Forfás

8th National Innovation Conference

A Foundation for Innovation

Collaboration between Education, Enterprise and Government

The Helix, Dublin City University

20 November 2003

Conference Proceedings

THE NATIONAL POLICY AND ADVISORY BOARD FOR ENTERPRISE, TRADE, SCIENCE, TECHNOLOGY AND INNOVATION

Functions of Forfás

Is é Forfás an bord náisiúnta um polasaí agus comhairle le haghaidh fiontraíochta, trádála, eolaíochta, teicneolaíochta agua nuála. Is é an comhlacht é a bhfuil cumachtaí an stáit maidir le chur chun cinn tionscail agus forbairt teicneolaíochta dílsithe ann. Is é an comhlacht é freisin trína dtiomnaítear cumhachtaí ar Fhiontraíocht Éireann le tionscail dúchais a chur chun cinn agus ar Ghníomhaireacht Forbartha Tionscail na hÉireann (GFT Éireann) le hinfheistíocht isteach sa tír a chun chun tosaigh. Is iad feighmeanna Fhorfáis:

- *comhairle a chur ar an Aire ó thaobh cúrsaí a bhaineann le forbairt tionscail sa Stát;*
- *comhairle maidir le forbairt agus comhordú polasaithe a chur ar fáil d'Fhiontraíocht Éireann, d'GFT Éireann agus d'aon fhoras eile dá leithéid (a bunaíodh go reachtúil) a d'fhéadfadh an tAire a ainmniú trí ordú;*
- *forbairt na tionsclaíochta, na heolaíochta agus na teicneolaíochta, na nuála, na margaíochta agus acmhainní daonna a spreagadh sa Stát;*
- *bunú agus forbairt gnóthas tionsclaíoch ón iasacht a spreagadh sa Stát; agus*
- *Fiontraíocht Éireann agus GFT Éireann a chomhairliú agus a chomhordú ó thaobh a gcuid feidhmeanna.*

Forfás is the national policy and advisory board for enterprise, trade, science, technology and innovation. It is the body in which the State's legal powers for industrial promotion and technology development have been vested. It is also the body through which powers are delegated to Enterprise Ireland for the promotion of indigenous industry and to IDA Ireland for the promotion of inward investment. The broad functions of Forfás are to:

- *advise the Minister on matters relating to the development of industry in the State;*
- *advise on the development and co-ordination of policy for Enterprise Ireland, IDA Ireland and such other bodies (established by or under statute) as the Minister may by order designate;*
- *encourage the development of industry, science and technology, innovation, marketing and human resources in the State;*
- *encourage the establishment and development in the State of industrial undertakings from outside the State; and*
- *advise and co-ordinate Enterprise Ireland and IDA Ireland in relation to their functions.*

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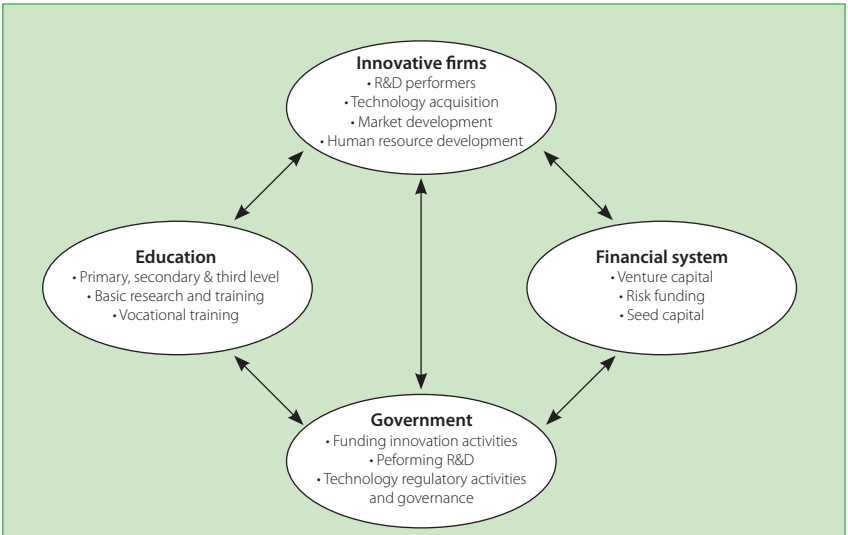
1 Introduction

National Innovation System

Innovation is the heartbeat of modern economies. Without it firms cannot introduce new products, services or processes. In today's globally competitive environment no firm, large or small, can survive without innovating. However, the paradox of innovation is that while it is driven by competition, it cannot flourish without co-operation, sometimes even between competing firms. Innovation no longer depends only on how firms, universities, research institutes and regulators perform, but on how they work together.

Thus, a national innovation system to be successful requires not only strong and vigorous components but also extensive and productive interactions between the components. Figure 1 outlines the main components of a national innovation system, as illustrated in the 1996 White Paper on Science, Technology and Innovation.

Figure 1: The main components and linkages of a National Innovation System



(Source: 1996 White Paper on Science, Technology and Innovation)

The key to building a successful national innovation system which is critical for Ireland's development as a knowledge-based economy is the development of partnerships between the main stakeholders.

The theme for the 8th National Innovation Conference was "A Foundation for Innovation: Collaboration between Education, Enterprise and Government."

Peter Cassells, Chairman of Forfás, officially opened and chaired the conference.

The opening address was delivered by Mary Harney, T.D., Tánaiste and Minister for Enterprise, Trade and Employment.

Claire Nauwelaers, Research Director, Maastricht Economic Research Institution on Innovation and Technology (MERIT) presented the introductory address on new policy approaches to national innovation systems. The response was delivered by Professor Jane Grimson, Vice-Provost, Trinity College Dublin.

Three workshop sessions, comprised of representatives of the main components of a national innovation system, then discussed how Ireland's national innovation system could be improved and strengthened. The workshop chairmen presented the recommendations from the workshops in the final plenary session.

The keynote address was given by Richard Riley, former U.S. Secretary for Education, on the theme on how university-industry collaboration can assist Ireland's innovation capability. The response to the keynote address was delivered by Dr Danny O'Hare, President Emeritus, Dublin City University.

Martin Cronin, Chief Executive of Forfás, delivered the closing address.

2 Address by the Conference Chairman

Peter Cassells, Chairman of Forfás

The chairman welcomed the delegates to the 8th National Innovation Conference which this year was been organised in partnership with InterTradeIreland. In particular, he welcomed Mary Harney T.D., Tánaiste and Minister for Enterprise, Trade and Employment, and the two keynote speakers, Richard Riley, former US Secretary for Education, and Claire Nauwelaers, Research Director, Maastricht Economic Research Institution on Innovation and Technology (MERIT).

He noted that the focus of the conference was on examining the totality of the innovation system whereas past conferences had focused on individual issues such as innovation and sustainable development and innovation and creativity. The chairman also said that the Conference would additionally examine the linkages between the main components of the national innovation system i.e. education, enterprise and government.

The selection of speakers reflected the focus of the conference; Richard Riley while Secretary for Education in the Clinton Administration was recognised for building close links between education and the world of work; Claire Nauwelaers specialises in studying national and regional innovation systems with particular focus on the transfer of knowledge into the economy and society.

Following a period of rapid economic growth, it is an imperative that the competitiveness of the economy be strengthened so as to facilitate the move to a knowledge economy. The chairman outlined the need for greater co-operation and partnership between education, enterprise and government. The need for greater collaboration between these sectors is important given that the economy is now at a critical stage.

He stressed that the time for action was now and it was, therefore, opportune for the delegates from the four sectors to address the linkages between them. He said it was also important that the delegates identify blockages within the system that might impede the development and transfer of new knowledge.

Mr. Cassells then invited the Tánaiste and Minister for Enterprise, Trade and Employment, Mary Harney, T.D., to deliver the opening address.

3 Opening address

Mary Harney, T.D., Tánaiste and Minister for Enterprise, Trade and Employment

The Tánaiste and Minister for Enterprise, Trade and Employment, Mary Harney, T.D., spoke of her pleasure at presenting the opening address for the 8th National Innovation Conference.

The Tánaiste noted that "moving up the value chain" had become the latest buzz phrase though she was not certain that its implications were fully understood. She noted that if we are to create an innovative society in Ireland then, based on the results of an OECD study, 50% of our long-term growth would have to come through innovation i.e. new product or service development. She predicted that Ireland's future competitiveness would come from productivity growth which would be fuelled by innovation. For innovation to flourish in Ireland, close partnerships were required between education and research and between industry and government.

She highlighted that the views of the Conference participants would be very important in determining whether Ireland has a properly functioning innovation system. It was necessary, however, to define what was meant by innovation. Innovation is often defined as the supply of new ideas to products, processes, organisations, management, marketing and services. New ideas on their own were not, however, enough; they would only be innovative if they were successfully marketed. Traditionally, innovation was viewed as a linear progression from laboratory to marketplace but the reality was that it was a very complex process with a host of dynamic factors at work.

The Tánaiste focused her address on the role of government in the innovation system. She noted that the European Union had set itself a target of increasing expenditure on research to 3% of GDP by 2010; currently, it stands at 1.9% of GDP. Ireland currently spends 1.5% of GDP on research while in some Scandinavian countries the level is closer to 4%. Two-thirds of the 3% target expenditure is to come from the private sector.

The government could play a major role in influencing the level of private sector spending on research. Science, technology and innovation has been a key priority for this government and this has been reflected in the 2004 estimates for the Department of Enterprise, Trade and Employment. While overall departmental spending had only risen by 3%, the allocation to science and technology had increased by 36%. The budget for Science Foundation Ireland has increased by 62% and Enterprise Ireland will have a budget of €83 million to support innovation, knowledge transfer and the commercialisation of knowledge from the universities. The Department of Education and Science has prioritised spending on the Programme for Research in Third Level Institutions.

The Tánaiste stressed that support for innovation was more than just the allocation of money; it was important to ensure that it was strategically targeted. Science Foundation Ireland had attracted some of the world's leading researchers to carry out basic research in Information Communication Technologies (ICTs) and in Biotechnology with the result that there were now some 130 different research teams working in these fields.

It is too early to say what discoveries would be made as a result of this investment but it is clear that the government's support for science, technology and innovation has moved Ireland into a higher added value space. In the past, Ireland's success had depended on attracting foreign direct investment because of its low cost structure, skilled workforce, low taxes and appropriate regulatory environment. Ireland could no longer compete on these factors against the new EU applicant countries and would have to move up the value-added chain.

Competing in the new higher added value space means that Ireland requires higher levels of skills which is the second role for government. The Tánaiste said it was important to ensure that the education system in Ireland produces the skills and intellectual capital on an ongoing basis to facilitate the transition to a knowledge-based economy.

Providing the appropriate regulatory environment was another important role for the government. Ireland has modernised its intellectual property and copyright laws and additionally has been pushing at a European level for the early adoption of the EU patent directive. The Tánaiste said that obtaining agreement on the patent directive would be one of her priorities for the EU presidency in 2004.

The Tánaiste noted the importance of venture, seed and risk capital for innovation and the need to marry financiers with innovators. The government has put together a very attractive tax regime for the financing of new business start-ups. She said that one such measure, the Business Expansion Scheme, was used by 50% of the companies supported by Enterprise Ireland as a source of seed capital.

In conclusion, the Tánaiste wished the conference well and said she looked forward to reading the papers from the keynote speakers with a view to learning how Ireland can put in place an innovation system that can generate future success for the economy.

4 Introductory address

Claire Nauwelaers, Research Director, Maastricht Economic Research Institution on Innovation and Technology (MERIT)

Policy-makers are increasingly making use of the concept of national innovation systems for analysing the innovation performance of an economy or region. At the core of a national innovation system are enterprises because they generate innovative products and services which leads to increased competitiveness and employment.

Though markets are the key sources of innovation, enterprises need inputs from other elements of the innovation system to develop new innovative products and services. These elements and inputs include:

- **The education and training sector**: This sector is the main provider of human capital;
- **Public sector R&D**: Research undertaken within the public sector today whether in State laboratories or third level institutions can be an important source of tomorrow's innovation;
- **Innovation supports**: To innovate effectively, companies need advice and mentoring, etc., to develop their strategic capabilities;
- **Regulatory environment**: Having the right legal framework is important for the transfer of knowledge, an important precursor to innovation;
- **Finance**: The provision of finance, particularly venture capital, is vital for new technology-based firms;
- **Government policy**: The government plays an important role in the system not only in the formulation of innovation policy but also in funding other parts of the system such as education and training.

Achieving an innovative enterprise sector requires not just the presence of these different elements but also the quality of interactions between them. Increasingly, the emphasis of national innovation systems is on flows of knowledge within the system and the focus, therefore, is on the diffusion and absorption of that knowledge.

Knowledge can be divided between codified knowledge (which can be transferred easily) and tacit knowledge (which is embedded in people). The latter being more difficult to obtain has become an important source of competitive advantage for countries.

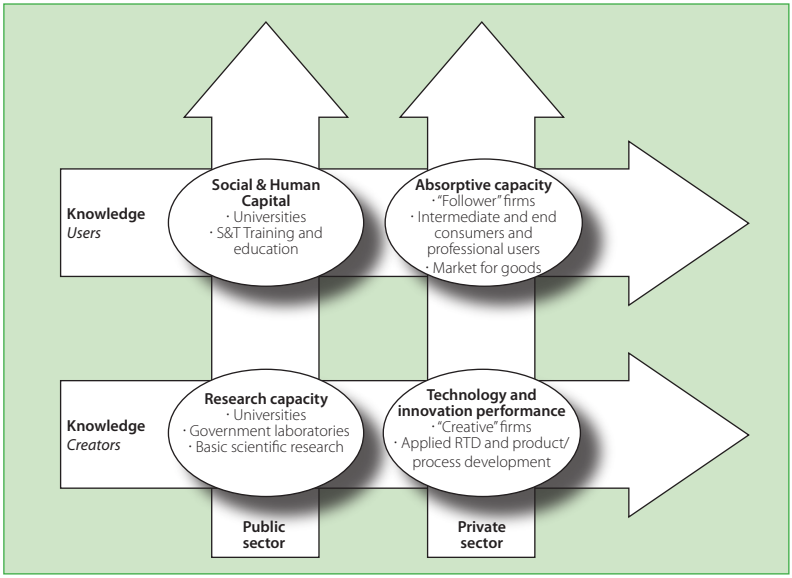
The focus on the diffusion and learning of knowledge has led to an increased awareness of the importance of social capital e.g. norms and culture, and organisational factors. These issues pose challenges for policy-makers because the impact of policy measures is harder to measure.

The role of governments within national innovation systems is changing. Governments are increasingly seen not just as providing resources for education and public sector R&D but also as having responsibility for removing barriers or blockages to the flow of knowledge within the system. Policy-makers increasingly need to think in terms of the system as a whole and on building linkages between the different elements of the system. Furthermore, the role of government is changing from that of an investor to one of facilitating and promoting partnerships between the different elements within the system.

A review of initiatives in the EU to support innovation showed that many countries put a disproportionate focus on the creation of knowledge at the expense of developing the capacity of companies to absorb knowledge created elsewhere within the system. The review also concluded that policy packages for fostering innovation were more effective than individual measures taken in isolation.

The monitoring and evaluation of innovation policies needs to be strengthened to facilitate learning in this new and complex area. This learning needs to take place at a regional, national and European level and the evaluation of policies should have regard for the intangible outputs such as organisational learning and development.

Figure 2: Indicative issues, actors and activities in a science, technology and innovation system as outlined in Claire Nauwelaers's presentation



5 Response

Professor Jane Grimson, Vice Provost, Trinity College Dublin

A national innovation system is about creating a framework and an infrastructure in which creativity and innovation can flourish and be exploited ultimately for the benefit of society and the economy.

Ireland is no longer a low cost country and coupled with the strengthening of the Euro there is a need for us to move higher up the value chain by developing knowledge-intensive industries which are founded on leading-edge research. Research which is directed at the acquisition and application of knowledge is a fundamental driving force for social and economic development. All of the available indicators such as the percentage of GDP spent on research, the number of researchers per 1000 of population, the number of patents produced and the number of scientific publications, point to the fact that Ireland lags behind its European competitors and has a lot of ground to catch up on if we want to develop as a knowledge economy.

Universities are major producers of this knowledge and are, therefore, at the heart of the process. The education sector faces a number of challenges in terms of contributing to the development of a knowledge society in Ireland. The first is the decline of interest in careers in science, engineering and technology among young people and it is especially a problem among girls. There are serious issues to be addressed here if the participation of young people in science, engineering and technology is to be encouraged and adopting the recommendations of the Task Force on the Physical Sciences is part of the solution. For their part, universities need to look at the balance of the courses they offer in terms of breadth versus depth.

Secondly, the role of the universities is changing. In addition to their traditional roles of knowledge creation (the research element) and knowledge dissemination (their education mission), two new roles are being increasingly identified. The first is contributing to public policy and the second is in the innovation area such as supporting spin-off activities.

The universities in Ireland also need to examine what they are doing in terms of their traditional educational role to be able to support the knowledge economy. There is a need to look at lifelong learning provision for people who are in employment and additionally there is a need for universities to produce more PhDs and Masters. The knowledge economy is not dependent on just scientists, engineers and technologists. We need people who come from the humanities and social scientists to work together with the scientists and engineers.

Career structures and reward systems in Irish universities need to be examined to allow for staff to become involved in spin-off activities. The example of the U.S. system where there is a lot more movement and flexibility for academic staff may provide some useful pointers.

Universities also need to do more in the area of inter- and multi-disciplinary research. Industry is inherently multi-disciplinary and perhaps the universities could be doing more to prepare graduates for working in this type of environment.

Funding is a huge issue for universities and there has been a huge transformation in the provision of funds for research through the Programme for Research in Third Level Institutions, Science Foundation Ireland and the two Research Councils. There is a need for ongoing support if we are to maintain the investment in state-of-the-art laboratories.

Claire Nauwelaers in her address pointed to the importance of policy co-ordination and what we tend to call joined-up thinking. However, there is a danger that we are going down the "donut" policy route of being joined up at the edges with a hole in the middle. Systemic innovation policies are at the heart of a successful national innovation system.

6 Workshop reports

Introduction

The workshops are an integral part of the annual Forfás Innovation Conference. They are considered to be the "engine room" of the conference where policy issues of direct concern to the three sectors of a national innovation system, education, enterprise and government, are discussed.

Each workshop was asked to discuss the contribution of their sector to the national innovation system and that of the other key stakeholders. The three workshops and their respective chairmen are listed below:

- **Education**
  Workshop chairman: Sir George Quigley, Chairman, Bombardier Aerospace;

- **Enterprise**
  Workshop chairman: Dr. Don Thornhill, Chairman, Higher Education Authority

- **Government**
  Workshop chairman: Mr. Liam Nellis, Chief Executive, InterTradeIreland

The workshop participants were asked to consider the components of a successful national innovation system and make recommendations on each of the following:

- How can this group contribute to the development of a robust national innovation system? (1 recommendation)

- How can the other key stakeholders contribute to the development of a robust national innovation system (2 recommendations)

Education Sector Workshop

Recommendations on the contribution of the Education Sector to the development of a robust national innovation system.

The Chairman, Sir George Quigley, noted that Ireland had made significant progress in relation to the innovation agenda and was moving from an investment-driven economy to an innovation-driven economy. Progressing the innovation agenda would require the higher education sector to be defined as a system in which the colleges interact with each other and integrate with the rest of the environment and the enterprise sector to recognise the new strategic direction needed to compete in an innovation-driven economy. The primary roles for government are in managing and co-ordinating the system as a whole—particularly the strategic interfaces—and in ensuring that innovation policies are aligned.

Education
Recommendation

- The higher education sector needs to be defined as a "*system*" that interacts within itself and integrates with the rest of the environment.

Enterprise
Recommendation

- Business enterprises need to develop the systems and capacity to use the new technologies emerging from the educational sector and to recognise that a different approach is required in an innovation-driven economy.

Government
Recommendation

- The government needs to provide consistent and co-ordinated policy and resource support to promote networking.

Enterprise Sector Workshop

Recommendations on the contribution of the Enterprise Sector to the development of a robust national innovation system.

Dr. Don Thornhill, the Chairman of the Enterprise Sector Workshop, outlined the crucial importance of cultural change (values, processes, organisational structure, etc.) both within individual firms and the sector as a whole if the sector was to assist in the creation of an innovation society. He also highlighted the importance for the enterprise sector of forming linkages both with second and third level education. Structures were needed to allow enterprises to access intellectual property in third level institutions and this needed to be complemented by a cultural change within the universities to dealing with companies. Making innovation a core value for government was also recommended by the workshop.

Enterprise
Recommendations

- Cultural change towards innovation is required in individual enterprises and within the enterprise sector to facilitate the transition to an innovation society.

Education
Recommendations

- The enterprise sector needs to develop linkages with the second level system through exchanges and placements in order to make teachers and pupils more aware of the business community.
- The National Code of Practice developed by the Irish Council for Science, Technology and Innovation (ICSTI) or the transfer of intellectual property should be implemented without delay.
- A significant change in culture within third level institutions needs to take place in relation to interfacing with industry.

Government
Recommendations

- Innovation should be made a core value for government.
- Greater importance should be attached to policy consistency, both between the activities of agencies and the budgetary allocation of government departments.
- The recommendations of the Task Force on the Physical Sciences should be implemented.

Government Sector Workshop

Recommendations on the contribution of the Government Sector to the development of a robust national innovation system.

The Workshop Chairman, Liam Nellis, highlighted the importance for the government sector of developing an agreed and shared vision for progressing a national innovation system. Furthermore, this vision should be implemented consistently and its core funding be ring-fenced. ICT Ireland was advocated as a model as how the enterprise sector might work more closely and on a joint basis with the higher education sector. The higher education sector for its part needs to collaborate more with the enterprise sector and there was a need for greater cohesion between higher education institutions on the island of Ireland.

Government

Recommendations

- As a major stakeholder in the National Innovation System, Government should implement a continuous process to review international best practice which contributes to effective National Innovations Systems and should evaluate how these can be adopted (or not) to improve the Irish innovation system.

Enterprise

Recommendations

- Networks both of an organisational and information nature are critical to the exchange of ideas between stakeholders in an innovation system. There is an identified gap in communications between Irish enterprises and, more importantly, in their interactions with researchers in the third level system. This needs to be addressed urgently.

Education

Recommendations

- The issue raised above is not just limited to enterprises. There is a need for the education sector to interact with enterprises to a far greater degree than heretofore. In view of the small size of the Island and the scale of the enterprises therein it would make economic sense for cooperation not to be limited by political boundaries.

7 Keynote address

Richard Riley, Former U.S. Secretary for Education

Mr. Riley began his speech on how university-industry collaboration could help Ireland become a nation of innovation by pointing out that the issue was much larger than university, government and industry collaboration, it was about Irish culture and how Ireland perceived itself as a nation.

No nation can hope to be innovative if it remains insular, bound by tradition alone and dominated by structures and institutions that diminish individual creativity. Individuals who take risks, who are willing to break the mould, make the difference when it comes to sparking innovation.

The speed at which Irish young people had taken to their new identity as Europeans suggests that Ireland is creating a new cultural identity that is much more open to innovation. This willingness to engage the modern world—to have a new sense of openness, flexibility and creativity—is an essential building block for economic innovation.

Another essential building block in Ireland's quest to become a nation of innovation is its willingness to invest for the long haul. This is a question of time. The nature of business, especially in the competitive world of information technology, requires an enormous amount of speed; time is everything. Nevertheless, the investments Ireland makes for the long term—and particularly the investments in education—pay enormous dividends in long-term economic success.

The decision by the Irish government to give many more Irish students the opportunity to gain third level education was clearly one of the foundations for Ireland's economic success in the last decade. And all through the 1990s, Ireland has kept a sustained focus on the important issues of equity and access to higher education and put a new emphasis on life-long learning. This is smart strategic and long-term thinking.

The challenges of equity and access remain today, however, and seem even more pressing given the anticipated one-third drop in Irish school-leavers by 2007. Ireland may face a significant challenge in developing a large enough pool of skilled IT and other workers to expand its economy. This suggests that much more will have to be done to extend the learning opportunities of the current Irish workforce and to give older workers a greater opportunity to keep developing their skills. It also suggests that much more will have to be done to lift up the 18 per cent of primary and secondary students who are disadvantaged.

Mr. Riley encouraged business leaders to adopt a position of enlightened self-interest in challenging deeply-ingrained, negative expectations about access to third level. It was not an issue that should be left for educators and government policy-makers to address alone.

The great paradox of our time is that science illiteracy is one of the hallmarks of modern society, even though we increasingly depend on science to achieve our social and economic goals. We need an enormous paradigm shift in science and mathematics education—a movement away from an education just for the elite to a new way of teaching that captures the interest of all students.

The U.S. has not done a very good job of teaching maths and science. Mathematics and science education in the U.S. has historically been above international standards in the early grades but falls below international standards by the time students finish their secondary education. One of the pressing tasks of American education is to rethink how these subjects are taught. There are other challenges to be faced in encouraging young people to go into science and IT. One such challenge is to change the negative perception of young people—particularly girls—towards careers in science, engineering and IT.

Thinking about how we learn at both the secondary and third level is increasingly a concern of American business and university leaders. Recently, the Business-Higher Education Forum of the American Council on Education released a major report, entitled "*A Nation of Learners*" which called for a fundamental redesign of how Americans think about learning at third level—the need to fundamentally alter centuries-old learning techniques by making major investments in new education technology. The report makes the point that some of the most innovative approaches to learning are the result of university-industry collaborations. The Peter Kiewit Institute at the University of Nebraska is one such example. The Institute combines the faculties of the College of Engineering and the College of Information Science and Technology. Equally important, the faculty and students of these two colleges work hand in hand with 150 business partners.

The development of university-industry collaborations is clearly something that is on the rise in the United States and builds on the existing and very strong collaboration between the federal government and the research universities. The federal government has encouraged the rise of industry-funded research through legislation and research programmes.

There is a growing awareness of the powerful role that "clustering" plays in developing university-industry collaborations. The research of Harvard professor Michael Porter has had a powerful impact on American thinking. The U.S. is dotted with successful economic clusters that are linked to well-established university research centres—Silicon Valley's links to Stanford University; the Route 129 cluster, which feeds off of MIT

and Harvard in Massachusetts; and the North Carolina Research Triangle, which is linked to Duke University and the University of North Carolina.

Even community colleges are well aware of the impact of clustering. Montgomery County Community College just outside of Washington, D.C. is located in the heart of what some call "DNA Alley," the mass of biotech companies clustered around the government's National Institutes of Health in Maryland. As a result, the community college working with the local economic development authority and other universities is in the early stages of designing and building a $150 million biotech park and campus to support the on-going work of these biotech companies.

The U.S. experience suggests that if Ireland wants to make its mark in biotechnology and other emerging fields, it will have to go full speed ahead in developing its research capabilities and in developing partnerships with leading research universities around the world. There are other lessons to be learned from America's on-going experience with university-industry collaboration:

- There is a strong need to develop a level of trust that allows partnerships to flourish;
- Successful partnerships are often built around intermediary organisations that can translate ideas back and forth between the different cultures;
- Partnerships often work best when a university and a company develop a comprehensive master contract before the research begins.

In addition to developing collaboration with industry, Irish universities should be encouraged to scale up their partnerships with their European and American counterparts. Irish university leaders also have a role to play in fostering a spirit of partnership and creating an ethos of collaboration among the many higher education institutes in Ireland, North and South.

Mr. Riley suggested two final issues for consideration by policy-makers in charting a course for innovation in Ireland. Firstly, recognise the powerful connection between economic innovation and creativity. The arts are at the edge and at the edge is where innovation begins. Ireland has a rich cultural heritage. The artistic renaissance of the last decade in Irish music, film, art and literature suggests that Ireland still has deep wells of creativity. There are many new emerging links between technology and the arts.

Secondly, realise that the core value at the heart of innovation is integrity. Innovators, in their pursuit of the new and what they see as important, are guided and sustained by a deep, abiding sense of integrity. Artists stay true to their art. Writers hold to their vision. And scientists across the world define their work by upholding the high values of the scientific credo. Integrity is a value that sustains innovation.

8 Response

Danny O'Hare, President Emeritus, Dublin City University

Educators and innovation policy-makers have looked to the U.S. for its innovation, its lack of regulation and for the role that the federal government plays in education.

The U.S. higher education system is characterised by diversity. The total of 4,000 higher education institutions in America include State-funded community colleges and universities as well as privately-funded universities. It is worth noting that of the top 20 universities in America, 18 are private. Additionally, not every university teaches engineering and only 235 colleges are regarded as research universities. The diversity within the U.S. higher education sector notwithstanding there is a willingness to jointly undertake common activities. Four of the leading universities are, for example, involved in a joint distance learning programme because they have found that it is too expensive to do it on their own. Irish universities, on the other hand, have shown little evidence of drawing together and seeking common causes. One suggestion is that the four Dublin-based universities and the Dublin Institute of Technology should get together to help with the establishment of a national science park.

Another difference between U.S. and Irish universities is the tenure system. The Provost of Cornell University, one of the great universities of the U.S., has suggested that it is too easy to secure tenure in the higher education system in Ireland. He also suggested the introduction of annual salary reviews.

The leading universities in the U.S. have learned the importance of finding the best talent in the world and paying what is necessary to attract them. This is the approach that Ireland must adopt—along with the financial commitment—if we are to compete.

There has been considerable discussion in Ireland on preparing for the knowledge society and much of the focus of this has been on the higher end of the skills spectrum. There is a danger that skills for the lower end of the labour market could be neglected in the rush by higher education institutions, particularly Institutes of Technology, to address the skill needs of knowledge workers.

It is common knowledge that the Institutes of Technology are seeking to link with or become universities. It is internationally accepted that when institutions link with a university it is the university ethos that will dominate. If this were to happen in Ireland we would run the risk of losing the diversity in our third level system which has proved so important for our economic success—just as it has in the U.S.

There may be opportunities for the Institutes of Technology to become more involved in the provision of undergraduate degree courses which would allow the universities

to become fourth level institutions. Ireland has too few post-graduates doing research work to support our transition to a knowledge-based economy.

I would like to see Irish universities becoming more aggressive in encouraging undergraduate students to undertake research. The MIT undergraduate research opportunities programme which allows students to be attached to research groups has much to be admired.

Higher education institutions need to reflect on the impact they have on second level education. Entry points to third level have a wash-back impact on the interpretation of the curriculum in second level. The dichotomy between second level experience and third level entry must be broken.

Educators should consider the introduction of general science and arts programmes at under-graduate level and provide specific tuition at levels 7 and 8. The conversion programmes which many third level institutions have been providing to people from diverse backgrounds by giving them a top up for a year or two and sending them to industry have been very successful.

There has been a significant increase in the amount of funding for third level research. Government and industry should recognise, however, it is not the task of academic researchers to also be proficient in the commercial exploitation of the results of their research. What is important though in the drawing up of research contracts is a clear relationship between research groups and industry. The access approach of Media Lab in the U.S. where companies pay to access the ideas and intellectual property points to a possible method that could be used in Ireland for bridging the industry-university divide.

Finally, it is also important that the recommendations of the Task Force on the Physical Sciences be implemented.

9 Closing address

Martin Cronin, Chief Executive Officer of Forfás

In closing the conference, Martin Cronin referred to the concern that government policy on innovation could result in the various elements of a national system of innovation being joined up but with a hole in the middle, the so-called "donut" phenomenon. Firstly, there was a need to go beyond intra-government policy co-ordination to a form of joined-up government that includes central strategic direction and oversight which was loose enough that it did not stifle innovation but tight enough that there was a basic level of coherence. Secondly, in a globalising world that was getting even more competitive there was a need for things to work better, working well would no longer be good enough.

He noted that there was some scepticism during the conference on the achievement of the EU's 3% expenditure target on research by 2010. Finland had already achieved the 3% target and is very happy with the result and its economy was growing strongly. Sweden, on the other hand, has also exceeded the target but is unhappy because it feels the output of their research is leaking away to other economies while its economy was not doing so well. Claire Nauwelaers had made the point well that knowledge creation was only one part of the equation and knowledge diffusion and absorption were equally important.

He said that there was a need to reflect on the development of context-specific as opposed to off-the-shelf solutions and on the provision of systems oriented approaches to SME supports.

In conclusion, he thanked the Tánaiste, keynote speakers, respondents, workshop chairmen and all the participants.

Forfás Board Members

Peter Cassells	Chairman
Martin Cronin	Chief Executive, Forfás
Sean Dorgan	Chief Executive, IDA Ireland
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Dr. William Harris	Director General, Science Foundation Ireland
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