector must be supported to move up the value chain in terms of research engagement to convert Innovation Voucher engagements into larger higher impact Innovation Partnership projects with local industry.

The business incubation units co-located on higher education campuses have the potential to support the creation and development of HPSUs (high potential start-ups). Currently, many of these centres are at capacity and an expansion of the incubation centres has the potential to increase the numbers of new indigenous companies. Enhanced regional incubation centres aligned with Technological Universities would support stronger regional development creating local employment and self-sufficiency. Greater investment in a national accelerator programne would also assist start-ups grow more effectively based on research and innovation.

How can we incentivise firms that are R&D active to scale their research efforts?

The EI 4 interlocking pillar model of 'Start – Innovate – Scale – Anticipate' must be further developed to build effectively upon current supports for industry involvement in R&D, connected through PRTLI Research Institutes and Technology Gateways and onto larger national research centres. Enterprise Ireland has invested over €34million in campus incubation facilities. These have a strong regional dimension and 94% of companies remain in region post-incubation. The incubation process leads to deep engagements between academia and new businesses in their critical formative period. However, the most difficult period for start-ups is the post incubation phase, which is when they often face their toughest challenges.

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[13] Presentation from Julie Sinnamon, CEO of Enterprise Ireland to IoTs presidents March 2015.

Providing increased capacity and capability to the Technological University sector has the potential to enable those companies to expand their horizons through a strong R&D with the TU having the bandwidth and capacity to support them to grow their business, their technology and their product portfolio to better ensure sustainable growth is achieved. Having access to a strong R&D capability can help young companies raise capital, recruit key personnel and accelerate their development in a sustainable way.

The partners in the Technological University for Dublin Alliance build on an excellent track record for incubation. The DIT Hothouse Team has supported over 200 knowledge-intensive companies who currently employ over 1,200 people and have raised over €100m in equity investment. In 2010, 10 of the 80 High Potential Start Ups (HPSUs) celebrated by Enterprise Ireland were DIT Hothouse companies. In 2011, the team also commercialised research at five times the rate of the other universities in Ireland, launched five spin-out companies and completed 20% of the technology transfer licenses in Ireland on just 3% of the national research expenditure. The Dublin Region Innovation Consortium (DRIC), including technology transfer and incubation services at DIT Hothouse, IT Tallaght, IT Blanchardstown, IADT and National College of Ireland, has been recognised by an international panel of Technology Transfer Directors as being a "gold Standard consortium". DRIC has been one of the top performing knowledge transfer offices in the HE sector with more invention disclosures, licences, spin-outs and patent applications per €10m research expenditure than any other partner consortium.

Pillar 4 International Collaboration and Engagement

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?

1. Increase spending on international collaborations from 3% of GBAORD to 5%.
2. Develop national mobility programmes to support student exchange to international research facilities and staff between Irish and international research facilities.
3. Actively promote the incorporation of international research organisations into Irish bids for international funding
4. Actively promote research opportunities in international research organisations to Irish researchers.
5. Identify and build international research facilities in Ireland that can be used by other international researchers
6. Promote joint appointments between Irish organisations and International Research Organisations

Public investment has helped Irish researchers to engage in more international collaboration leading to increased grants, networking opportunities, profile building and enhancement of the researcher formation process.

However, SSTI policy needs to:

- Sustain PRTLI Cycle 4 established National Platforms as vehicles for more consolidated international engagement;
- Ensure that access to research infrastructure through international collaborations is widely promoted and accessible to all;
- Ensure that memberships and participation in international collaborations is independently coordinated and reviewed to ensure value for money;
- Develop a specific structured scheme to support the best talent across all discipline areas to engage in international collaboration.

Support for the development of joint PhD awards through for example Marie Skłodowska-Curie European Joint Doctorate programmes would also be beneficial to fostering further international collaboration. It is interesting to note that the first H2020 call for European Training Networks in 2014 attracted over 1500

applications for traditional PhD programmes while the European Industrial Doctorates (EID) and European Joint Doctorates (EJD) each attracted ca. 150 applications. Assisting Irish HEIs to engage in EID and EJD would be helpful to growing new collaborations as a base to be leveraged for larger scale research programmes. This might include a fund dedicated to help meet co-funding requirements in MSCAs.

What additional measures can be taken to maximise the engagement of industry as a partner in this regard?

Funding incentives should be put in place to incentivise collaboration and engagement with business and enterprise. Policy should reward HEIs and companies that form strong partnerships. The most productive collaborations are strategic and long-term in nature, built around a shared research vision. Funding directed at longer term strategic programmes of R&D rather than short-term projects should be considered, with staff exchanges/secondments as an integral part of the process. Strategic partnerships designed to run for five to ten years deliver greater and often unanticipated benefits to all parties through a virtuous circle of interactions.[14]

Institutes of Technology have considerable untapped potential to engage with industry to develop sustainable research. However, there is often a disconnect between the demands of education programmes and the research mission of institutions who experience constraints on their activity through the heavy teaching loads of academic staff which limit their involvement in R&D activity. A rebalancing of the academic workload model, therefore, recognising the importance of research engagement as a core activity for academic staff can add to this substantial research capacity.

What additional measures could be taken to enhance Ireland's participation in Horizon 2020 and other EU Programmes – industry, academia, SMEs and MNCs?

Irish researchers need to become more involved in EU wide collaborations to gain effective access to competitive consortia for applications for EU funding. A proactive approach to funding strategic researcher mobility from and to Ireland, aimed at forging and deepening collaborations should be considered (similar to the Brazil Science Without Borders initiative).

Effective participation in H2020 also involves high indirect costs to coordinating institutions in preparing competitive proposals. In order to achieve better success in a very competitive environment and to attain the ambitious targets set for Ireland's participation and funding from Horizon 2020, a targeted scheme for research academics focussed on leading international collaborations should be developed.

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

What could we do to further enhance our landscape and institutional arrangements to maximise the impact of research excellence and deliver jobs?

Technological Universities provide a real opportunity to have a much more engaged and collaborative university model with wide-ranging connections to professional, regulatory and statutory bodies, NGOs and to wider society. An applied technological and scientific research focus is one of the defining features of a Technological University and enshrines professional practice in all aspects of its education from Level 6 up to Level 10 doctoral education. Technological Universities will provide Irish enterprise with access to

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[14] From 'Making Industry-university Partnerships Work - Lessons from Successful Collaborations' (2012) report produced by the Science/Business Innovation Board AISBL http://www.sciencebusiness.net/Assets/94fe6d15-5432-4cf9-a656-633248e63541.pdf

additional capability and infrastructure to support research and innovation. Their role and distinct focus, therefore, needs to be taken into account within any new framework for market-focused research activity (p.38).

The Irish Research eLibrary (IReL) is an example of access to international research infrastructure in the form of a national electronic library, jointly funded by the Science Foundation Ireland (SFI) and the HEA. IReL enables researchers to have access to a world-class electronic library service comparable to any such service in the international research community. To be a truly national resource, however, IReL needs to be available to all higher education institutions, rather than the present situation where 7 Irish universities and RCSI enjoy full access and only limited resources are available to the Institutes of Technology. Equality of access to research infrastructure should be a fundamental principle underpinning public investment in research and innovation.

Is there a need for a complementary market focused research centre structure in Ireland and how should that be organised?

Nationally, the large-scale research centres funded by SFI propose to extend their reach using their Spokes model. This risks duplicating the effort and resources devoted to establishing Technology Gateways which already enjoy strong effective relationships with industry. The Technology Gateway Programme has provided a key access point for industry, especially the SME sector, and has a proven track record of efficient and effective knowledge transfer, delivering additional value for research in excess of €13 M with 42% of the total directly coming from industry. Therefore, it makes more sense to increase Technology Gateway capacity and provide it with connectivity to the larger research centres. The geographic distribution of the Technology Gateways also provides for a more balanced regional development strategy.

In the absence of any evidence to the contrary (actual demand for this service for example), the Technology Gateways as *"market focused research centre[s]"* should continue to be supported. Within a two year timeframe, a mechanism should be developed to provide core sustainability funding (a common international model) while leveraging their success to date and assessing the need for more of these centres.

How can Ireland optimise its strategic advantages of location, scale and environmental quality as a fundamental component of its research infrastructure?

Ireland has a relatively low population density, an unspoilt landscape, a rich tradition for high quality food production, and a rich cultural history linked to the international Irish diaspora. All of these factors combine to create a cultural, gastronomic and tourism industry with a potential to attract large numbers of visitors to our shores and the attendant spin-of enterprises to support this. This allied to the potential for ICT capabilities to enrich tourism experiences, improve agricultural practices and make the rich history of Ireland more accessible to all, points towards new cross-cutting AHSS – ICT opportunities that should be further considered within research prioritization.

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?

Public investment and increased spending on research infrastructure over the course of SSTI 1 has resulted in a significant expansion of capacity, levels of research activity and overall coherence of the research and innovation system. PRTLI has been particularly significant for higher education institutions through strategic development of research capacity at the institutional level while building clusters of collaboration and better systemic integration.[15] Sustaining this infrastructure is critical. The HEA National Access Policy is very

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[15] Interdepartmental Committee on Science, Technology and Innovation. (2015). Consultation Paper for Successor to SSTI. P. 37

much welcomed, but there should be a similar National Access costing model, applicable to all institutions, recognised by all funding agencies.

The development of a national system for PhD education and funding for Structured PhD programmes, a legacy of investment under PRTLI and the former IRCHSS and IRCSET, led to a major expansion of PhD outputs over the timeframe of SSTI and emergence of collaborative national platforms for graduate education. However, while some mainstreaming has occurred[16] the lack of funding support for collaboration and consolidation of discipline-based networks has seen some initiatives in graduate education falter. AHSS disciplines have been particularly hard hit in this regard. Collaboration within the context of regional clusters, as defined by the HEA,[17] has potential for further development of graduate education partnerships at the local level though further development is needed to foster coherence at the national level.

From the perspective of HEI-industry partnerships, the most effective business academia partnerships are characterized by the engagement of individuals who understand both worlds and become the driving force behind successful partnerships. Funding and incentivising strategic partnerships designed to run for five to ten years between academia and industry to deliver greater and often unanticipated benefits to all parties through a virtuous circle of interactions should be considered.

Effective business academia collaboration is one that enables business to do things it can't do for itself. Companies are increasingly moving their R&D focus away from basic research toward applied closer-to-market research or addressing company immediate needs. This results in companies having a more limited capacity to look into the future and make informed decisions on longer-term strategic directions and investments. Increasingly, they turn to the academic sector to know what is going on at the frontiers of research. Long-term strategic partnerships focus the creativity and talent of HEIs on enabling future innovations that can be taken to market by industry and deliver benefits to society within a five to 10 year timeframe.

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

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?

Supporting research with commercial potential and promoting higher education that incorporates an enterprise-oriented dimension is central to the role of the Technological University. A frequent shortcoming in applied research proposals for EU funding calls is the business development plan to demonstrate that the proposal makes sense. Science and technology researchers tend to be poorly equipped to develop such sections of funding proposals and national supports to enhance knowledge and expertise in this area are needed. Key areas to be addressed include: describing the business and business model (strategic goals), clear identification of the market to be addressed, including proper assessment of market need, size, prospects, routes to market, competition and SWOT analysis, legal, societal and market dependencies, financial models and funding requirements to translate from R&D commercial reality. Technological Universities will address this by fostering a stronger engagement between science and technology research and business, incentivising and requiring research centres to develop appropriate business (in its broad sense) research units.

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[16] p.38
[17] p. 68

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

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.

We have seen significant investment in the last decades in buildings and R&D facilities. The areas of greatest weakness are in:

- Sustaining the technological edge of the established research centres,
- Improving awareness of and access for business/enterprise to the capabilities housed in higher education,
- Placing greater focus on programmatic funding for young researchers - the lifeblood of any research centre - as opposed to funding of individual projects, to build capacity, provide continuity, and
- Promoting high-risk/high-impact research with rigorous quality controls.

What are the synergies between Government's goals in building a better society and the goal of creating jobs and economic growth?

The whole of government approach to innovation for job creation and societal benefit is fundamental to SSTI. 'A stronger economy and a better society' are two sides of the same coin. A flourishing economy with opportunities for all citizens will foster the development of better society either indirectly, through the ability to provide more and better 'social services' or directly arising from local, community-based initiatives. SSTI 2 can make direct contributions to this process by addressing so-called Grand Challenges. These challenges can be either uniquely national challenges, or exist within the broad definition of the International Grand Challenges such as those framing the implementation of Horizon 2020. Challenges such as Climate Change, Ageing Society, Food Safety and Security, Water Access, Secure Societies and A Changing World have distinct local variations that Ireland could usefully address, contribute to the international solutions and gain a sustainable economic advantage.

Pillar 8 Research for knowledge and developing human capital

What more can we do to best harness the potential of our knowledge base for sustainable economic and social well-being?

At the heart of Ireland's research and innovation system is its cohort of highly trained researchers and knowledge workers for which the HE sector has particular responsibility. Key challenges for STI policy include:
- Maintaining formation of skilled people
- Releasing further potential of resources within the HE, and particularly the Technological University sector
- Ensuring better visibility and recognition of researchers' achievements and contributions to innovation

Key to this must be the formation of skilled people within an intellectually supportive and innovation sympathetic, development environment. The number of skills required of today's knowledge workers

continue to expand, driven by external competition and internal demand. People must continue to improve and to be better prepared.

A sustainable career structure for researchers is urgently needed. We invest heavily in developing human capital potential on short-term contracts only, too often, to have the knowledge and expertise they develop at taxpayers' expense depart when contracts end. We need long-term career structures to support high-level researchers with proper access to pensions, maternity leave entitlements, and other supports available to whole-time employees.

What additional steps can government take to ensure the development of human capital across the population to ensure the success of the new Strategy?

Have a unitary approach to funding RD&I across the whole higher education system. Give all HEIs access to core funding for R&D activity but tied to performance.

Notwithstanding the need for distinctive missions, place universities, technological universities and IoTs alike on the same footing with regard to research funding. Treat all researchers, irrespective of the home institution, equally with regard to access to pensions, and other entitlements.

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?

The research performance indicators (RPIs) used to monitor performance continue to be overly reliant on traditional measures such as peer-review publications and citations. This disadvantages many who operate in IP-sensitive areas and close to market research in which commercial sensitivities can limit publication opportunity. A broader suite of (RPIs), to better capture research performance at the individual and institutional level is required, which has very clear and unambiguous definitions to ensure consistency in reporting. RPIs need to assign appropriate value to IP generation company engagements yielding measurable impacts, e.g. new products, employment creation, improved competiveness, new markets, etc.

A transparent and reliable accountability mechanism for evaluating outputs is needed. This should be internationally benchmarked, drawing from previous experiences of research assessment and should meet the following objectives:

- Support the development of research and enterprise development,
- Encourage researchers to remain at the frontiers of their research,
- Encourage public-private partnerships for research and economic development,
- Encourage companies to engage in research in support of their business objectives,
- Provide assurance to funders and to the public alike that their investment is well used, effective and of benefit to them and to wider society.

In terms of doctoral training, more emphasis is required on non-traditional routes to PhD, including professional and work-based doctorates. For its part, the Joint Graduate Research School of the TU4Dublin Alliance has integrated employability skills training including entrepreneurship within its Structured PhD programme.[18] Further opportunities to enhance doctoral training can include research student internships in SMEs, thereby increasing the research absorptive capacity of the company. Consideration should be given to expanded opportunities for funded support of such schemes such as the Irish Research Council industry-based PhD schemes and enterprise partnership schemes.

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[18] http://dit.ie/researchandenterprise/graduateresearchschool/phdopportunities/phdprogramme/

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?

The national reform agenda for higher education is largely based on consolidation. A key element of the reform strategy is the formation of a strong Technological University sector that is clearly differentiated from the traditional university model. Allied to this are the proposed Regional Clusters, intended to provide connectivity and coherence to the overall national RD&I axis.

However, the discussion document does not clearly articulate a research role for the Technological University. Nor does it provide for funding models to redress the very real and significant imbalance in research funding for the traditional university sector versus the remainder of the higher education system. The proposed Technological University sector, with its regional distribution, has an untapped capacity to engage with and support regional SME growth and development, creating local industry (94% of companies incubated in their business incubation units remain in region post-incubation), employment and social advancement. However, despite the assertion by EI (*the Enterprise Ireland role is currently not about capacity building but rather about bridging capabilities between Institutes of Technology and local industry and the development of ongoing regional strategies involving Institutes of Technology*),[19] both the capability bridging AND capacity building aspects must be addressed in a concerted fashion if there is to be a sustainable regional RD&I service provided.

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?

Long overdue is a proper career path structure for post-doctoral researchers in Ireland, with security of tenure and proper equitable access to portable pension plans irrespective of the organisation involved. The current rewards system for postdoctoral researchers is woefully inadequate and unattractive, given their very high levels of expertise, and the personal time and cost investments in education required to achieve those levels. This ongoing situation makes it very unattractive for young scientists to stay in research roles.

How can the Action Plan for Jobs 2015 objective to increase the number of researchers in enterprise be fulfilled?

More programmes with stronger incentives for business/enterprise to become involved in industry-based PhD programmes are needed. Currently, these are unattractive due to the duration of the PhD programme which is not always consistent with the R&D need of the company which tends to be immediate and short-term in nature. Encouraging and incentivising companies to think more strategically, and to have longer term development projects more attuned to the PhD requirements, could provide the uplift required.

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The three partner institutions of the Technological University for Dublin Alliance - the Dublin Institute of Technology, the Institute of Technology Tallaght and the Institute of Technology Blanchardstown - are passionate in their commitment to realising the goals of national research and innovation strategy for the benefit of Irish society. We look forward to playing an integral role in the development of STI through the vehicle of a new type of Higher Education Institution in the Irish Research Landscape and once again are grateful for the opportunity to contribute to the consultation process.

March 23rd, 2015

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[19] Presentation from Julie Sinnamon, CEO of Enterprise Ireland to IoTs presidents March 2015.