

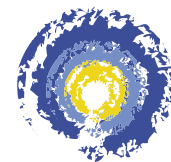


## PROMOTING ENTERPRISE-HIGHER EDUCATION RELATIONSHIPS

March 2007



The National Policy and Advisory Board for Enterprise,  
Trade, Science, Technology and Innovation



Advisory Council for Science  
Technology and Innovation  
An Comhairle Eolaíochta

## **ADVISORY COUNCIL FOR SCIENCE, TECHNOLOGY AND INNOVATION**

The Advisory Council for Science, Technology and Innovation is the Government's high-level advisory body on STI policy issues. It serves as the primary interface between stakeholders and policy policymakers in the STI arena. The Council was established by Government in April 2005.

The Council's remit is to contribute to the development and delivery of a coherent and effective national strategy for STI and to provide advice to Government on medium and long-term policy for STI and related matters.

The Council operates within the context of the arrangements put in place by Government in June 2004 for the Co-ordination and Governance of STI matters, which include the Cabinet Committee and the Inter-Departmental Committee for STI and the Office of the Chief Science Adviser.



**Minister Micheál Martin, T.D.**

Minister for Enterprise, Trade and Employment

## FOREWORD

I am delighted to welcome this report of the Advisory Science Council (ASC). The Council is a key element of the new governance structures for science, technology and innovation (STI) in Ireland. The Council provides critical stakeholder input to the Government's drive to create a knowledge based economy. It thus plays a key role in the implementation and monitoring of the Government's new Strategy for STI which was launched last summer.

This Strategy recognises the importance of developing higher education-industry relationships in Ireland. Higher education institutions (HEIs) are an invaluable source of scientists and researchers within any national innovation system. Similarly, enterprises are pivotal to delivering returns to our economy. Not surprisingly then, the most dynamic and innovative countries have developed policies to encourage enterprise-higher education (HE) collaborations.

Enterprise-HE relationships can be mutually beneficial for all parties concerned. The recent significant public investment in research and in building excellence in the higher education system means companies large and small can use the knowledge, expertise and facilities of the universities and institutes of technology to help build their technological capability and develop the technologies that will underpin future products and services. Enterprise-HE links also offer HEIs the opportunity to see their research brought to market for the benefit of society.

This review of enterprise-HE relationships by the Advisory Science Council draws upon international good practice and is timely in that it seeks to progress the implementation of the Strategy. The Council finds that the two key constraints to the deepening of enterprise-HE research collaborations in Ireland are the low absorptive capacity of enterprises for research and a gap in the availability of applied research that enterprises can readily access. The Council makes a number of insightful and far-reaching recommendations for Ireland to overcome these constraints. These will be taken forward by the Inter-Departmental Committee on Science and Technology and Technology Ireland.

On behalf of the Cabinet Committee on STI, which I chair, and on behalf of the Interdepartmental Committee on STI led by my Department, I would like to thank the ASC for taking on this critically important work. I look forward to working with the relevant parties to progress the recommendations contained therein.



**Minister Micheál Martin, T.D.**

Minister for Enterprise, Trade and Employment



**Foreword for Minister Mary Hanafin, T.D.**

Minister for Education & Science

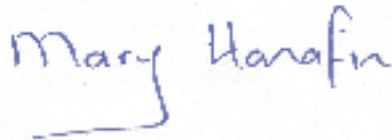
The publication of this report ‘Promoting Enterprise-Higher Education Relationships’ is both timely and relevant.

In issuing the Strategy for Science, Technology and Innovation in 2006, the Government recognised the need for a major increase in research activity to underpin Ireland’s competitiveness and economic growth. The Strategy outlines a comprehensive programme to create a world class research capability in Ireland.

In order to maximise return on investment in higher education it is vital that effective linkages between higher education institutes and enterprise are fostered that will facilitate the transfer of scientific knowledge. This report makes several specific and far reaching recommendations in this regard.

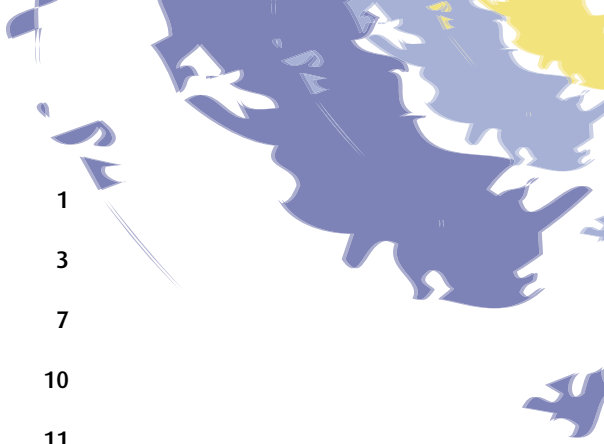
Closer interaction between public knowledge institutions and enterprise is widely recognised as being increasingly important, as global competition forces companies to innovate more and strengthen core areas. Collaboration with knowledge institutions enables companies to gain access to new knowledge, specialist skills and the latest technologies. Higher education should, therefore, be underpinned by a coherent policy approach that includes the public and private sector.

It is appropriate that the Advisory Science Council for Science, Technology and Innovation is carrying out this review at a time when new arrangements have been put in place to ensure effective implementation of the Strategy for Science, Technology and Innovation. My Department will be taking a lead role in this process through its Chairmanship of the Higher Education Research Group, which is representative of all the major public funders of research and is tasked with co-ordinating their investment in higher education institutions. We look forward to working closely with all concerned and particularly with Technology Ireland to progress the recommendations outlined in this report.

A handwritten signature in blue ink that reads "Mary Hanafin". The signature is written in a cursive style with a long horizontal stroke at the end of the name.

**Minister Mary Hanafin, T.D.**

Minister for Education & Science



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## EXECUTIVE SUMMARY

In modern economies, closer interaction between public knowledge institutions and enterprise is increasingly important, as global competition forces companies to specialise and strengthen core areas. By working closely with knowledge institutions companies gain access to new knowledge, specialist skills and the latest technologies.

The Advisory Science Council has therefore undertaken a review of the relationship between enterprises and higher education institutions (HEIs), both here and in a number of comparable countries (Austria, Finland, Belgium and Denmark) in order to better understand the driving forces behind such relationships and to assess the situation in Ireland and whether changes are needed in critical areas influencing these relationships.

## FINDINGS AND CONCLUSIONS

The two key constraints to the deepening of enterprise-higher education (HE) research collaborations in Ireland are the low absorptive capacity of enterprises for research and a gap in the availability of applied research capability that enterprises can readily access.

Research commissioned by the Council indicates that HEI-enterprise collaboration operates at a very low level in Ireland, and that the structures for encouragement and support of the process have failed to achieve the level of contribution appropriate to Higher Education Expenditure on Research and Development (HERD). This is consistent with the findings of the Enterprise Strategy Group report published in 2004.

One necessary condition for good collaboration is the existence of a substantial and sophisticated business sector R&D performance (BERD), with an absorptive capacity for research and technological developments. Levels of BERD in Ireland remain below the EU average and this is a major contributor to the low levels of interaction with HE researchers.

Enterprises in Ireland are particularly reliant on higher education (HE) researchers given the relatively small number of applied and industry-focused public sector research institutes. Intermediary structures between higher education institutions and enterprises have been successful in facilitating greater linkages between the two sectors in other countries. These intermediaries are generally active in the applied research space. For support measures for HE-enterprise linkage to work effectively the absorptive capacity of firms must be developed and the 'applied research gap' must be addressed.

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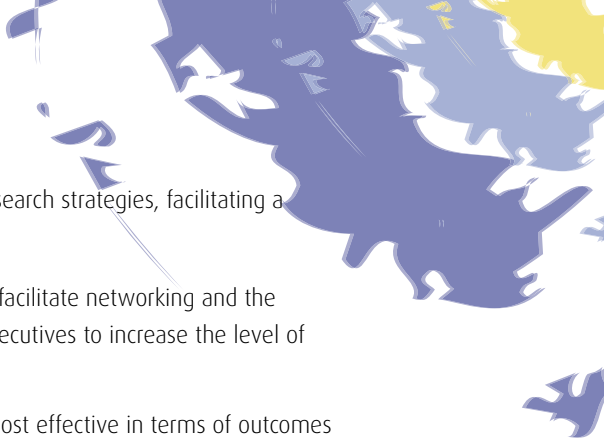
## RECOMMENDATIONS

The Council proposes that the development of an applied research capability be prioritised under the Strategy for STI, 2006-2013, to give SMEs access to scientific and technological knowledge that they can apply to the development of their products and processes. Joint research programmes which promote direct collaboration between enterprise and science are a well established policy intervention mechanism in other comparator countries. Good practice in other countries is to develop thematically focussed programmes that apply an enterprise-driven approach to defining joint research teams, have a long-term perspective of co-operation, and rely, at least partially, on an 'infrastructure' approach, i.e. the establishment of institutions and/or facilities that are operated both by enterprises and science institutes.

The Government's Strategy for Science, Technology and Innovation sets out a range of initiatives to be further developed to address the applied research gap and to build the absorptive capacity of firms. In this context the Council makes a number of recommendations for how to optimise the impact of the Strategy.

### **A holistic and structured approach is recommended:**

- ▶ A major new initiative is required to develop in-depth competence in applied research and new applied research groups in support of innovation in enterprises.
  - ▶ The development and research funding agencies should engage with enterprise to identify where collaboration would be most useful and identify a spectrum of innovation needs such as technical support and consultancy services for collaborative research.
  - ▶ The groups should be enterprise led and should ideally be located on or close to the existing HEI campuses while maintaining a governance structure that ensures their autonomy and protects their distinct mandate and culture of applied research. Thematically focussed programmes should be developed which apply an enterprise-driven approach to defining joint research themes.
  - ▶ The agencies need to strengthen the absorptive capacities of SMEs with respect to R&D, innovation management capabilities and the use of external knowledge and advice.
  - ▶ In addition, measures are required to stimulate SMEs with sufficient in-house capacity to establish direct research and consulting contacts with public research performers.
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- ▶ HEIs need to make a clear policy statement on the role of industry in their research strategies, facilitating a change in culture with respect to working with industry.
  - ▶ Business and higher education representative bodies should establish fora to facilitate networking and the exchange of information and should appoint dedicated industry/HE liaison executives to increase the level of mutual understanding between enterprise and the HE sector.
  - ▶ Competition based approaches of allocating public money have proved the most effective in terms of outcomes in other countries. Therefore, the most appropriate knowledge partners (universities, IoTs, national and international research providers) should be encouraged to participate in HE-enterprise joint projects through open competition.
  - ▶ The Council proposes that in the first instance responsibility for establishing the required applied research capability be assigned to Technology Ireland. Over time, and based on the success of Technology Ireland's initiatives, consideration might be given to the establishment of a new Applied Research Foundation.

## 1. INTRODUCTION

In modern economies, closer interaction between public knowledge institutions and enterprise is increasingly important. One of the reasons for this is the increasing global competition which forces companies to specialise and strengthen their core areas. By working closely with the knowledge institutions companies gain access to the new knowledge they need as well as the latest technologies. Interacting in relation to research and development is the most important, but not the only, medium for achieving this goal.

Since the performance of any national innovation system may be judged by the efficiency with which it facilitates the transfer of scientific knowledge from knowledge producers (higher education and non-higher education public research) to knowledge users, it follows that the development of effective linkages between higher education institutions (HEIs) and enterprise is particularly important for the smooth functioning of the Irish innovation system. Enterprises in Ireland are particularly reliant on higher education (HE) researchers as R&D performers, given the relatively small number of public sector research institutes.

The Advisory Science Council has therefore undertaken a review of the relationship between enterprises and HEIs, both here and in a small number of comparable countries, in order to understand better the driving forces behind such relationships and to assess the situation in Ireland and whether changes are needed in critical areas influencing these relationships. The Council believes that continued economic growth and prosperity is dependent on strengthening the links between knowledge generators and enterprise.

This Statement presents the findings of this review and the Council's recommendations.

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## 2. ENTERPRISE-HEI LINKS IN IRELAND

Three components constitute the core of an enterprise-science system: public science (HEI and other public science and technology institutes), enterprise and a framework of supports/barriers in which these two operate.

The major component of an enterprise-science system is an enterprise sector capable of absorbing and adapting knowledge flows from public science. One necessary condition for good collaboration found in every country is the existence of a substantial and sophisticated business sector R&D performance (BERD). While levels of BERD in Ireland have been growing rapidly in the past they still remain below the EU average and this is a major contributor to the low levels of interaction with HE researchers. Table 1 below compares BERD in Ireland with other countries.

**Table 1: Business R&D Trends**

	1997	1999	2001	2003	2005	2006
BERD (€m) Ireland	612	784	900	1105	1329	1560
% GNP	1.01	1.03	0.93	0.94	0.98	1.05
EU (25) as % GDP	1.10	1.13	1.17	1.12	1.12	1.12
Denmark % GDP	1.30	1.42	1.65	1.77	1.67	1.67
Finland % GDP	1.85	2.20	2.42	2.42	2.46	2.46

**Source:** Forfás BERD Surveys

With regard to public science, Ireland is in effect limited to the HE sector and there are serious concerns about the level of interaction between enterprise and HEIs. This is demonstrated in Table 2 below which examines enterprise financing of higher education R&D (HERD) since 1996. In that period, and particularly since 2000 with the advent of significant new funding for HE research, the level of HERD has increased dramatically and is now approaching international averages as a percentage of national output. However, enterprise financing of HERD has declined in real terms over recent years. Consequently, the percentage of HERD financed by enterprise in Ireland has declined from levels which were at or above OECD averages in the late 1990s to less than half that level in 2004. This is not unexpected as the focus of the new public investment was to build capabilities in fundamental research in areas of potential relevance to enterprise.

**Table 2:** Funding of HERD by Enterprise

		1996	1998	2000	2002	2004	2006*
HERD (€m)		198	254	276	341	492	600
Financed by Enterprise (€m)		13	17	15	13	13	20
% HERD Financed	Ireland	6.6	6.7	5.4	3.8	2.6	3.3
by Enterprise	OECD Avg	6.2	6.0	6.2	6.0	6.0	6.0

**Source:** Forfás HERD Surveys

\*2006 figures are estimates which are to be confirmed in the 2006 Forfás HERD study

While the above indicator is only one measure of enterprise-HE linkage the story it tells is confirmed in a study undertaken for the Council by the CIRCA Group. This study is based mainly on a series of interviews and focus group meetings with academic researchers and industrialists.

The major overall finding of the study is that HEI-enterprise collaboration operates at a very low level and that the structures for encouragement and support of the process have failed to achieve the level of contribution appropriate to HERD.

This conclusion is clear from the static levels of enterprise funding of HE research, from the virtually unanimous view of enterprise about the difficulties which exist, and from the perceptions of academic researchers about the uncertainties and lack of incentives attached to enterprise collaboration.

Since market failure is the rule rather than the exception when it comes to knowledge flows from public science to enterprise, all countries with successful collaboration between the two have a policy mix of public measures to encourage enterprise-HE linkages and a substantial level of resources allocated to it. Enterprise Ireland (EI) is the public agency with major responsibility for science and technology programmes with an enterprise focus. Currently, EI's annual budget for these programmes is about €100m, of which only about 12% is allocated to HE - Industry links. The distribution of this budget across various support mechanisms is shown in Table 3.

**Table 3** Enterprise Ireland S&T Programmes, 2006

	<b>% RTI Budget</b>
<b>Supports for R&amp;D and innovation in firms:</b>	45%
<b>Commercialising Research</b>	
Commercialisation Fund	22%
Incubator Space in IoTs	10%
HE Tech Transfer Offices	2%
<b>Enterprise-HE Links</b>	
Funding of joint R&D projects (Innovation Partnerships)	5%
Applied Research Enhancement in IoTs	2%
Centres	3%
Enterprise-led networks	2%

In practice, the major support mechanism is the Innovation Partnerships. The other elements – centres and enterprise-led networks – are still in transition/pilot stage. The Commercialisation Fund, while large, is academic driven and has no enterprise involvement in the research.

Recognising the imperative to increase effective HE-Industry linkages, EI is introducing a number of initiatives including a doubling of the budget for Innovation Partnerships, the development of Enterprise-Led Research Networks based on consortia of companies defining their medium term research to benefit their sector and international competitiveness, new support for technology transfer offices in universities to professionalise their interventions with industry and to influence more flexible procedures in colleges, a refocused Commercialisation Fund that will facilitate industry to mentor academics as they develop their research ideas with commercial potential and funding new applied research centres in IoTs to help build the technical capabilities to work with companies in their locality to have real regional impact.

Science Foundation Ireland is encouraging HE-enterprise interaction via the Centres for Science Engineering and Technology (CSETs). Seven CSETs have been established to undertake research in core thematic fields of interest to enterprise, and with enterprise providing 20 percent of the total budget. Some of the HE facilities established under HEA programmes are also relevant, such as the Tyndall Institute, the Dublin Molecular Medicine Centre and the Conway Institute.



## 3. INTERNATIONAL COMPARISONS

### 3.1 INTRODUCTION

This report has made extensive use of a joint DG Enterprise/Austrian Government study published in 2001 titled **‘Benchmarking Enterprise – Science Relations’**. It studied co-operation, in eight EU member states (Austria, Belgium, Finland, Germany, Ireland, Italy, Sweden and UK) as well as the US and Japan, between enterprises (enterprise) and higher education institutions and public sector research establishments (referred to as ‘science’). The Council also commissioned a follow-up on this study by the same Austrian group to undertake a critical review of mechanisms used to promote enterprise-HEI links in four countries of a similar size to Ireland – Austria, Belgium, Finland and Denmark.

Stimulating and strengthening enterprise-science relations (ISR) is high on the agenda of technology policy in all countries studied. Given the complex nature of ISR there is a very diverse range of specifically designed policy measures and programmes in place to address this policy objective. This section summarises the experiences of Austria, Belgium, Finland and Denmark in this area. The study demonstrated that these countries, starting from a position very similar to Ireland in the mid-nineties, have now moved far ahead.

### 3.2 AUSTRIA

For many years the low level of interaction and collaboration between science and enterprise was seen as a bottleneck in the Austrian innovation system. In the first half of the 1990s, enterprises funded only 4 per cent of R&D in the universities. The reason for this low level of contact was believed to be the structure of Austrian enterprise, the low level of specialisation in dynamic, technology-oriented sectors, and low levels of business R&D. Attempts to overcome the barriers on both sides met with only limited success. These attempts failed to recognise the need for joint research planning and concrete collaboration embedded in common structures.

Two structural innovations in the mid to late 1990s have been successful in achieving:

- ▶ A change of research strategy in companies, so that they now place more emphasis on collaboration with scientific institutions to obtain access to new information and the results of more fundamental research
- ▶ A change of attitude in public research institutions, whereby collaboration with enterprises is no longer thought of as unscientific and thus superfluous

- ▶ An increase in BERD (business sector R&D) from below 1% of GDP in 1995 to 1.42% in 2004.
- ▶ The two structures involved are the Christian Doppler Gesellschaft (CDG) and the 'Competence Centre' programmes established in the latter half of the '90s.

The CDG has set up applied research laboratories operating as public private partnership between enterprise and universities. They are located in universities and financed for a seven year period, 50% by enterprise and 50% by government. In 2005 36 laboratories employed 325 staff, of which nearly half were doctoral students, operating in fields such as nanotechnology and materials science, chemical engineering, biotechnology, ICT, mechatronics and mechanical engineering. The annual budget is about €10m for the programme. Research topics are determined by the industrial partners; because of the applied nature of the research each laboratory generally has just one enterprise funder.

Competence Centres have a longer-term perspective and focus more on strategic research of longer term interest to enterprise. They are established to foster innovative networks between firms to conduct joint research on a specific field, with possible inclusion of HE researchers. There is a bottom-up approach to defining the thematic orientation and an emphasis on long-term collaboration between enterprises and HE researchers. There are different kinds of Competence Centres (about 40 overall involving 450 firms), with the newer K-Plus programme aimed at HE-enterprise cooperation in more advanced technologies.

### 3.3 BELGIUM

In Belgium there are several examples of good practice in encouraging greater interaction through mobility of researchers. PhD scholarships are awarded for those working on joint enterprise-academic research projects, undertaken either in Belgium or abroad. Enterprise is involved in defining the project objectives and also hosts the research for some part of the work. Enterprise also funds either 25 percent (large firms) or less for SMEs.

The FIRST Spin-off programme provides funding aimed at training university researchers to become managers of their own companies in the field of emerging technologies. It enables them to exploit their research results commercially via the creation of a spin-off company in the local region. Courses in entrepreneurship and management are at the heart of the initiative.

Leuven R&D is a separate entity within the Catholic University of Leuven to promote and support the transfer of knowledge and technology between the university and enterprise. As of 2005 this had resulted in 50 spin-off

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companies employing more than 2000 people. It is similar to the successful Birmingham Research and Development Limited, the technology transfer company of the University of Birmingham in the UK.

### 3.4 FINLAND

Finland has also recently introduced a doctoral support programme for people in enterprise undertaking a PhD at a local university.

The Finnish Technology Agency, TEKES, invests about half of its annual budget of €400m in programmes and mechanisms to increase enterprise-science links. These include the Technology Clinics, which are aimed mainly at SMEs with technological problems or needs and which link the firms with the leading researchers in Finland and internationally. There are a wide range of such clinics and they provide experience for firms in co-operating with universities and research institutes.

Through its Cluster Programmes and its Technology Programmes TEKES has created a culture of applied research based on identified enterprise needs.

### 3.5 DENMARK

Although the Danish corporate sector chiefly consists of many small businesses in low-growth industries, business expenditure on R&D increased from 1.02% in 1993 to 1.8% in 2003. Denmark has been one of the world's ten richest countries for decades. This is attributed to a culturally rooted ability to collaborate, adapt to new requirements and find new solutions. Danish innovation policy objectives therefore place a strong emphasis on:

- ▶ Strengthening cooperation between knowledge institutions and the private sector
- ▶ Strengthening technology transfer between the two sectors
- ▶ Improving commercialisation of research results
- ▶ Increasing the output of PhDs

The **Action Plan for Public-Private Partnership on Innovation**, launched by the Danish government in 2003, aims to make Denmark among the best in the world in cooperation and interaction between knowledge institutions and enterprises. Six major areas will be supported:

- ▶ Cooperation on research and innovation
- ▶ Access to competencies
- ▶ Commercial utilisation of public research
- ▶ New framework conditions for universities' interaction with society
- ▶ Focus and prioritising in public research
- ▶ Access to qualified technological services and advice.

**There are a wide range of programmes in Denmark to support this agenda. Examples are:**

- ▶ *Innovation Accelerating Research Platforms*, as a tool to identify research areas which can accelerate innovation in society in the short to medium term
  - ▶ *High-Tech Networks*, integrating SMEs into knowledge and technology transfer networks
  - ▶ *Innovation Consortia*, promoting cooperation between enterprises, public research institutes and technology services agencies
  - ▶ *Research Consortia*, promoting longer-term cooperation in research between public research institutes and a minimum of three firms
  - ▶ *150 Percent Tax Deduction*, for public-private research collaboration and research training programmes
  - ▶ *Incubator Initiative*, by which incubators are set up as limited companies to help researchers to commercialise knowledge and to overcome barriers during the start-up of knowledge intensive spin-offs.
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## 4. FINDINGS FOR IRELAND

### 4.1 FOCUS OF PREVIOUS INITIATIVES

Over the past 30 years, Ireland has had a succession of initiatives aimed at linking science with enterprise, going right back to the National Science Council/National Board for Science and Technology policy of promoting commercial relevance in research projects.

There is a common thread in the approach that underlay previous attempts to harness public research for commercial development. In the absence of public research organisations, the HE institutions have been placed at the heart of many initiatives.

The 1989-1994 National Development Plan introduced the Programmes in Advanced Technology (PATs) as the first major initiative that focused specifically on the commercialisation of science. Six PATs were established in the early nineties with the aim of encouraging research activity in enterprise and transferring technology from HEIs to enterprise. In working towards this aim the PATs developed a number of HE-based research centres in their core technologies in order to generate the knowledge base necessary to attract industrial involvement. These centres were a partnership between colleges, enterprise and the state sector. The independent review of the PATs published in 1997 by the Enterprise Evaluation Unit described them as an important resource with the potential to make a considerable contribution to enhancing Ireland's research and innovation capability.

During the period following 2000 and particularly in the context of the establishment of SFI and PRTLI and a shifting balance between basic research and activities for industry, it became clear that the PATs model was no longer meeting its original objectives. Consequently, the PATs were dissolved and many of the centres were merged into the larger research centres.

Higher Education Institutions are successful in establishing enterprise links if judged by a select set of criteria, and it is of great national interest to play to their strengths in this regard. Linkage with major research-performing MNEs have been established, most notably in the ICT sector through CSETs such as the Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN). The reason why these links are successful is that they can be established on basic research platforms and require little compromise in research interests by the academic partner. The major initiatives that are being undertaken through the IDA and SFI to promote these linkages are creditworthy and important and should be strongly encouraged.

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Another area where HEIs have potential in the commercialisation of science is the establishment of campus companies. Again, these are usually a spin-off from basic research.

However, while the HEI's play an essential role in establishing our national intellectual capital, it needs to be recognised that their ability to translate that into a flow of technology and innovation, in particular to SMEs, is far more modest.

Product and process innovation is not something that can happen as a supplementary activity, but requires the whole-hearted commitment of time and intellectual energy of researchers and it can be difficult for HE researchers to prioritise while also seeking to excel in traditional academic pursuits. Similarly, HE institutions have traditionally found it difficult to develop appropriate structures to engage with enterprises and to contribute to economic development in that way. This problem is not, of course, unique to Ireland and the question of a 'third mission' for HEIs – interaction with enterprise – is being addressed in many countries, with mixed results.

Mutual understanding is best served by transfers of personnel between HE and enterprise. The IRCSET 'Enterprise Partnership Scheme' funds a placement programme on the lines of the First PhD International Programme in Denmark to promote involvement of enterprise in PhDs and also to facilitate partial placement of PhDs in enterprise during their studies, and the 'Doctoral Studies for Employed Persons' programme also in Denmark to promote pursuit of PhD by enterprise research staff. This is a new scheme which has yet to make an impact but needs to be supported by both academia and enterprise.


Notwithstanding the potential of such initiatives, many of which are still in the pilot stage, the major challenge for national policy at this time is to face up to the country's applied research gap. The ISR agenda must be broadened beyond the Higher Education sector by promoting complementary research capability that is an intermediary between academic research and enterprise R&D.

## 4.2 THE APPLIED RESEARCH AND ABSORPTIVE CAPACITY GAPS

While large, research-intensive MNEs have the capability to interact with HEI's in areas of fundamental science of common interest, it is SMEs, both indigenous and foreign-owned, which have serious problems.

SMEs are interested mainly in incremental innovation, which demands an intimate knowledge of existing technologies and markets and which is based on applied science and technology. SMEs have particular difficulties

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in getting access to this knowledge in an absorbable way that they can apply to products and processes and to accessing a corps of expertise in technology platforms relevant to their needs.

With the exception of a number of Teagasc centres and the Tyndall Institute which have a history of working with enterprise, there have been no specific research centres focused on the development needs of enterprise. However, a number of initiatives have been taken e.g. NIBRT and the Digital Media Research Centres.

There is an absence in Ireland of the intermediary structures between higher education institutions and enterprise which have been successful in facilitating greater linkages between the two sectors in other countries. These intermediaries are generally active in the applied research space.

A range of support measures already exists to encourage higher education –enterprise collaboration but the evidence set out in Section 2 which is supported by external evaluations, suggests that these measures are not working. The poor absorptive capacity of the Irish SME sector is undoubtedly a major contributory factor but international experience suggests that this will only be solved in conjunction with a major programme to build applied research capability.

## 5. CONCLUSIONS AND RECOMMENDATIONS

Industry-Science Relationship (ISR)-related policy initiatives should be embedded in a comprehensive and long-term oriented science and technology policy, in order to achieve sustainable changes in behaviours and structures. The Enterprise Strategy Group Report (2004) recognised the need for increased public funding for enterprise-academic collaboration, applied research, technology transfer, commercialisation and in-firm R&D. The Government Strategy for STI, 2006-2013, also identifies the need for a more coherent and client-centred approach to the provision of public supports for research and innovation to assist enterprises, both indigenous and foreign-owned, to undertake continuous product, service and process innovation in a knowledge driven environment.

The Advisory Science Council has determined that the two key constraints to the deepening of enterprise-HE research collaborations are the low absorptive capacity of enterprises in Ireland for research and a gap in the availability of applied research capability that enterprises can readily access. At the same time that substantial resources have been invested in building up the research capabilities in the HE sector it has become apparent that a significant gap exists in the applied research area of most relevance to enterprise.

Involvement of SMEs in ISR activities is a major issue to broaden the use of scientific knowledge in the enterprise sector. Good practice follows a two-sided approach:

- ▶ Firstly, absorption capacities of SMEs with respect to R&D, innovation management capabilities and the use of external knowledge and advice, should be strengthened, quite apart from any issues to do with ISR.
- ▶ Secondly, SMEs with sufficient in-house capacity may be stimulated to establish direct research and consulting contacts with public research performers

In multinational industry the trend is to replace the traditional focus on in-house research with an open innovation platform approach that involves access to international expertise. Many MNCs will wish to partner with institutions conducting high quality basic research. The level of funding potentially available from MNEs is substantial, but it is highly mobile and Irish institutions must compete with other providers worldwide. This is a significant opportunity for Irish colleges. In recognition of this, Ireland is heavily investing in the creation of research activity of a scale and quality likely to attract MNE funding.

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**Based on the analysis of the gaps in the Irish context and practice in other countries the Council identifies five guidelines to develop a stronger system for Ireland.**

- 1.) The first is applied research capability in the form of joint research programmes which promote direct collaboration between enterprise and science. These are a well-established policy intervention mechanisms in other comparator countries. Good practice particularly refers to thematically focussed programmes which apply an enterprise-driven approach to defining joint research themes, have a long-term perspective of co-operation, and rely, at least partially, on an 'infrastructure' approach, i.e., the establishment of institutions and/or facilities that are operated both by enterprises and science institutes. Teagasc for the food sector and the Tyndall Institute are examples of what is needed. New structures such as NIBRT demonstrate what can be achieved.
  - 2.) Competition-based approaches for allocating public money have proved to be the most effective in terms of outcomes.
  - 3.) A third goal must be to foster the direct commercialisation of research results emanating from public science through academic start-ups/spin-offs, especially in fields such as biotechnology, genetic engineering, new materials, and new information and communication technologies. Good practice covers the provision of specialised supportive infrastructure that reduces transaction costs and information asymmetries, provides advisory support and pre-seed capital for start-ups, and raises the perception by researchers of the commercial potential of the research results they have achieved through various awareness measures.
  - 4.) All of the reference countries also emphasise the importance of personnel mobility and interaction in graduate education. This is an important mode of interaction and often establishes informal networks which are an important basis for further channels of ISR. Good policy practice is often related to exchange programmes which particularly address the personnel needs of SMEs, to joint graduate education programmes that involve enterprises in the definition of the theme of a thesis and allow students to carry out practical R&D work at the enterprise, and to qualification programmes for enterprise researchers at universities (e.g. PhD programmes for enterprise researchers).
  - 5.) Finally, given the high risks and costs, public promotion of ISR in science-based industries is especially needed in the early stages of new technology development. Networking programmes and bottom-up initiatives on a competitive level are most promising.
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## The Council makes the following recommendations:

### 5.1. BUILDING APPLIED RESEARCH CAPABILITY

- i) A major new initiative is required to achieve the development of in-depth competence in applied research and the development of new applied research groups which will support innovation. It needs to address the technology needs and deficits of SMEs as well as some of the larger MNEs which are primarily involved in manufacturing activities. In the context of the Government's Strategy for STI, the key objective of this initiative should be to establish applied research capabilities and research groups in selected technology platforms, which would be identified in consultation with enterprise. The 'Competence Centres' proposed in the *Strategy* are one model for this applied research capability, together with the expansion of the enterprise-led research networks approach.
  - ii) The new Applied Research Groups must be enterprise-led, originating from intensive consultations with enterprise on research and technology needs and they must continue to have on-going interaction with enterprises, including enterprise funding, guidance and governance. It is extremely important that these investments are informed by the market and the needs of enterprises and priority setting exercises need to be designed in this way. In this regard, the enterprise sector must be deeply involved in the development of the research groups and networks, which will complement the more fundamental research undertaken by groups set up with the support of Science Foundation Ireland and the Higher Education Authority.
  - iii) The development and research funding agencies will need to take the lead in establishing the mechanisms, procedures and networks where consultation can take place between enterprise and researchers to identify strategic technologies or technology platforms (a group of technologies with wide applicability) which are vital for facilitating greater innovation in enterprise.
  - iv) These research networks and consultative frameworks will need to be of a long-term nature so that enterprise can have a continuing involvement in guiding the research effort.
  - v) The model should be to develop applied research groups that meet the criteria of *Culture, Competence and Continuity*:
    - ▶ by culture is meant a clear mandate and commitment to applied research and technology transfer, supported by a professional management system;
    - ▶ by competence is meant that the group has an in-depth knowledge of its technology area and, by virtue of its close relationship with companies, a full understanding of company needs;
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- ▶ Continuity is critical for the accumulation of skills and the achievement of the necessary competence. It can only come from having a core group on long-term career contracts rather than being assembled only for a project term. An important part of continuity is technical sustainability. The Applied Research Groups should therefore have some links with academic research to avoid senescence.
  - vi)** Funding of new initiatives, whether applied research groups or new centres, should be based on award through open competition among the full range of providers – universities, institutes of technology, national and international research providers. The Groups should be well resourced with facilities and equipment of a high standard, awarded following a competitive process open to organisations nationally and internationally. The Strategy for Science, Technology and Innovation 2006-2013 allocates close to €400m over the eight year period to support for enterprise collaboration with Higher Education. The development of applied research groups should be funded from this source.
  - vii)** The new applied research groups should ideally be located on or close to existing HEI campuses. It is crucial that they have distinct governance that ensures their autonomy and protects their distinct mandate and culture of applied research. The relationship with the HEI can be defined by a Memorandum of Understanding (MoU) or legal agreement which would among other things spell out arrangements for both sides to have access to each other's facilities. They will need strong professional management with a commercial background as well as operational independence from the HEI but the potential for recruiting researchers with the right profile and the ability to link with academic researchers.
  - viii)** For all collaborative research initiatives and those developed to meet the needs of enterprise, it is essential that there is clarity from the outset on the process and timetable for the review and evaluation of such research initiatives, taking into account the specific technological area and enterprise sector of the research activities. It is also important that there is clarity as to the options for the evolution or sun-setting of such new initiatives and the designated responsibility and accountability for this process should be dealt with as part of the governance arrangements.

## 5.2. HIGHER EDUCATION COMMITMENT TO ENTERPRISE COLLABORATION

Each HEI needs to develop clear policy statements on the role of enterprise collaboration in its research strategy, facilitating a change in culture with respect to working with enterprise. This is a fundamental starting point for the development of an effective HE-enterprise collaboration system. Each HEI in receipt of funding under schemes to encourage working with enterprise should be required to define the role of enterprise research partnerships in their

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overall research strategy. This declaration should differentiate between their role in the creation of start-ups and their role in servicing the needs of existing enterprise. It should also ensure that the declaration filters down to the level of the individual researcher. The Royal Irish Academy<sup>1</sup> have recently set out a number of requirements to better foster enterprise-higher education collaborations, including in relation to developing a more positive disposition of researchers towards enterprise and these could be addressed through such institutional statements.

### 5.3 NETWORKING ENTERPRISE AND HIGHER EDUCATION

To improve the level of mutual understanding between enterprise and the HE sector, it is recommended that enterprise and HE representative bodies such as IBEC and the Chambers of Commerce and the IUA and CODIT establish fora for the exchange of information and networking and should appoint dedicated enterprise/HE communications executives to foster interactions between enterprise and the HE sector. Such initiatives would also assist in developing mutually acceptable procedures and processes to make new collaborations more efficient and effective. The communications executives would play key roles in the promotion of HE services and systems to enterprise, and represent HEI difficulties in dealing with enterprise. Those appointed should liaise and cooperate with each other.

### 5.4 IMPLEMENTATION

While there are a variety of ways to implement the above recommended approach in a coherent way, the Council proposes in the first instance that responsibility for establishing the required applied research capability be assigned to *Technology Ireland*, the new dedicated support structure for industrial research and development announced in the *Strategy for Science, Technology and Innovation*. It would oversee a more coherent approach by EI and IDA as well as SFI and HEA and set up a new structure to develop the applied research groups.

Over time and based on the success of Technology Ireland's approach alternative consideration might be given to establishing a new *Applied Research Foundation*, as an analogue to *Science Foundation Ireland*, to undertake the task of developing applied research groups in cooperation with enterprise and the HE sector. The Foundation would have a separate legal entity and all funding for applied research would be channelled through it.

The one issue to stress is urgency. Ireland is some years behind other comparator countries like Austria in giving enterprise-science relationships the priority it deserves. A timetable should be established for the implementation of the above recommendations and a semi-annual appraisal of progress will be undertaken as part of the Council's review of the Strategy for Science, Technology and Innovation.

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<sup>1</sup> Academia-Industry Interface – From a Research Perspective, Royal Irish Academy, July 2006

## **APPENDIX 1. MEMBERSHIP OF COUNCIL TASK FORCE**

### **COUNCIL MEMBERS**

Dr. Leonora Bishop (Chair), IDA Ireland

Prof. Dolores Cahill, Conway Institute, UCD

Mr. Ian Cahill, LM Ericsson and Nova UCD

Prof. Donald Fitzmaurice, ePlanet Ventures

Prof. Anita R. Maguire, UCC

Prof. Tom McCarthy, IMI

Dr. Reg Shaw, Wyeth

### **ADDITIONAL MEMBERS**

Mr. Sean Baker, Iona Technologies

Prof. Joe Cogan, UCD

Dr. Liam Donnelly, Teagasc

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### **RESEARCH AND TECHNICAL SUPPORT:**

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