



ICSTI
IRELAND

Irish Council for Science,
Technology and Innovation

ICSTI Statement

Commercialisation of Publicly Funded Research

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Forfás



Established by the Government and Forfás to advise on Science, Technology and Innovation

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- To advise the Minister on the strategy for the preparation and implementation of national programmes in science and technology.
- To advise the Minister on the strategic direction for State investment in science, technology and innovation.
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ICSTI STATEMENTS

State Expenditure Priorities for 1998	September 1997
£250 Million Scientific and Technological Education (Investment) Fund	January 1998
Science in Primary Schools	May 1998
A Partnership Approach to Research Funding – The Need for a National Science and Engineering Research Fund	May 1998
Mechanisms for Prioritisation of State Expenditures on Science and Technology	June 1998
Innovation in Enterprises in Ireland	July 1998
State Expenditure Priorities for 1999	November 1998
Investing in Research, Technology and Innovation (RTI) in the Period 2000 to 2006	January 1999
Technology Foresight Report	April 1999
Public Research and Technology Services for Innovation in Enterprises	September 1999
Benchmarking School Science, Technology and Mathematics Education in Ireland Against International Good Practice	September 1999
Science in Second Level Schools	October 1999

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Summary

The Issues

In modern industrialised economies, it has been shown that the output from science and technology has been doubling every seven to ten years. Total intangible investment exceeds physical investment in a number of them. These economies are commonly classified as knowledge-based, their reliance on knowledge being their key feature. Ireland is on track to becoming a knowledge-based economy due to national, European and multinational influences on its educational, technological and work environment.

In this context, the transfer of research and development results from universities, institutes of technology¹ and Government research institutes to the commercial market place for public benefit - the commercialisation of research - is an activity of increasing importance. While the primary outputs of research are knowledge and education, which in turn both produce skilled researchers and make Ireland more attractive to industry, there are increasing opportunities to derive economic benefits from the enhanced commercialisation of research. However, to date, Government Departments and their agencies have under-invested in the commercialisation of non-commissioned research even relative to the historically low level of publicly funded research and development (R&D) carried out. As the opportunities for commercialisation increase, targeted action must be taken to avail of them.

Only a proportion of R&D projects can be expected to provide results suitable for progressing down the road to commercialisation. However, relative to the previous low level of investment, the massive boost in public funding of non-commissioned R&D currently in train will raise the level of research in Ireland substantially. This increase can be expected to give rise to a proportionate increase in the opportunities for commercialisation. Institutions should continue to return the benefits of commercialisation of research, firstly to Ireland and secondly to Europe, where possible.

¹ Throughout this statement, the term institutes of technology will be used to include the Dublin Institute of Technology (DIT) and all of the institutes of technology.

To exploit the opportunities effectively, the environment, the policies being implemented and the incentives under which the key actors - the researchers - operate also have to be favourable. Otherwise, entrepreneurs will not be able to bring research outcomes to the market place. Entrepreneurs, including those from academia, are key to continuing, and increasing the amount of, successful commercialisation of research.

Currently, the environment for the commercialisation of research, as determined by the policies of Government Departments (such as Agriculture, Food & Rural Development, Education & Science, Enterprise, Trade & Employment and Health & Children) and their agencies is not seen as favourable. The increase in public funding of research and development in Ireland warrants a corresponding increase in the actions of these stakeholders in support of commercialisation of research. The host institutions of researchers also have a significant role to play in providing positive incentives in the future.

The Recommendations

To develop a positive culture, a supportive framework and incentives are required. The following actions are recommended:

- In regard to the commercialisation of research, Government Departments should make a clear statement of intent and set specific objectives; should ensure that agencies under their aegis have adequate procedures in place and should commit sufficient resources to commercialisation of research. Measurement of progress against the objectives should be undertaken in addition to monitoring to ensure the effective use of resources. (p18)
- Funding agencies should encourage commercialisation of results of research they sponsor. They should drive forward the process of commercialisation, allocate funds for the initial stages of commercialisation of R&D and carry out an audit of

projects already supported to review the possibilities for commercialisation. There is scope for Enterprise Ireland (EI), including the PATs (Programmes for Advanced Technology), to play a more pro-active role in supporting new businesses, ventures and products arising from research in third level institutions. (p18-19)

- Universities, institutes of technology and research institutes should see commercialisation of R&D as an essential mission. They should encourage it as an option for all researchers in third level institutions and research institutes. They should have clear policies, allocate senior management responsibility and designate both sufficient personnel and adequate resources. In the area of intellectual property and spin-off companies they should adopt a flexible approach.

Universities, institutes of technology and research institutes should take all reasonable steps to obtain the maximum benefits for the economy and society and should support researchers in their commercialisation activities by offering incentives and by ensuring that no unnecessary barriers are in place. Financial returns should be proportionate to the services they provide. They should seek normal commercial royalties from patents and licences. The negotiation of equity holdings in spin-off companies should be consistent with achieving appropriate returns for all parties involved. (p19-21)

- In the Irish context, the resources available to the industrial liaison offices for commercialisation activities in third level institutions are totally inadequate. It is recommended that resources for the technology transfer/commercialisation function be increased substantially and that this be enabled by the relevant funding authorities. Interaction between researchers and industry clusters should continue to be facilitated by the industrial liaison offices with an increase in activity in this area being recommended. (p22)

- ICSTI believes that research outcomes are not being commercialised in sufficient numbers due, in part, to the lack of financial resources to advance the projects to the proof of concept stage. This work can be carried out by third level institutions, by research institutes and by companies. It is recommended that proof of concept funding be provided through the relevant agencies and Government Departments to third level institutions, research institutes and small and medium-sized enterprises, on a competitive basis. In the case of the research institutes, this funding should extend to demonstration trials where appropriate. The Council sees a particular need for Enterprise Ireland to review and strengthen its role in this area. (p24)
- It is recommended that an adequate new source of first stage venture capital finance be provided. After the proof of concept stage, early or seed venture capital can still be difficult to obtain, particularly for projects with long lead times which may require significantly greater funding than shorter term projects. This fund would be targeted at bridging the finance gap which exists for projects in which capital is at risk for longer periods. Given the experience of Enterprise Ireland in this area, ICSTI would welcome its involvement in establishing this fund. (p26)
- It is recommended that the Higher Education Authority, in developing its policies for the allocation of public funding to the universities, should have regard to the need to encourage the institutions to pursue active policies for the commercialisation of research. (p26)
- Training in commercialisation activities should be provided as an option for all researchers and research programme managers, both in third level and in research institutes. ICSTI exhorts the HEA, for the colleges, and Government Departments and agencies, for other researchers, to support and encourage this activity. (p27)

Additional key recommendations are that:

- The development agencies should support and assist in providing suitable formal networking fora for enterprises throughout the country on a regular basis. These fora could, for example, facilitate interaction between entrepreneurs and/or contact between entrepreneurs and those offering finance. (p27-28)
- In addition to the incubation supports currently available, the establishment of a small number of incubation companies to support start-ups requiring specialist facilities, business advice, mentoring and support services through their formative years should be encouraged and financially assisted. This could take the form of a public private partnership with each incubation company providing specialist support for several start-up companies. The Council would welcome the involvement of Enterprise Ireland in such a partnership. (p28-29)
- Systematic monitoring of a selected range of commercialisation indicators should be undertaken as an ongoing priority. (p29)

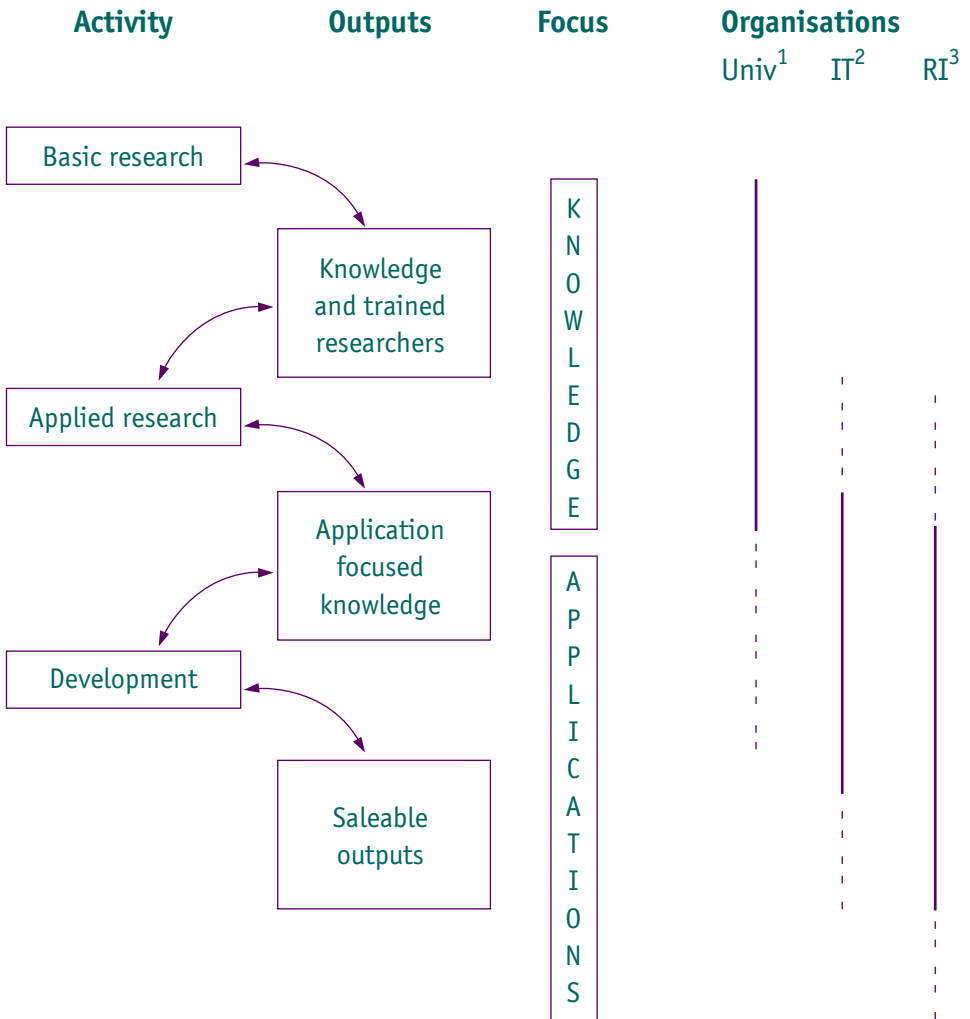
1. Introduction

This statement of the Irish Council for Science, Technology and Innovation makes recommendations aimed at improving the means, circumstances and conditions for the transfer and commercialisation of non-commissioned, publicly funded research activities and outcomes in higher education and public research institutions.

Publicly funded research refers to work funded from the Irish Exchequer with or without assistance from European Structural Funds. The research is carried out in universities, research institutes (e.g. Teagasc) and the institutes of technology. The funding bodies include the Higher Education Authority, Enterprise Ireland, the Health Research Board and the Marine Institute. In the case of research institutes, funding may be provided from the organisation's grant-in-aid or from the Productive Sector Operational Programmes under the National Development Plan e.g. the non-commissioned food research programme. In many cases, the work is part-funded by the university or the research institutes' own resources.

In this statement, technology transfer is defined as the transfer of research results from the universities, institutes of technology or research institutes to the commercial market place for public benefit. Commercialisation takes several forms including patenting, licensing and other entrepreneurial activity such as new company formation. The activities and organisations involved are shown in Figure 1. The processes involved are highly interactive and feedback occurs at all levels. As one moves from basic research outputs towards saleable outputs the costs involved and the value added increases non-linearly. For clarity, the continuum of basic and applied research and development has been represented in the figure as discrete activities. The main areas of activity of the different research bodies are indicated, the solid line representing the core area of activity and the dotted line other areas of activity.

Figure 1 Research Commercialisation



1 Universities
 2 Institutes of technology
 3 Research institutes

2. Commercialisation in Practice

2.1 Public Research Community

In developed countries the trend has for some time moved towards a “knowledge based economy” in which intangible investments in knowledge production, knowledge transmission and knowledge transfer become key activities in raising productivity and living standards.

In the knowledge based economy, the prime function of all third level institutions is education. In universities, the education function has traditionally had strong support from research. The international reputation of the university depends to a large degree on the quality of research and the track record as frequently measured by the publications of its researchers. Education at third level helps to ensure a flow of highly educated persons to participate in the labour force.

In recent decades there has been a recognition in Ireland and abroad that universities are a major resource with the capacity to make a direct contribution to industrial and economic development through the activities that are part of the knowledge and technology transfer process.

In universities the dominant research culture is to carry out cutting edge work and to publish in refereed journals in order to enable the researchers and their host institution to be recognised by their peers world-wide in their chosen fields of research. In regard to research commercialisation, some Irish institutions have by their record shown themselves to be comparable to universities in the USA. These successes need to be learned from and built upon.

Universities have developed policies in regard to their commercialisation of research activities. All have industrial liaison offices (ILOs), many have a track record in patenting and licensing and a number have also invested in incubation space to assist campus company formation and start-up. Commercialisation activity to date includes demonstration of the capability of the universities to incubate companies that have become successful on the world stage.

The institutes of technology have a tradition of quality teaching of immediate relevance to industry and more recently of research applied to solve problems for firms, particularly those in their region. In the last decade commercialisation activities have become more prominent in some institutes.

In Ireland, the institutes of technology have only relatively recently been enabled by statute to conduct research. They have begun to develop a research capability and are focusing their research on core areas having strategic importance to the institution. Several are developing policies in the area of research commercialisation, have ILOs, and have systematic enterprise training programmes for graduate entrepreneurs. Some have registered patents, have acquired incubator space for small companies and, in a small number of cases, operate a seed fund for start-up enterprises.

The focus of attention in the research institutes has been on applied research which, when disseminated, improves the productivity and competitiveness of their sectors. Only limited attention has been devoted to commercialisation in the sense of intellectual property development or the spinning out of start-up companies.

Internationally, research institutes have a long and well established record in research. In the post World War II period, a major expansion of these bodies has taken place world-wide. Their mission is to carry out research and development with and for industry. In Ireland the research institutes sector has not developed to the same extent. The main focus has been on the natural resources, agriculture and marine sectors particularly. In the post research and development phase, the main emphasis has been on disseminating results for potential use by companies and entrepreneurs. Very limited emphasis has been placed on piloting the newly developed products and processes or on creating new ventures. This represents a gap in commercialisation activity.

2.2 Commercialisation Supports

Historically in Ireland a heavy reliance was placed on the State in the area of research, innovation and entrepreneurship. Enterprise Ireland (EI) has a responsibility to help to grow the sales, exports and employment of Irish companies. In the area relevant to this report its objectives are to maximise the number of technology based start-ups with high potential and to facilitate the transfer of technology arising from research into industry in Ireland. EI's activities cover all the links in the chain from initial research to company formation and development. Financial support is available for research both in the third level and in companies, but not to public research institutes (which are usually funded through their parent Department). This funding covers intellectual property creation and initial evaluation of commercial feasibility (through the CORD grant) and provides venture capital through the Campus Companies Venture Capital Fund. In addition advice and general business planning support is provided through the Campus Company Programme. A further source of funding supports the building of incubator centres.

A valuable research, technology and commercialisation resource resides in the Programmes for Advanced Technology (PATs). EI, in partnership with third level institutions, is refocusing the PATs so that the creation and commercialisation of intellectual property and knowledge becomes more clearly their prime focus. EI also seeking to adapt the Strategic Research Grants Scheme² so that finance can be provided to researchers wishing to take commercial ideas which arise to a proof of principle/prototype stage.

Shannon Development through the Innovation Centre at the National Technology Park at Plassey in Limerick also has a wide range of supports including entrepreneurship courses, innovation facilities and access to venture capital.

2 *Strategic Research Grants Scheme: Operated by Enterprise Ireland, this fund supports pre-competitive third level research of medium term interest to industry as part of the Government Operational Programme for Industry. Grants may cover 100% of all eligible costs (staff, equipment, material and travel) and the maximum size of grant is £100,000.*

Supports, particularly to start-up companies and entrepreneurs, are also provided by the Business Innovation Centres (BICs)³, County Enterprise Boards (CEBs) and other local development agencies. BIC supports in Ireland include assistance with feasibility studies, business plan guidance, seed funding and incubation facilities. The CEBs provide business counselling and training, feasibility studies and grants.

Mentoring, by experienced business people and other professionals, is an additional valuable support for entrepreneurs and is part of the portfolio of services of the development agencies.

Incubators

An area which has become established particularly in North America is the process of new company incubation. There, incubators provide services to companies in their formative and start-up phases including administrative services and counselling, accounting and legal advice, assistance in business planning, organisation and team building as well as the raising of capital.

Activity in Ireland in this area has been growing from small beginnings over the last 2 decades. A number of Irish universities have incubators while others are in the process of putting them in place. Developments include the expansion of incubation facilities in Trinity College Dublin which has purchased an enterprise centre, part of which it plans to convert to an incubator centre. University College Dublin and Dublin City University have been approved for funding of such centres, through the EI incubator centre scheme, while University College Cork and NUI-Maynooth have suitable designated sites.

The institutes of technology in the border counties have built incubators. Dublin Institute of Technology has purchased an enterprise centre, part of which may be converted to incubator space. Carlow IT has been approved for funding for an incubator under the EI

³ *BICs: These are not for profit organisations, established with EU and local funding, which typically seek to increase entrepreneurial activity and to support start-up companies.*

Incubator Centre Scheme while Athlone IT and Cork IT have suitable sites. Under the Regional Operational Programme, the BMW (Borders, Midlands and West), South and South-east assemblies have agreed to provide special funding for incubators in the institutes of technology in those regions. Incubation facilities are also available through the BICs and, on a commercial basis, from companies such as Growcorp.

However, in comparison with facilities abroad, there is little provision of specialised incubation and support facilities. These are particularly important in areas such as biotechnology and information and communications technologies.

Venture Capital

Traditionally, the area of venture capital has been the one in which the private sector has been the most active, principally in the post start-up phase. More recently the sector has become more involved in the commercialisation of research. Stockbrokers, business angels and other intermediaries are now involved to a limited but growing extent in addition to the traditional fund managers. Venture capital in Ireland is an expanding but relatively immature business which, in terms of R&D based start-ups, tends to focus on areas such as e-commerce and computer software where outputs can be moved forward with a relatively low level of investment.

Closely linked to venture capital is the organisation of fora at which entrepreneurs, including those coming from the research community, can network with other entrepreneurs and with individuals and organisations providing services to those starting up a new business, including venture capitalists.

2.3 International Practice

Encouragement for the commercialisation of research is a focus of public policy particularly in countries with a strong publicly funded research base. Appendix 1 contains some examples of good practice in areas such as technology incubators, proof of concept funding, technology licensing, enterprise fora and courses for entrepreneurs.

3. Research Commercialisation in the Irish Context

Scientific advances and technological change have become important drivers of economic performance, wealth creation and improvements in the quality of life. Scientific progress has become a more direct driver of technological development especially in R&D intensive areas such as biotechnology, information and communications technologies and new materials. Only a proportion of R&D projects can be expected to provide results that will warrant consideration to progress down the road towards commercialisation. This is true in the case of commercial companies and it applies even more in the case of R&D supported from public funds since many of the funding schemes are not designed with commercialisable outcomes in mind. In addition, as individual projects move in the direction of commercialisation, there are many opportunities to fail: only a small proportion will reach the market place.

3.1 Level of Research and Development

The volume of research performed and its nature also have a major impact on the creation of opportunities for commercialisation. Historically, the funding for research from domestic public funds has been limited. However, more recently, there has been a substantial turnaround. Starting in 1997, the Higher Education Authority's Programme for Research in Third-level Institutions (PRTLTI) has provided major new financial support for priority research facilities and programmes developed by the institutions. The establishment of Science Foundation Ireland (SFI) will give a further boost to the funding available for research particularly in biotechnology, information and communications technologies and related areas. The research funding to be provided by the SFI will be open to research teams attached to both third level and public research institutes. In addition, Teagasc has received a major injection of financial support in the area of biotechnology research.

Both the volume and quality of scientific output in Ireland improved relative to that in other countries during the 1980s and early 1990s. Evidence from the amount of publication in international refereed journals indicates world level performance by Irish researchers in

a number of fields. The very substantial increase in finance being made available from public funds should raise the level of research substantially and enable many more research teams in Ireland to achieve world recognition.

The level of investment in commercialisation of publicly funded R&D in Ireland has been even less than that warranted by the small scale of funding of research itself and the opportunities for commercial exploitation arising. Given the very large increase in publicly funded research now in train the opportunities should be correspondingly greater. It is important that there is a favourable environment in which policies supporting commercialisation are implemented and that sufficient resources are effectively employed to exploit the opportunities.

3.2 Organisational Structure

Researchers are at the heart of the public research system. The quality of the output from the system depends to a very large extent on them. The environment in which researchers operate is determined predominantly by the institutions involved, their attitudes and policies. Currently, the environment is less attractive for the researcher than should be the case. There is also a lack of recognition of commercial exploitation of research as a valid option for researchers and the policies in place can discourage researchers from taking this option. Government Departments, funding agencies and host institutions all play a role in determining the framework under which research and development are conducted.

Government Departments determine the broad R&D policy: in some instances they operate programmes of funding directly (e.g. Department of Agriculture, Food & Rural Development) or more generally they monitor their implementation (e.g. Departments of Health & Children, Enterprise, Trade & Employment or Education & Science). The general approach is one of prudent management of resources under their control ensuring that monies are spent wisely for the objectives for which they are allocated and that value for money is achieved. Relatively limited attention has been given to

commercialisation concerns and, as the opportunities in this area are increasing, there is a need for Government Departments to recognise more directly that significant benefits may be gained through the pursuit of commercial opportunities that may arise and to actively support commercialisation.

Funding agencies also have a responsibility in regard to commercialisation of research. They have well tried procedures for the allocation of monies using competitive tendering and assessment of research quality by peer review or strategic and economic relevance depending on the particular programme. Generally resources for commercialisation of research activities are not provided and in some cases barriers discouraging commercialisation exist.

Early stage commercialisation activities are therefore constrained by research organisations drawing the necessary funds from other budget or from third party sources. There seems little doubt but that opportunities are not being identified or not being fully pursued.

Host institutions are important players. In the third level sector, resources are constrained and have to be garnered from external third parties. For example, at third level, not only is there no specific budget for commercialisation but such activities are not recognised (e.g. for promotion). Consequently activities such as preliminary technical evaluation and patenting struggle to get adequate attention. The institutes of technology in particular have very limited discretion to provide resources for R&D or for its commercialisation from their own resources. Host institutions have a significant role to play in providing positive incentives, a greater role than they have taken in the past.

In the case of the research institutions adequately resourced personnel with responsibility for commercialisation are not always in place, not provided on a permanent footing or are only assigned for specific programmes. Designated budgets for commercialisation are rarely provided. Clearly the current situation is inadequate and procedures, more in keeping with the potential benefits, need to be adopted.

4. Priorities

In modern industrialised countries the output from science and technology has been growing rapidly. It is estimated that the stock of knowledge is doubling every seven to ten years. Moreover the nature of investment has altered and total industrial intangible investment is greater than physical investment in a number of countries. In Ireland we are increasing investment in knowledge generation from public funds and we now need to facilitate its exploitation. In this context, the commercialisation of non-commissioned research takes on an increasing importance for us with an economy on track to becoming increasingly knowledge-based. The first priority and most critical objective must be to develop a positive culture and a supportive framework to enable the exploitation of outcomes of non-commissioned research.

4.1 Supportive Framework

Government Departments have a clear responsibility to provide the overall, co-ordinated framework for the commercialisation of research. This should be set out in a clear statement of intent which should be reflected in their strategy statements. This intent should be demonstrated by ensuring that agencies and other bodies under their auspices have adequate procedures in place for identifying and developing research outputs with commercial potential. Departments should commit sufficient resources to commercialisation of research. Measurement of progress against their objectives should be undertaken in addition to monitoring to ensure the effective use of resources.

ICSTI believes that much more can be done by Government Departments to encourage commercialisation and to integrate it into the mainstream of R&D activities. Not all projects are suited to commercial exploitation but, without a national supportive framework, significant returns from suitable research may be lost.

Funding agencies should provide the necessary incentives and create a climate that fosters commercialisation from the research which they sponsor. ICSTI identifies Enterprise Ireland as having a

key responsibility in this area, in light of its roles both of dispersing public funds and supporting Irish industry, and recommends that it reviews and strengthens its activities in the support of commercialisation. Other agencies with responsibility include Teagasc, the Marine Institute, the Higher Education Authority and the Health Research Board.

It is recommended that funds be set aside for the initial stages of the process of commercialisation, such as feasibility studies and patent applications. Such funding could be used to source specialised services such as legal, patenting, market and technical expertise. Only a proportion of research projects will yield results which offer commercial possibilities. However, when funding agencies have a call for proposals for funding, they should invite applicants to identify their plans for the application of research outcomes and possible commercialisation. Funds should be allocated, on a competitive basis, for commercialisation activities over a portfolio of projects. Each agency should carry out an audit of projects previously supported and review, with the researcher, the possibilities for commercialisation. This may mean funding agencies taking the initiative to move the commercialisation process forward.

The **host institutions** are a first point of contact for the researcher. Each can help their researchers by ensuring a supportive context for commercialisation with clear policies and incentives. Commercial exploitation of R&D should be encouraged as an option for all researchers in the third level sector and should be an essential element in the mission of all third level research institutes. The role of the entrepreneurs, including those from academia, as risk takers who can bring the outcomes of research to the market place is of key importance in the commercialisation process and their activities should be supported and rewarded.

International experience is that if senior managers and administrators recognise the importance of, and show their commitment to, the commercialisation of research then the activity will flourish. It is

recommended that, in addition to having clear formal policies in regard to commercialisation, they should designate management responsibility and allocate adequate resources. In regard to policies the following warrant specific attention. Intellectual property, its ownership, the distribution of any royalties and what actions will be taken to encourage exploitation should be clearly stated. A second area in which clear formal policies are required is that of new start-up companies arising from the research and its outcomes. Particular attention should be given to the holding of equity, which ICSTI has identified as an issue in successful commercial interaction for both industry and researcher institutions.

In regard to both these areas host institutions should adopt a flexible approach that:

- takes all reasonable steps so that the maximum benefits are obtained for the economy and society,
- offers incentives to researchers and others for the commercial application arising from R&D carried out on its campus,
- ensures no unnecessary barriers are created to hinder commercialisation of research and its outcomes.

In this context the general approach should be to achieve a financial return proportionate to the services provided. Host institutions should seek normal commercial royalties on any patents and licenses and implement policies on holding equity in spin-off companies consistent with achieving appropriate returns for all parties involved. The tracking of intellectual property, as it progresses towards commercialisation, and the implementation of suitable audit procedures should be undertaken.

In the area of incentives, particular attention should be paid to the way in which commercialisation activities are treated for career development, the provision of sabbatical leave to work in industry at home or abroad and the provision of flexible employment terms

for staff involved in new company creation and development, with a view to facilitating and rewarding commercialisation activity.

ICSTI sees positive action by host institutions in supporting commercialisation as essential for appropriate gains to be drawn from the increased public funding of research. In most cases, management should take greater responsibility, by firmly supporting researchers who wish to follow the route of commercialisation and by putting in place equitable alternative mechanisms for commercialisation where the researcher does not wish to engage in that process. In all cases, researchers should be rewarded for their efforts in the mainstreaming of commercial activities.

Research institute management should have responsibility to determine the most appropriate procedures to manage the commercialisation of research function in their institute (e.g. Teagasc, the Marine Institute). The policy in this regard could include the identification of research with commercial potential and committing personnel and financial resources from their own resources to drive the process forward. This would include identifying and protecting intellectual property, licensing and technology transfer to companies and the spin-out of start-up companies. Commitment could be shown by having a reward system that focuses on the direct exploitation of the R&D results.

Particular consideration should be given by EI to the role of the Programmes for Advanced Technology (PATs) in supporting new businesses, ventures and products through the commercialisation and technology transfer process and their interaction with the industrial liaison offices. ICSTI advocates that the PATs should work with the colleges, supporting their actions where appropriate.

4.2 Industrial Liaison Offices (ILOs)

The second and more specific priority is in the area of the third level sector and the ILOs. With the increase in R&D funding, from national programmes and from sources arising from promotional work by the universities to diversify their funding base, an increase in opportunities for commercialisation activity is anticipated. This will result in a corresponding increase in the demands on the ILOs for a wider variety of specialised services. Serving the broader nature and increasing frequency of demands requires a level of personnel which is well beyond the scope of present staffing resources and associated budgets.

International experience indicates that third level institutions with a strong research base are devoting increasing resources and management attention to the function of these offices. Many have appointed technology transfer officers for specific disciplines, or in some cases have appointed separate technology transfer officers for specific sectors. In either case, the focus of such specialists is on the commercialisation of research including auditing of previous and current research to identify commercial potential; monitoring research to protect intellectual property; managing patenting and licensing and the formation of new companies stemming from on-campus research programmes. The trend abroad is that the director of the ILO is supported by one or more specialists. Effective technology transfer requires such specialists as technologies are becoming more complex and industry more knowledge driven. ILOs should be in a position to take the initiative in the area of commercialisation rather than to react to individual projects as they arise.

In the Irish context, the resources available to ILOs are insufficient in proportion to the commercialisation opportunities. Even a ten-fold increase in resources would not bring us to the level of our principal competitor countries. The main requirements are for appropriately qualified and experienced personnel and the necessary budget dedicated to the technology transfer function.

It is recommended that all universities increase the resources for the commercialisation function substantially and that they are enabled to do so by the relevant funding authorities. ICSTI sees the Higher Education Authority as having particular responsibility for enabling this action, in its role of developing third level education to meet national needs.

While the level of commercialisation activity in some universities may not merit a team of full-time designated specialists, ICSTI recommends that the level of staffing should be built up in each university to a level sufficient to advance the opportunities for commercialisation. In addition, space, administrative support staff and a budget should be provided to enable the commercialisation function to take place at an appropriate level. In some cases, where commercialisation of research is a well-established function, significantly greater resources, commensurate with the activity levels in the university and their potential for growth, should be provided.

Institutes of technology should be adequately resourced, in a similar fashion to that outlined above for the universities, in proportion to the scale of their activities in the area of commercialisation. Sufficient funding should be available to source specialist services on a case by case basis.

Interaction between researchers and industry clusters should continue to be facilitated by the industrial liaison offices with a particular focus on interaction with industry clusters. Fora should be organised in which researchers can meet managers from strategic clusters of industry to sharpen the awareness of both sides of the opportunities for commercialisation of research. ICSTI welcomes the efforts of Enterprise Ireland, and others, in this area and encourages them to target and increase their activities.

4.3 Finance

Priority number three is finance. As referred to previously, research outcomes are not being commercialised due, in part, to a lack of financial resources to take these projects to the proof of concept stage. Internationally this type of funding is provided, in the main from public funds, to bridge the gap between scientific discovery and the prototype stage thus enabling a well informed judgement to be made on the commercial prospects. Individual cases may require expenditure in the range from £50,000 to as much as £500,000. The main support from public funds currently available is the CORD grant from Enterprise Ireland. These are designed to cover examination of commercial feasibility with a maximum grant level of £30,000 at the expenditure level indicated.

While acknowledging that CORD funding has been of benefit to projects at a more advanced stage, ICSTI views the sums available and the conditions for accessing them as being unsuited to many nascent projects. This is particularly true for projects with a long gestation period such as many of those in biotechnology.

It is recommended that proof of concept funding be provided through the relevant agencies, such as Enterprise Ireland and the HEA, and Government Departments to third level institutions, research institutes and small and medium-sized enterprises.

The anticipated level of expenditure per project is in the range from £50,000 to £100,000 although in highly capital intensive areas, e.g. biotechnology, the required funding could climb substantially above the £100,000 level. ICSTI believes that, in order to clear any initial backlog of projects and to support proof of concept activities in the future, the necessary expenditure level could be as high as £3,000,000 per annum.

Bringing a project to the proof of concept stage may be insufficient to achieve transfer to commercial use in some cases. An example is the case of the transfer of a process technology to an established sector of industry by a research institute. The most efficacious and economically beneficial way may be by means of a demonstration trial on a factory floor in a company's premises. Following any appropriate measures to protect intellectual property, the outcomes of such a trial would be public information and the findings would be available to all firms. These projects should be eligible for proof of concept funding. ICSTI notes the current funding arrangements for research institutes by their Department and, in line with the proposal for increased support of commercialisation by Departments, recommends that those Departments take on the responsibility for funding their agencies for the anticipated increased level of proof of concept activities.

First stage venture capital is a further area of finance that warrants specific attention. Venture capital as a business has grown very substantially in Ireland in recent years. A survey on behalf of the Irish Venture Capital Association indicates that in excess of £200 million in venture capital finance was extended in the three years ending in 1999. Of this, £23.3 million was in early-stage companies and three quarters of the transactions were for less than £1 million. In the case of new ventures entailing longer lead times and where capital is at risk for longer periods (e.g. biotechnology), the market is less well developed and a gap still exists for first stage finance.

Enterprise Ireland, in a joint public private partnership with the universities and private sector interests, are investors in a joint public/private venture - Campus Companies Venture Capital Fund. It has on occasions invested in emerging third level campus companies. However as the fund is required to operate under normal commercial criteria for VC funds, it has had to ensure a balance of risk in its portfolio. For this reason campus companies represent only about one quarter of its investments. The proposed proof of concept fund will bring forward a greater number of high potential projects, and the CORD grants will support the subsequent determination of their commercial feasibility.

There still remains a significant finance gap to take projects to the stage where the risk and business plan are at a level to warrant investment by the Campus Companies Venture Capital Fund and indeed by other commercial venture capital funds.

It is therefore recommended that a source of first stage finance be provided which can take a longer-term view on projects in universities or emerging from them and is not constrained by the return on investment periods expected under normal venture capital funds. Given its experience in this area, the Council would welcome the involvement of Enterprise Ireland in establishing this fund.

4.4 Researcher Awareness

In recent years a number of well-publicised examples of companies going to the stock market have raised the awareness of the business potential of ideas and results being generated by the public research community.

It is quite clear that sometimes such commercially oriented outcomes are not desirable or productive for many researchers. Academic researchers in particular may wish to concentrate on achieving valuable research outputs. In these cases the onus will be on the host institution and the public research funder to provide alternative means of exploiting the commercial opportunities that may arise. It is recommended that the Higher Education Authority, in developing its policies for the allocation of public funding to the universities, should have regard to the desirability of encouraging the institutions to pursue active policies for the commercialisation of research.

Venture capitalists, industrialists and entrepreneurial researchers all indicate the lack of commercial awareness of entrepreneurs as a deficiency and that improved awareness would be beneficial. Training in business skills and business mentoring for researchers is provided by some State agencies and at some universities. A programme of enterprise development training for graduates with industrial

experience has recently been established to provide the skills required to establish and run a business. Awareness of areas such as patenting, intellectual property rights, business planning and negotiation can assist entrepreneurial researchers to commercialise their products and skills. In other cases such awareness can lead researchers to pass the business aspects to others while being involved in a technical capacity in the company built around their research.

All researchers and research programme managers should have the option of training which will provide an understanding of the activities involved in the commercialisation of research including the formation and development of new enterprises. The objective is not to convert researchers into business people but to enable them to appreciate the range of skills necessary for success in the commercial arena and to facilitate where appropriate their commercialisation of research. This training should be made available, in the opinion of the Council, by research organisations with funding for commercialisation activity from their parent body. The HEA, for the colleges, and Government Departments and agencies, for other researchers, should support and encourage this activity.

4.5 Business Venture Fora

Business venture fora operate in a number of ways. One model that received significant media attention involves regular meetings between people offering early stage finance and entrepreneurs, often with presentations by entrepreneurs to enable financing deals to be made. An example of this type is the 1st Tuesday Club which is a private sector concern that operates in a number of countries including Ireland.

A different approach is exemplified by CONNECT which started in San Diego, California and also operates in a number of locations in the USA and Europe. There is a strong focus here on networking as a tool to help entrepreneurs. In the Springboard programme, a mentor assists the entrepreneur in preparing a presentation which is

subsequently made to a board comprised of people with experience of particular relevance. The board gives constructive feedback at a meeting which may be followed by informal contacts between individual board members and the entrepreneur. This process assists the entrepreneur in building up a network of contacts relevant to their business idea and needs. Providers of finance are only introduced at a later stage and then on an occasional basis.

In Ireland there are only limited opportunities for formal networking involving entrepreneurs including those involved in research based start-ups, service supply and investment. It is recommended that the development agencies ensure that suitable networking fora take place on a regular basis throughout the country. ICSTI sees Enterprise Ireland as playing a pivotal role in co-ordinating fora on a country-wide basis.

There is also a role for the ILOs, in co-ordinating the interaction of their institution with key industry sectors, and for the PATs in facilitating research/industry interactions.

4.6 Incubation Companies

As indicated above, several universities and institutes of technology have or are in the process of establishing incubation facilities where campus companies can avail of space often with a limited range of business services. Other facilities can be accessed through, for example, the Business Innovation Centres. Dedicated specialised facilities e.g. specialised workshops or clean rooms, and access to high speed communications are rare.

Incubation as a commercial business is established in the USA and elsewhere. Incubators for research based start-ups, involving dedicated specialist facilities and business mentoring and providing access to early stage venture capital, could smooth the path to the commercial arena for a greater number of projects in Ireland. In addition to the incubation supports currently available, the

establishment of a small number of incubation companies to support start-ups requiring specialist facilities and services through their formative years should be encouraged and financially assisted. Incubation companies, each supporting several start-up companies, may be most effectively established by means of a public private partnership. The Council would welcome the involvement of Enterprise Ireland in such a partnership.

4.7 Monitoring and Evaluation

Very limited information is currently available on the levels of activity and the outcomes of support for the commercialisation of publicly funded research.

It is recommended that:

- continuous systematic monitoring be carried out,
- public bodies keep systematic records of their activities in commercialisation of research,
- formal evaluation of public support for the process, including the improvements from the implementation of the recommendations in this report, should be made.

Commercialisation indicators could include:

- invention disclosures reported in third level institutions and research institutions,
- patents applied for,
- revenues from licensing and fees from royalties,
- number of patents generating revenue,
- spin-off firms established and their survival rates,
- private sector investments in public spin-offs,

- license agreements with companies,
- the level of company/institution interaction as measured by the number and size of new commissioned projects secured and
- the number and size of next stage grants awarded (e.g. RTI grants)⁴.

International benchmarking could usefully be undertaken as part of the monitoring process.

ICSTI recognises the importance of allocating responsibility for the co-ordination of such monitoring and evaluation. It notes the involvement of Forfás in such actions, for example its responsibility for annual national research surveys, with the co-operation of other agencies and institutions, and the role of the HEA in data collection and evaluation in the universities. ICSTI requests the Office of Science and Technology under the research remit of the Department of Enterprise, Trade and Employment to commission this work.

The collection and public release of financial data is sensitive and confidentiality in regard to individual projects and organisations should be ensured.

The Operational Programmes 2000 - 2006 provide the opportunity to implement the changes recommended which ICSTI believes will bring about a substantial increase in the commercial exploitation of publicly funded non-commissioned R&D.

4 *RTI grants: Administered by Enterprise Ireland, these grants are available to Irish-based firms in manufacturing and internationally traded service businesses. The scheme covers high quality, risk intensive R&D projects, which are essential for companies to establish or to maintain their overall competitiveness. Projects can relate to either product or process development. Maximum grant rates vary between 25% and 45% of eligible expenditure and the maximum grant is £350,000.*

Appendix 1

Examples of Good International Practice in Research Commercialisation

The following are examples of good practice in research commercialisation abroad:

- Technology Incubator Programme: Israel
- Proof of Concept Fund: Scotland
- Technology Licensing: USA
- Matching Service: Finland
- Entrepreneurship Course: USA.

Technology Incubator Programme: Israel

Established by the Israeli Government in 1991, the Technology Incubator Programme supports very early stage entrepreneurial projects through grants and administrative supports. Each incubator is an independent non-profit making legal entity which can run 10-15 R&D projects simultaneously. 100% finance is provided by the Government for administration of the incubator and 85% funding is provided for 2 years to each of the companies/projects in the incubators. In 1999, 26 incubators, with almost 230 projects and 900 high-tech professionals, were supported through a budget of US\$30 million.

Typically, companies remain in the incubator for 2 years after which time they are expected to survive on other State supports or on outside investment. Incubators have a salaried director with the other members of the management team acting on a voluntary basis. There is a legal requirement that a minimum of 50% of incubator staff are recent immigrants, many of whom come from the former Soviet Union. The programme is seen as building high-tech R&D capability in Israel.

592 projects have left the incubators since the programme began in 1991 with 200 remaining in incubation. Approximately 50% of those which have left incubation are still operational and almost 40% have attracted further investment.

Proof of Concept Fund: Scotland

The Proof of Concept Fund was launched as a 3 year, Stg £11m pilot initiative in October 1999 by the Scottish Executive and is administered by Scottish Enterprise, the Government funded economic development agency for north east, central and southern Scotland. The fund was a recommendation of the Knowledge Economy Taskforce Report. The purpose of the fund is to address the development gap between scientific discovery and the proof of concept or prototype stage at which normal commercial types of funding can be accessed. It is being allocated through competitions to higher education institutions and research institutes for projects at the pre-development conceptual stage.

The fund is being directed towards proof of concept activity which supports the development of clusters of companies and organisations in related industries which have economic links including skills and infra-structural needs. The clusters are biotechnology, semiconductors/microelectronics, optoelectronics, food and drink, oil and gas and creative industries (e.g. media industries). The funding levels are from Stg £50,000 to Stg £500,000 with one call for proposals in 2000 and two per year thereafter. Successful proposals were made in the first call in the areas of biotechnology and semiconductors/microelectronics.

Technology Licensing: USA

Of the 3,600 universities in the United States, some 500 are research universities. Of the total, one in twelve have technology licensing offices (TLOs) with 4,800 patent applications (1998) and 350 spin-off

companies per year. Revenues from technology licensing are about 2 per cent of university revenues.

In the area of technology licensing universities have:

- transparent and extensive policies,
- extensive and effective contractual procedures,
- TLOs varying in size and competence and having professional staff.

It is a requirement for researchers to disclose inventions which may be commercialised through the office for technology licensing. An example on a scale relevant in the Irish context is the Georgia Institute of Technology.

Typically, the researchers receive 30-50 percent of royalties. The TLO receives 15 percent of the gross income and in addition takes equity in new spin-offs based on university technology.

Matching Service: Finland

Sitra, a company established by Finnish statute, conducts and commissions research, provides loans and other financing, awards grants, offers surety and guarantees and participates in development projects as well as owning stocks and shares in companies. Seed finance and commercialisation of technologies are two of its operational areas. In 1996, Sitra launched its matching service as a meeting place for private investors and entrepreneurs. The objective is to link investors, venture capitalists and entrepreneurs, to improve the flow of investment capital and management expertise into start-up and growth companies and to offer better opportunities for syndicate investments. In addition, Sitra operates a commercial mechanism - INNOTULI - which is a phased exploitation fund covering feasibility, proof of concept and venture capital stages.

Entrepreneurship Course: USA

California Institute of Technology provides a course on entrepreneurship open to both undergraduate and postgraduate students. Essentially, the course contains all the elements critical to building a business and to understanding the language of business. The topics covered include:

- Caltech's disclosure and patent policies
- Caltech's incentives and grants, technology transfer, and deals
- Patents and intellectual property
- Strategic role of patents and litigation
- Marketing in technology-based enterprises
- Formation of corporations and types of partnerships
- Options and other financial instruments; vesting
- Accounting and financial reports
- Venture capital
- Financial control
- Initial public offerings
- Human resources issues, job descriptions, and compensation
- Benefits, pensions, and litigation risks
- Business plans
- Mergers and acquisitions
- Corporate finance overview
- Corporate partnerships and strategic alliances
- Dealing with Wall Street
- Caltech-based case studies

Appendix 2

ICSTI Task Force on Commercialisation of Research

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Dr. David Melody	Loctite (Ireland) Ltd.	
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ICSTI STATEMENTS

State Expenditure Priorities for 1998	September 1997
£250 Million Scientific and Technological Education (Investment) Fund	January 1998
Science in Primary Schools	May 1998
A Partnership Approach to Research Funding – The Need for a National Science and Engineering Research Fund	May 1998
Mechanisms for Prioritisation of State Expenditures on Science and Technology	June 1998
Innovation in Enterprises in Ireland	July 1998
State Expenditure Priorities for 1999	November 1998
Investing in Research, Technology and Innovation (RTI) in the Period 2000 to 2006	January 1999
Technology Foresight Report	April 1999
Public Research and Technology Services for Innovation in Enterprises	September 1999
Benchmarking School Science, Technology and Mathematics Education in Ireland Against International Good Practice	September 1999
Science in Second Level Schools	October 1999

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