

Irish Academy of Engineering

Response to the Consultation Paper for Successor to Strategy for Science, Technology and Innovation

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The Irish Academy of Engineering

The Irish academy of Engineering is an all-Ireland body, concerned with long-term issues where the engineering profession can make a unique contribution to economic, social and technological development.

Its members are Irish engineers of distinction, drawn from a wide range of disciplines, and membership currently stands at approximately 145.

Drawing on the experience and knowledge of its distinguished members, the Academy works to facilitate communication and dialogue on engineering-related matters. It regularly publishes reports and analyses, some jointly with other learned and professional bodies.

The Irish Academy of Engineering,
22 Clyde Road, Ballsbridge, Dublin 4
Telephone: +353 1 665 1337

academy@engineersireland.ie

www.iae.ie

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Focus

This consultation offers the opportunity to focus on the technology and innovation elements of the Strategy for Science, Technology & Innovation. This focus can increase the probability that the state will get an economic or enterprise dividend from the investment in research.

In recent years there has been a strong and welcome focus on research prioritisation. This prioritisation exercise identified research areas that are aligned with sectors and industries where Ireland has, or can develop, international competitive advantage.

However, the emphasis is still on scientific research and there is little discussion or indeed investment on developing technology and innovation; developing the engineering research and the structures that can develop the knowledge to harness engineering expertise to solve problems, fulfill needs or satisfy wants.

Henry Petroski, a professor of engineering and history at Duke University, in an IEEE Spectrum article Nov 2010 entitled 'Engineering is Not Science' argues that confusing the two keeps us from solving the problems of the world.

He states :-

'Science is about understanding the origins, nature, and behavior of the universe and all it contains; engineering is about solving problems by rearranging the stuff of the world to make new things'.

The Engineering community needs to play a larger role in understanding our enterprise problems and in plotting a path to sustainable economic development.

Therefore in our input on the new strategy, the IAE try to articulate the benefits of an increased focus on technology and innovation, ensuring that we focus on the 'D' in R&D.

In this context the current HEA review on how to improve the linkages between academia and industry are most welcome. In the UK the Royal Academy of Engineering have been requested by government to undertake a similar review (i.e. Dowling Review). Through IAE members, who are also RAE members, we have been assured of access to the inputs and findings of that review.

In this response please note:

- [Consultation Paper Questions shown thus](#)

- IAE Response shown thus

Pillar 1 - Investment in STI and key goals/targets

Key areas to be explored include:

- What should Ireland's ambition be in STI?
 - Must continue to be the basis for enterprise policy.
- Ireland is currently an innovation follower and lags other small developed countries in R&D intensity. Should we have more ambitious targets for investment.
 - We must have more ambitious targets.
- How can that level of ambition be justified? Where would we target increased funding and how could this be justified?
 - We are an open economy in an increasingly globalised world. If we hope to maintain our standard of living then we must either compete by constantly increasing productivity, or compete on the basis of differentiated products and services. Only by understanding the needs of markets/customers and then satisfying those needs in a superior differentiated way (normally through technology, knowledge, skills etc) can we extract value or a premium price from customers.

Today we have an unhealthy reliance on foreign direct investment. The main driver is tax. It is not prudent to base our policies on tax into the future as global pressures (state, customer, morality) drive an element of harmonization.

We must target increased funding from EU (2020) and Industry. RDI performance of the enterprise base in Ireland must be improved.

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?**
 - There is a danger that research for its own sake will lead to disappointing economic outcomes. We may need to look at how to reinforce the existing structures and deliverables for SFI Centre to optimize their impact.
 - Research prioritisation should fund research & development activity in design, technology, innovation and commercialization processes.
 - An OECD 2013 Economic Survey Report on Ireland states that Research Technology Organisations (RTOs) such as Germany's Fraunhofer Institutes are lacking in Ireland. They recommend that *"the Government should move to setting up a pilot RTO. The aim should be that the RTOs are eventually seen as the place to go for technological solutions for firms"*.
- **How best do we identify emerging areas of opportunity and challenge i.e. horizon scanning?**
 - The IAE consider that it is an opportune time to initiate another **Technology Foresight** exercise (last one in 1999). Technology Foresight is a recognised process for bringing together scientists, engineers, industrialists, government officials and others to identify areas of strategic research and emerging technologies likely to yield the greatest economic and social benefit and which will, in the long term, sustain industrial competitiveness.

IAE herewith offers to utilise its base of fellows to provide resources to assist/lead in the Technology Foresight exercise.

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?
 - broaden RD&I activity in the indigenous sector and build absorptive capacity?
- A major drive should be mounted to target MNC corporations at the CTO level in the US. Ireland needs to sell its research capability at the highest level. IDA is world class in selling to CEOs and CFOs, however we may need to develop skills in selling to CTOs and VPs of Engineering.
- The 'Knowledge Box' offers an opportunity to strengthen the number of innovation performers in the MNC sector. To be effective we must resist the temptation to provide wide qualifying criteria and instead we must ensure that we use the 'Knowledge Box' to drive real research, technology and innovation performance.
- Anecdotal evidence suggests that PhD graduates and research post doctorates are not moving from academia/research centres into industry in sufficient numbers. We should actively encourage mobility into the indigenous sector to build absorptive capacity.
- 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?
- No comment at this time.
- How can we incentivise firms that are R&D active to scale their research efforts?
- Knowledge Box

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?
- 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?
- 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?

- We must insist on better performance within EU programmes. For those centres that have an economic impact dimension we must move towards having a funding model of :-

Industry	33.3%
EU	33.3%
Irish State	33.3%

- More transnational research and innovation programmes must be encouraged, to improve the success rate of applications for support under the Horizon 2020 Programme, particularly given the EU Commission's stated aim of increasing such activities in the peripheral member states. The existing State agencies engaged in this process have built up a considerable expertise in this area and their engagement with industry, particularly SMES', to overcome their reluctance to undertake the bureaucratic processes involved, must be further enhanced.
- The Academy, through its engagement with the Euro-CASE Energy and Innovation Platforms and their associated dialogues with the EU Commission, are aware that there exists a strong appetite in Europe for such transnational cooperations, particularly in the Research and Innovation field. This is strengthened by the general belief that, with an emphasis in the Horizon 2020 programme on increasing activity in the peripheral EU nations, Ireland is considered one of the best positioned of such nations to benefit from that EU Commission objective.

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?
- Is there a need for a complementary market focused research centre structure in Ireland and how should that be organised?
- How can Ireland optimise its strategic advantages of location, scale and environmental quality as a fundamental component of its research infrastructure?
- 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?

➤ We recommend that a close examination be conducted into institutional arrangements in Ireland and the equivalent institutions in the USA and Scandinavia that have been most impactful in generating downstream jobs and wealth.

➤ In this context we would refer the Committee to the transcripts of the Intel Labs Europe Lecture Series (Oct.'11 – May '12), organized by the IAE, a copy of which was included in our submission of 27th Jan. '15. In particular we would draw attention to the papers presented by Mr. Justin Rattner, Corporate VP and Director of Intel Labs and Prof. Dr. Henning Kagermann, President of the German National Academy of Science and Engineering [**acatech**].

➤ **RTOs**

Whereas existing structures and institutional arrangements have achieved considerable success in improving Ireland's research rankings, we need to complement them with structures that have a more overt focus on technology and innovation.

Consideration should be given to establishing Research Technology Organisations (RTOs) that are market-led and problem oriented. RTOs such as the Fraunhofers in Germany, TNO in the Netherlands and VTT in Finland are not alone involved in research but are also experienced in working with industry, are close to applications and products, understand industrial processes and can take part in the development part of the cycle.

The UK Association of Independent Research and Technology Organisations (AIRTO) describes its members as 'market-led, problem oriented, businesses and organisations serving all facets of technology transfer and innovation, and who secure their own ongoing existence and growth through success in this market place'.

The Technology Strategy Board (innovate UK) established the Catapult Centres in the UK. These seek to help innovative individuals and companies benefit from concentrated expertise, access to cutting-edge equipment and specialist facilities to develop and test ideas in reality.

➤ **Procurement**

The recently published EURO-CASE Innovation Platform Summary Report (Dec.'14), which was previously submitted, correctly identifies the role that public procurement can have in stimulating innovation. In other countries the defence/military budgets have traditionally acted as funders of innovative technologies and solutions. Ireland is a small market without such recourse. However by defining problems that need to be solved in agriculture, the environment, energy and health, the public procurement budget can act as a powerful catalyst. Innovative procurement also has the potential to move us beyond a simple linear model of innovation. The linear model assumes that we work out from the research. However real innovation is more often found in working back from the problem

➤ **Adapting versus Creating**

In a fast changing global environment we need to develop the agility and the flexibility to adapt technologies that are developed elsewhere. Today most of the institutions in our ecosystem are very heavily focused on research and have little interest in developing or adapting IP that is sourced elsewhere. We now need organisations that are focused on solving problems and developing solutions irrespective of the source of the technology. Therefore we need to develop strong technology watch capability in our system. Programmes like the Bio Innovate Programme have the potential to shift the mindset from 'research out' to 'solution in'

(see also IAE response to Pillar 7).

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?
- The IAE welcomed the establishment of Knowledge Transfer Ireland (KTI) and recognize the excellent delivery achieved to date. Likewise in respect of the Technology Transfer Strengthening Initiative (TTSI).
- There are however concerns that the STEM Outreach initiatives are not reaching sufficient secondary and primary school pupils and teachers. It is recommended that an increased proportion of the science budget be devoted to this area.
- The SSTI(2) objective is, per the consultation document, targeted at growing employment. This implies that we are ideally seeking to spin off or enhance existing FIPCo's who would manufacture in Ireland, rather than sellout to a MNC. A FIPCo obviously need a product that has a potentially significant market, after taking competition into account. Identifying such a product needs an informed insight into the market, and also into the pipelines of potential competitors. This is an area where other locations probably have a networking advantage in understanding market demand, and what potential competitors have in their pipelines.

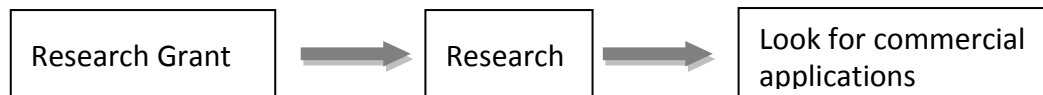
The IAE therefore recommend a dedicated body with a global research capability and remit that would enhance market intelligence on and into niche areas of demand, likely competitors and market sensitivities on price.

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

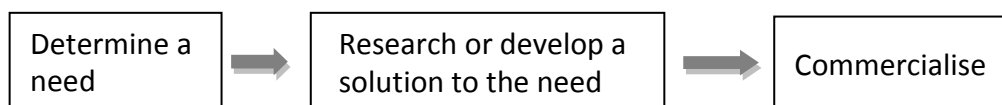
Key areas to be explored include:

- 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.
 - 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?
 - 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?
 - 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?
- The Academy are of the strong opinion, that for the efficient translation of research into jobs, the current Academic Research Model produces few jobs or company start-ups (see also the Intel Lecture series paper by Mr. Justin Rattner, previously submitted, and our response under Pillar 5).

The current Academic Research Model in its simplified form is as follows:-



The alternative recommended Commercial model (e.g. Bio Innovate Programme) may be simplified as follows:-



It is clear that the Commercial model is going to produce many times the number of start-ups and entrepreneurs per unit cost. When applied by commercial organisations it produces jobs in a relatively short term. It is the Academy's estimate that the Commercial model will be an order of magnitude more effective at creating jobs than the current academic model. Its unattractiveness to pure academics is that it may not be conducive to publications or citations. However, it is possible to marry the two because the Commercial model results in a large number of needs that can only be solved by academic research. Once the research has been done, then commercialisation can happen.

- In respect of energy issues the Academy's position has most recently been set out in its "Response to Green Paper on Energy (July 31, 2014)", submitted to the Department of Communications, Energy and Natural Resources. It may be downloaded from our website at www.iae.ie, under publications. The Academy's response raises serious concerns in respect of current government policies pertaining to national competitiveness, emission reduction targets, security of supply and the necessity for more rigorous and extensive research, to direct policy formation.
- In our publications, "The Future of Manufacturing in Ireland – Interim Report (Oct. 2013) – (Chapter 5)" and "Policy Advisory – Achieving Ireland's Energy and CO₂ Reduction Targets – An Alternative Approach (June 2013) – (Section 1.2)", the Academy drew attention to the dichotomy between the government's policies to significantly expand the national herd and reduce Non-ETS emissions. Both documents called for research and innovation by government and the private sector, to deal with potential increases in green house gases and phosphate levels, as a result of expanding the national herd. The urgency for both remains high. (Ref: www.iae.ie – publications).
- Also note the call for Cross Departmental co-ordination to encourage development of food companies, in the IAE Manufacturing Report.
- As a contribution and reference to the low carbon economy issue, we would refer you to the Academy's Policy Advisory publication listed above and our "Policy Advisory – Towards Low-Carbon Transport in Ireland (July 2014)".
- We have previously expressed concerns, under Pillar 6, as to the extent and depth of the outreach being achieved under STEMs programme.

- Excellent work is being undertaken by Enterprise Ireland in maximising Ireland's potential draw down of funding under EU's Horizon 2020 Programme. Additional approaches worth pursuing are also highlighted in the Euro-CASE Innovation Platform Summary Report (Dec.'14), a copy of which was previously submitted and in which initiative the Academy were active participants.

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?
 - What additional steps can government take to ensure the development of human capital across the population to ensure the success of the new Strategy?
 - How can we ensure that the requisite links between research and scholarship are maintained across all RPOs?
 - 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?
 - 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.
 - How can gender equality in publicly funded research activity be further enhanced?
 - How can the Action Plan for Jobs 2015 objective to increase the number of researchers in enterprise be fulfilled?
 - Should research and innovation performers be supported to engage citizens more actively in the innovation process to achieve optimal outreach to the public?
- In its publications "The Future of Manufacturing in Ireland – Interim Report (Oct. 2013) – (Chapter 9)" and "Engineering Research and Economic Development – Engineering Research in Irish Economic Development (Dec 3, 2010)", the Academy set out key policies and strategies required to exploit the potential of our knowledge base. These recommendations are still relevant and urgent.

- As with the requirements of the EU Horizon 2020 programme, any national programme must insist on excellence in research.
- The Interdepartmental Consultation paper contains a mixture of objectives and the methods or strategies by which those objectives will be achieved. To more readily grasp its intention we find it assists if objectives and methods are separated, as follows:-

Objectives:

1. Create sustainable jobs through optimal organisational arrangements and excellent research.
2. Have an IP regime that encourages knowledge transfer from research into sustainable jobs.
3. Through research develop human capital.

Methods:

1. Invest public research funds in a limited number of prioritised areas.
2. Ensure governance to achieve research excellence.
3. Encourage and Incentivise enterprise-level R&D.
4. Develop structures and methods to translate research into jobs.
5. Develop human capital through research.

Item 5 is the logical outcome of the above segregation.

- The conclusions and proposed Institutions' consolidations, on pages 67 & 68, are noted without comment at this time. It is noted however that these do not extend to encompass the OECD 2013 comment on the lack of Research Technology Organisations (RTO's), such as Germany's Fraunhofer Institutes, in Ireland. It is not clear whether or not the Interdepartmental Committee are of the opinion as to the desirability for such RTOs, which the Academy strongly favour (see are responses under Pillars 2 & 5).