Functions of the Irish Council for Science, Technology and Innovation (ICSTI)

- To advise on science and technology policy-related issues in response to specific requests from the Government (through the Minister responsible for Science and Technology) or from the Board of Forfás.
- To advise the Minister responsible for Science and Technology, the Office of Science and Technology and the Board of Forfás, on the Council's own initiative, on policy for science and technology and on related matters.
- 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.
- To undertake from time to time such other functions as the Minister may decide. In this case the information sought is to be submitted to the Minister.

Summary

To succeed in business, firms have to innovate and stay close to markets that are becoming increasingly competitive. Innovation involves selling new and modified products (and processes) to existing or new markets, in addition to managing the overall change process effectively.

Innovation is now a continual process, taking place throughout and between firms, as well as with other players in the economy. R&D is almost always a major component of the innovation process, particularly in the case of the kind of high-value products that fit with Ireland's current economic and industrial development position. This country needs its companies to innovate at a world-class level. Government must play its role in a strategic partnership with enterprises. Government gains by helping enterprises to compete successfully in world markets. This helps society - given that successful innovation expands productive potential and provides highly skilled jobs that sustain and improve both the standard of living and the quality of life.

In this context, ICSTI recommends that carefully considered state assistance measures should be used both to prime the technology-based innovation process and to draw together the necessary players through increased interaction and collaboration. In particular, a tax credit for incremental R&D expenditure (using 1998 as the base year) should be introduced, alongside grant assistance for R&D by start-up companies and by those seeking to implement a significant shift through a company development plan based on R&D and innovation. There should also be a continuation of favourable tax treatment on royalties for patented inventions. The Council also recommends a network of local and accessible "innovation officers" to assist small companies in drawing on the "help system" as well as access to venture capital.

The Higher Education colleges have an increasingly important role in the innovation process. Further efforts must be made to create and promote centres of science/engineering-based competence that address industry needs. The Council also recommends clear guidelines on the ownership of intellectual property and an Irish version of the "Teaching Company Scheme", involving graduate placements and medium-term college-industry collaboration. Significant support for educational programmes for life-long, technology-related learning, particularly in the increasingly important area of technology and innovation management, is seen to be of key importance.

The State should underpin all of these actions through promoting awareness of the need for innovation, devising strategic research initiatives (analogous to those within the European Framework Programme) and ensuring access to world-class information and communications technologies (ICTs).

The Importance of Industrial Innovation

This is the first statement by ICSTI on issues pertaining to technological and industrial innovation at the enterprise level. The Council believes that innovation in industry represents a most important set of strategic challenges and opportunities for both firms and Government.

To succeed in business, firms have to innovate and stay close to markets that are becoming increasingly competitive. Innovation involves selling changed i.e. both new and modified - products (and processes) to existing or new markets, in addition to managing the overall change process effectively. The changes can be either minor or major in nature, with a higher dependence on technology tending to be characteristic of major innovations. In recent years, in order to stay ahead of the competition and find new ways to anticipate customer needs, firms are being forced to move towards the more risky, radical end of the innovation spectrum. In this they can now exploit the opportunities presented by information and communications technologies (ICTs) in particular and new technologies in general.

Innovation is now a continual process, taking place throughout and between firms, as well as with other players in the economy. R&D is almost always a major component of the innovation process, particularly in the case of the kind of high-value products that fit with Ireland's current economic and industrial development position. This country needs its companies to innovate at a world-class level.

Government must play its role in a strategic partnership with enterprises to:

- communicate the importance of innovation and R&D for long-term growth and development;
- identify and eliminate barriers to investment in R&D and the other elements of the innovation process;
- ensure that the relationship between the scientific and technological infrastructure and industry prospers and
- bring about as favourable an environment as possible for innovation, e.g. in terms of regulatory, legal and taxation arrangements.

Government gains by helping enterprises to compete successfully in world markets. This helps society - given that successful innovation expands productive potential and provides highly skilled jobs that sustain and improve both the standard of living and the quality of life.

Recommendations of ICSTI Task Force

Challenges of Innovation and Entrepreneurship

Knowledge, technology and innovation are becoming increasingly important factors in the development and continued competitiveness of successful firms and industries in the modern globalised economy. While these are primarily the responsibility of companies themselves, they are not exclusively so.

1. Given that firms face an array of barriers and constraints and since innovation is crucial for employment and wealth creation, the State must recognise and promote technology-based innovation, in particular in enterprises that are committed to growing in this economy (irrespective of ownership or origin). This is vitally necessary in making Ireland less dependent on mobile "greenfield" investment and in maintaining our current industrial and economic performance.

   This means developing and implementing an overall system that is conducive to the innovation process in both new and existing firms - a favourable "national system of innovation", as it has been called in the STIAC Report and the White Paper on Science, Technology and Innovation. This statement seeks to build on both these policy documents.

2. Carefully considered state assistance measures must be used both to prime the technology-based innovation process and to draw together the necessary players through increased interaction and collaboration, in order to improve on our relatively poor past performance record.

Innovation in Firms

Firms have the major role in innovation but the State has an important complementary role.

3. In-house development, including R&D, has to be encouraged very strongly, since the firm will obviously have its own best interests at heart. To this end, a tax credit on company profits for bona fide R&D (for all incremental expenditure, for example, using 1998 as the base line) should be introduced. An additional or alternative approach would be to base the amount of the credit on the social charges for R&D staff (e.g. employer's PRSI).
4. As too few companies still participate adequately in R&D, the Council recommends that continued (matched) grant assistance should be focussed on R&D by start-up companies and by those seeking to implement a significant shift in company development, based on R&D and innovation.

   (Both preceding points take into account that the availability of public funds may be more restricted after 1999, due to decreasing European Structural Funds.)

5. As invention can be an important basis for innovation, the Council recommends the continuation of the existing favourable tax treatment of royalties for patented inventions where the technology concerned is applied to product or process development in Ireland (or EU markets, if required).
6. Given the importance of small firms in the economy and their problems in coping with the complex elements of innovation, the Council recommends a network of local and accessible "innovation officers" to assist small companies in drawing on the necessary "innovation system" resources and linking effectively with the range of public and private organisations involved in assisting in the innovation process.

7. As access to venture capital for real innovation is crucial, the Council recommends that, in addition to the Enterprise 2000 Fund for seed capital currently being promoted by the development agencies and the Bank of Ireland, Government continues to support this access within schemes, such as BES, where preference should be given to projects aimed at "technical development".

Research & Training Competence to Enable Innovation

In a global economic environment, it is no longer enough for the individual firm to have a given set of capabilities and competences. It must also have the capacity to effectively acquire new ones. The Higher Education colleges have an increasingly important role in this process.

8. Excellence in science and engineering must be strongly promoted in the Higher Education sector to ensure that the research, skills and technical qualifications produced are "world-class".
9. Further efforts must be made to create and promote centres of science/engineering-based competence that address industry needs as expressed through joint state/company-funded schemes such as the "Applied Research Programme".

   The Council also recommends a new initiative to encourage both research cooperation and technology transfer - i.e. an Irish version of the practical and successful, UK-based, state/Higher Education/industry initiative, the "Teaching Company Scheme", involving both graduate placements and medium-term college-industry collaboration.

   There is a need to facilitate and expedite the negotiation of the ownership of intellectual property rights between funders (industry) and performers (colleges). The ownership position of the industrial partners, especially if they are paying a large proportion of the costs, will clearly have to be given due weight in these discussions.

10. The Council recommends support for educational programmes for life-long, technology-related learning and specifically encourages further initiatives in the increasingly important area of technology and innovation management.

Government System of Innovation

The State can have an important strategic management role in seeing the innovation process as an integrated system.

11. The State must have a clear vision of innovation as a process involving many aspects and actors. It should promote awareness of the need for innovation, as well as of the support mechanisms in place for its encouragement, through specific policy initiatives such as the current Science, Technology and Innovation Awareness Programme. It is important that the support system should be as user-friendly as possible, especially for small companies.
12. National strategic research initiatives, analogous to those within the European Framework Programme, should be funded in priority areas identified through the strategic overview being taken through the ICSTI Technology Foresight initiative.
13. The infrastructure for ensuring access to world-class information and communications technologies (ICTs) should continue to be put in place by funding and facilitating the necessary state and private sector investment.

Task Force Report

Ireland is an emerging technology-based economy and our future depends on the capability of our enterprises to compete in the global technological environment.
...A programme of research and development in an enterprise implies a commitment to a structured approach to facing the challenge of new technology in the global environment.

The Competitiveness Challenge '98,
National Competitiveness Council

Challenges of Innovation and Entrepreneurship

Knowledge, technology and innovation are becoming increasingly important factors in the development and continued competitiveness of successful firms and industries in the modern globalised economy of which Ireland is now an integral part. In many countries, organisational barriers and institutional rigidities, leading to insufficient interaction and networking between organisations (within what are now seen to be "innovation systems"), can be added to technology-related factors as complementary constraints on development. Government has a major role in addressing both technological and organisational barriers and increasing the level of collaboration within and between regions and national economies. Governments must also try to reap the benefits of the globalisation of industrial research and to facilitate the growth of collaborative international technology efforts.

A "systems" approach to innovation policy means that Government must consider the impact of a whole range of policies on firm and national innovation performance. Examples include the overall regulatory environment, especially for small firms; general competition policies that can facilitate or hinder collaborative research and specific rules on the ownership and disposal of intellectual property rights (IPRs).

Enhancing the ability of firms to find, evaluate and adapt technology and know-how to their own needs is a policy priority. Governments can assist firms in becoming "learning" organisations and in developing core capacities for formulating technology strategies and managing the innovation process.

Managers too must understand a number of "systems" both inside and outside the firm and the importance of organisational innovation if they are to carry the overall innovation process to a successful conclusion. These include: production and research systems, encompassing the relationships between functions such as R&D and marketing; financing systems and public support systems. Firms must have methodologies in place to identify trends in each system and strategies to respond to these changes. The State also needs to give due consideration as to how it and its agencies can help companies to cope with this "systems complexity" challenge.

The effective creation and management of an appropriate and conducive culture lies at the heart of both technological and organisational innovation. This implies the need to design systems and processes that will result in continuous commitment to incremental change, consistent with the values and expectations of the workforce. Firms can face this challenge by: working in teams; maintaining effective interpersonal relationships; communicating effectively; adapting to change and better integrating young, talented and skilled people.

A positive climate for innovation and enterprise is important not just within the firm itself but also in the community and society in which the firm and/or the individual innovator or entrepreneur is based. Government must promote the importance of innovation and facilitate its achievement. This means minimising red tape in all State activities and taking imaginative initiatives at all administrative levels - local, regional, national and supranational.

Innovation in Firms

Firms have the major role in innovation but the State has an important complementary role. In this context, in-house development, including R&D, has to be encouraged very strongly, since the firm will obviously have its own best interests at heart.

- **Tax Credits and Grants**
  The public sources of finance for innovation in firms are taxation measures and grants. Ireland has adopted an "enhanced write-off" approach in its tax legislation in the area of R&D expenditure. A 3 year 400% write-off of incremental expenditure was incorporated in the Finance Act 1995 and modified in the 1996 Act. The deduction still had many restrictions and was little used by either foreign or indigenous research performers.

  A tax credit reduces the tax liability of a company pound for pound by the amount of a certain item of expenditure. *The Council believes that companies funding R&D should receive a full tax credit on incremental expenditure over the base financial year, 1998-99.*

  In the Netherlands, a tax credit is offered on the employer's PRSI-type payments for technical personnel. Given that wages and salaries typically account for approximately 50% of R&D costs, this is an effective method of reducing the impact of such costs. As with the existing PRSI relief in relation to newly recruited workers, the relief could apply for a limited period only, e.g. 7 years. This could be an alternative to the broader incremental expenditure approach.

  An appropriate form of tax credit should be included in the 1999 Finance Bill.

  In recent years R&D grants have largely been provided from Structural Funds through what has been known as "Measure 1". The Council's view is that (given that such funds will be more restricted after 1999, although any shortfall can be made up through direct Exchequer provision) the focus of grant assistance should be on firms at the start-up stage or those clearly seeking to achieve critical mass in Ireland through a clear and explicit company development plan. *This guideline should be taken into account by the Office of Science and Technology (OST), particularly in the context of negotiations for Structural Funds for 2000-2006.*

- **Patent Relief**
  Since innovation is often based on the proprietary position created by patents, it is highly desirable to encourage their development and exploitation in Ireland. The treatment of patents has in practice been an area that has differentiated the Irish tax system from that of other countries and is as follows:
    - the cost of registration and annual fees payable are deductible expenses;
    - the cost of purchasing a patent can be claimed over its lifetime;
    - income from patented inventions, which have largely been developed in Ireland, is broadly free of tax.

  This income relief is an effective incentive only where the R&D activity is carried out in a company separate from that which ultimately uses the technology. Subsequent to the passing of the Finance Act 1994, the relief has not been available to most companies paying tax at the higher rate, whether or not they have organised a separate R&D company. *The Council believes that patent income relief should continue to be available as an incentive for innovation, provided it is exploited in the State (or the EU, if that is required for legal reasons).*

- **Responding to Problems Related to Firm Size**
  Size-related factors appear to be important in determining innovation (and particularly R&D) commitment and performance. *ICSTI believes that one way to address this is to develop local intermediaries between enterprises, industrial development agencies, Higher Education (HE) institutions, EU and private financing institutions. These "innovation officers" or intermediaries would relate to small firms in the way that the agricultural advisory or extension services relate to the farming community.* This should be complemented by the Networks Initiative recommended by STIAC and the White Paper. This has recently been successfully piloted under the aegis of Partnership 2000. For small firms in particular, networks can be a response to a sense of isolation in increasingly globalised markets. These recommendations should be addressed by the Department of Enterprise, Trade and Employment.

- **Seed and Venture Capital**
  In addition to the welcome initiative by Forbairt and the Bank of Ireland to each put £5m into the Enterprise 2000 Fund, there is a need to look to additional private sources of funding. These include the banks themselves, private investors (including what have become known as "business angels") and professional seed and venture capitalists. In innovation terms, sources for both "start-up" and "project" funds are important. In the US, Small Business Investment Companies (SBICs), licensed by the Small Business Administration, are privately organised and privately managed investment firms. With their own equity capital and with funds borrowed at favourable rates through the Federal Government, SBICs provide venture capital to small independent businesses, both new and already established. *For the next round of Structural Funds and beyond, the Council believes that the SBIC approach could to be looked at for Ireland.*

  Recent empirical research in Ireland has shown that there is a funding gap for R&D in firms in the £0.5-£2.0m turnover range. Business Angels could have an important role in filling this gap. *An initial approach might be to allow more favourable treatment of Business Expansion Scheme (BES) funds aimed at risky product and process development, as a prelude to more dedicated funding mechanisms and networks, including SBICs.*

  As an alternative to accessing and using public and particularly private venture capital, Irish firms, especially in higher technology areas, could, perhaps, be persuaded to "go public" *by providing State assistance towards the costs associated with going on the stock market,* e.g. the NASDAQ and now its European equivalent (EASDAQ). This option would require further consideration in terms of the evolution of "secondary" markets and other aspects of the Irish and alternative stock exchanges.

  A range of departments and agencies would have to be involved in implementing these initiatives.

Research & Training Competence to Enable Innovation

- **Skills**
  As far as innovation is concerned, the Higher Education colleges have an increasingly significant role in ensuring that their graduates and post-graduates have the potential to become skilled and adaptable researchers, technologists, technicians and managers. Excellence in the education and training of scientists and engineers (as well as other graduates) remains the central role of the colleges. Being as innovative and entrepreneurial as possible is also crucial. This can be addressed through formal courses and industrial placements - alongside more informal learning-for-living activities, that start in college and continue for the rest of professional life.

- **Higher Education - Industry Co-operation I: Applied Research**
  The need for closer interaction on applied research between firms and the Higher Education colleges has been recognised for some time. *ICSTI believes that a significantly increased number of engineering and other collaborative projects and programmes should be funded through the Applied Research Programme.* Three-yearly reviews/renewal procedures would correspond to the PhD cycle and allow researchers working on applied projects to aspire to such qualifications. The Departments of Enterprise, Trade & Employment and Education & Science and their agencies, firms and colleges themselves - as well as joint bodies such as the CHIU (Committee of Heads of Irish Universities) -IBEC (Irish Business & Employers Confederation) Forum - are all involved in encouraging more collaborative arrangements based on industry needs.

  There should be clarification of the ownership of intellectual property rights/royalties arising from collaboration. The ownership position of the industrial partner, especially if they are paying a large proportion of the costs, will clearly have to be given due weight.

- **Higher Education - Industry Co-operation II: Teaching Company Scheme (TCS)**
  One way of addressing the need to enhance relationships between the HE colleges and smaller firms would be *to set up a form of Teaching Company Scheme in Ireland.* The TCS is based on partnerships between academic groups and companies who need access to academics' skills and knowledge. It is important that any activities under this scheme should be seen to be clearly industry-driven. *ICSTI believes that such an initiative should be taken to improve relationships between the HE colleges and firms, with a particular focus on engineering-related needs. This should be looked at by the new agency Enterprise Ireland as a complement to the existing Techstart and Techman programmes for transferring technical expertise into Irish-based firms.*

- **Learning for Innovation and Innovative Learning**
  In the global economic environment outlined above, it is no longer enough for the individual firm to have a given set of capabilities and competences. Rather, it must also have the capacity to effectively acquire new ones. In this sense, being a *learning firm* has become the key to success. The firm's capacity to learn and to transform itself in this new context is a crucial competitiveness factor. There is a need to continuously rebuild the skills of the individual and the technological and organisational capabilities of the firm.

  Continuous learning is a necessary element of innovation in all parts of the economy, including so-called low-tech and traditional sectors. Even in highly-developed economies the learning taking place in traditional and low-tech sectors is as important for economic growth as the learning taking place in a small number of insulated high-technology firms, especially given its importance in overall competitiveness. *The HE colleges can also assist in this process of life-long learning/learning-for-living.*

  In addition to informal learning processes being increasingly important, the capacity to manage technology and innovation has become a crucial aspect of management education. This includes the formal Management of Technology (MOT). A number of colleges, North and South, have an interest and involvement in this field. *A "networked" initiative, giving a broad geographic and disciplinary base to the management of technology and innovation would be an appropriate response to a need increasingly recognised by industry and a greatly improved capability in the colleges. It would also be an appropriate area for North-South co-operation in science, technology and innovation. This should be implemented by Enterprise Ireland.*

Government System of Innovation

- **A Vision of the Innovation System**
  There are a number of elements and stages experienced by companies engaged in the innovation process - usually, but not always, including some R&D inputs. (See APPENDIX page 21.) Innovation will vary depending on the external environment and internal characteristics of the company and is usually characterised by continuous interactions between the people and factors affecting its genesis and progress. The State can have an important strategic management role in seeing the innovation process as an integrated system. The key point from a management perspective is to allow for the maximum communication and feedback between the elements, stages and individuals/teams involved.

  The Council believes that access to innovation assistance currently provided to firms must be greatly simplified - both in terms of individual schemes and their delivery. A new directory on all aspects of the innovation interface between firms and the state on the lines of **Innovation Ireland**, produced by Forfás, is required and will need to take account of the impact on State assistance for innovation of the new enterprise agency arrangements.

  This must be part of a continuing process of awareness-raising among a number of audiences, *involving the extension of the current 3-year Science, Technology & Innovation Awareness Programme recommended by STIAC and the White Paper (funded by the Office of Science & Technology (OST) and managed by Forfás) beyond 1998.* These initiatives must also be seen against the background of the new network of small firm innovation officers recommended above.

- **Foresight and Research in Strategic Technologies**
  The ICSTI Technology Foresight Task Force is undertaking a review of the current trends/future impacts on the economy of a number of sectors/technologies. The Foresight process offers the opportunity to establish a consensus approach to identifying *a new Framework Programme for Strategic Research in Ireland,* (modelled on the European Framework Programme) that would prioritise more effectively the investment of public funds. This could play an important role in encouraging a higher level of co-operation on strategic research between firms, colleges and research bodies. *Such an approach is consistent with the new administrative arrangements under the White Paper, including the Interdepartmental Committee, the OST and ICSTI.*

- **Telecommunications and Related Infrastructure**
  Given the increasing importance of broadband and other telecommunications facilities for innovation and industrial development, *the infrastructure for ensuring access to world-class information and communications technologies (ICTs) should continue to be put in place by funding and encouraging the necessary state and private sector investment.*

Appendix

THE INNOVATION PROCESS

The Elements of Innovation

Industrial innovation may be defined as the successful introduction by companies of new or improved products, processes and management techniques and is a vital component in the success and survival both of firms and of regional and national economies. Firms have the ability to increase their competitiveness through innovation, at home and abroad, which, in turn, leads to increased or sustained market share and profits. Innovation takes place in a number of forms and is generally manifested in:

- the improvement of existing products and/or processes
- the development of new products/introduction of novel production methods, often based on new technology.

There are a number of elements and stages experienced by companies in the innovation process - usually, but not always, including some R&D inputs. Innovation will vary depending on the external environment and internal characteristics of the company. A key point from the management perspective is to allow for the maximum communication and feedback between the elements, stages and individuals/teams involved.

State Supports for Innovation - what is available?

The range of state supports available to innovating firms is described in Innovation Ireland, a comprehensive guide to state incentives produced by Forfás as part of the on-going Science, Technology and Innovation Awareness Programme. This guide covers:

- **Research & Development;**
- **Making & Improving Your Product;**
- **Recruitment & Training of Technical Personnel and**
- **Market Identification & Development.**

Within these four headings the state support is divided into three categories of assistance:

- **Services to the firm,** such as assistance with specific technologies e.g. information technology and biotechnology;
- **Money direct to the firm** e.g. feasibility and R&D finance and
- **Tax relief to the firm** e.g. patent income relief.

These are presented on a "matrix" basis featuring each of the elements of innovation.

Schemes of **General State Assistance** (addressing all elements and stages of the process) - such as Enterprise Link, a Forbairt/Enterprise Ireland phoneline service which assists companies to identify their problems and source the solutions - are also outlined.