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Irish Council for Science,
Technology and Innovation

Investing in Research, Technology and Innovation in the Period 2000 to 2006

Forfás

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Summary

- Ireland's industrial and economic future rests in our becoming an innovation-driven economy. Investment in research, related human resources and the application of enabling technologies will allow us to attract new generations of foreign investment and create indigenous firms which are internationally competitive. Ireland has a unique opportunity over the period 2000 - 2006 to put the necessary investment in place.

- Part of the fundamental rationale for investment in research, technology and innovation (RTI) is contained in the strong evidence of its links with economic growth, and in particular its contribution to Ireland's industrial growth and employment over the recent past. High tech sectors and R&D-intensive firms (e.g. Software, Pharmaceuticals, Electronics, Medical Devices) have contributed substantially to overall growth in manufacturing, exports, sustainable employment, upgrading of skills in the workforce and growth of the traded services sector. The challenge is to determine the sectors, and the related technologies and expertise, which will be the main drivers of growth in the future and to invest in the aspects of RTI which will allow Ireland to identify, create, attract and sustain those sectors. For make no mistake, RTI capability is a key determinant of competitive success in promoting investment in these sectors in Ireland; and in determining the output, exports and employment that derives from this investment.

- RTI contributes directly to Ireland's industrial development through the development of indigenous firms, the creation of new technology-based firms and the attraction, retention and development of high tech foreign direct investment. Investment in RTI in the more traditional sectors such as agri-food can help them to become more innovative and competitive as they face greater global market pressures into the next millennium. RTI investment can also help to achieve other national policy priorities such as sustainable exploitation of our natural resources (e.g. marine, renewable energies), improvement of the physical infrastructure (telecommunications, transport) and human resource development through research and training in the third-level education sector. The major challenges which Ireland faces today - growing sustainable employment (and at the same time the risk of skills shortage in some areas), balanced regional development and sharing of growth, exploiting the information society, globalised trade and competition - can all be addressed through wise investment in RTI as an intrinsic element of the range of actions necessary.

- While Ireland's overall RTI performance has moved towards the EU average, there are still gaps in that performance. Total spending on R&D in Ireland is at 1.4% of GDP compared with an EU average of 1.9%. Furthermore, there is still a significant way to go to reach or exceed the levels of investment by leading and progressive RTI nations which spend in the region of 2.5 - 3% of GDP on RTI activities.

- In the case of business spending on R&D, which has seen the greatest degree of convergence towards EU average levels, the apparently better comparative performance reflects the fact that a high proportion of industrial firms in Ireland operate in high tech sectors, including IT, chemicals and pharmaceuticals. It should also be borne in mind that this convergence has to an extent been driven by a small proportion of firms and by the availability of supporting EU Structural Funds.

- To maintain the desired growth in business R&D and to encourage a higher proportion of firms to engage in RTI activities that will sustain future growth and competitiveness will require ongoing public support in the future. However the level of public investment in RTI is considerably behind the EU average and has not kept pace with the growth in business spending and, therefore, the demand for RTI-based knowledge, expertise and infrastructure. Furthermore even this relatively low level of public investment in RTI is heavily dependent on EU Structural Funds.

- A new programme of investment in RTI should, therefore, aim to invest substantially in the RTI base of the country, as a means of enhancing innovation and competitiveness, in order to increase output and employment by:

- Helping firms to develop new products, services and processes that help them to maintain and grow market share
- Increasing the number of companies performing effective R&D in Ireland
- Increasing the scale of RTI investment by companies in Ireland
- Encouraging firms to access and exploit R&D and technology from international sources
- Increasing the numbers of researchers and technicians employed in Irish industry
- Strengthening the research capability in the third-level and State research institutions, in particular to meet the R&D and skills needs of the economy
- Increasing the quantity and quality of the R&D linkages between institutions and companies
- Increasing the amount of public investment in RTI in identified priority areas for national economic and employment development by allocating State/EU support for these areas on a competitive basis
- Promoting private investment in R&D and in new technology-based firms.

- A new EU-supported investment programme should focus on the following four areas:
  - **RTI for Industry** e.g. support for R&D, innovation training and the collection and dissemination of technology intelligence in firms
  - **RTI Collaboration** involving industry, third-level colleges and public research institutes at home and abroad
  - **RTI Infrastructure** including public investment in key technologies, skills and research facilities to strengthen the national research capability and the ability of colleges and institutes to collaborate with industry
  - **Natural Resource based-RTI** for the development and improved competitiveness of the natural resource sectors.
- The Council believes that the promotion of sustainable development and protection of the environment should be an intrinsic part of the operation of RTI measures in the new programme.
- The Council believes that in deciding the balance of investment in the above areas a strong emphasis should be placed on building up the performance, capability and skills of the business sector in terms of R&D and innovation and in promoting industry/institution collaboration. Only in this way can Ireland effectively reap the benefit of investment in research and human resources in the education and State sectors.
- **Finally, the Council is strongly of the view that RTI performance in Ireland must not only be benchmarked against that of other EU countries. It must, increasingly, be benchmarked against that of leading RTI investors and progressive emerging economies in other parts of the world including for example, Sweden, Finland, Israel, Taiwan, Singapore, New Zealand and Malaysia.**
  - **Within this wider comparative framework available data would suggest that Ireland should aim to achieve a level of spending on R&D equivalent to 2.5% of GDP. This would mean additional public investment of the order of £200 million per year.**
  - **In proposing such a medium-term objective, the Council strongly emphasises that it does not advocate an increase in public expenditure on R&D simply in an effort to meet some artificial statistical norm. Such an approach would be imprudent, would be likely to result in the inappropriate use of the scarce resources available for R&D purposes and would lack credibility. Future public sector R&D expenditure profiles, including both increases and decreases, should be developed**

on a sector-by-sector basis as an intrinsic part in achieving the development objectives for each sector and the prioritisation of resources for this purpose. The Council has set out how this could best be achieved in its recent report entitled "Mechanisms for the Prioritisation of State Expenditures on Science & Technology" (June 1998).

Investing in Research, Technology and Innovation in the period 2000 to 2006

1. Introduction

Following the publication of "Agenda 2000 - For a Stronger and Wider Union" in July 1997, which sets out the EU Commission's thinking on the development of the European Union over the medium term, Ireland is currently in the process of devising a new National Development Plan (NDP) and preparing for negotiations for a new round of EU funding support for the period 2000-2006.

The purpose of this paper is to outline the important contribution which Research, Technology and Innovation (RTI) makes to national development and why sustained investment in RTI should be a priority for Ireland in the period of the next National Development Plan and Structural Funds Programme.

In that context there is no doubt that the critical role which RTI plays in economic and social development is now widely recognised at both national and EU levels.

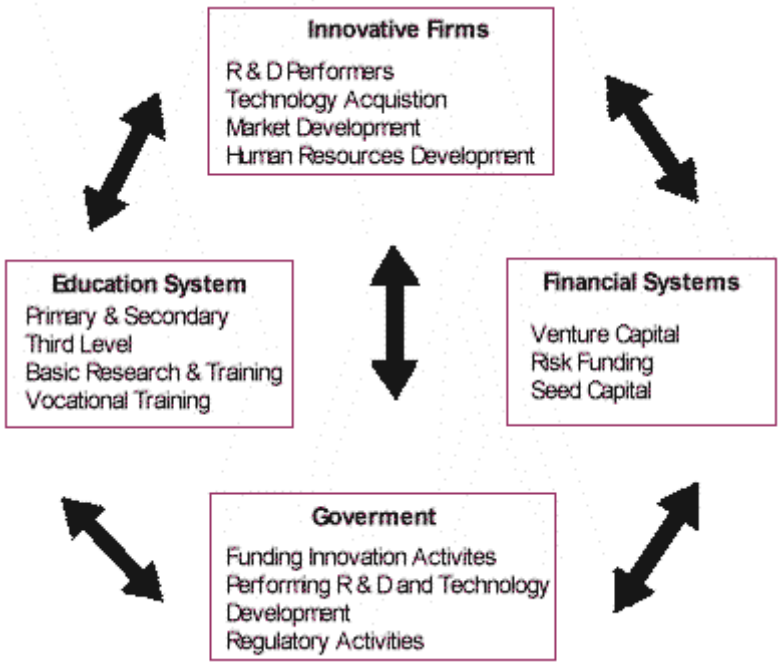
Agenda 2000 states that:

"Knowledge policies - research innovation education and training - are of decisive importance for the future of the Union… the Union must focus research activities on improving the competitiveness of the European economy, thereby promoting the creation of new jobs. It is particularly important that Europe should be able to transform scientific and technological breakthroughs into industrial and commercial successes. In this connection, innovation by small and medium sized enterprises is a particularly important factor on which to build. The creation of innovative high-tech companies in Europe must be encouraged."

In Ireland, both the Partnership 2000 agreement between the social partners and the Government's Action Programme for the New Millennium also underline the importance of research, technology and innovation to national development.

These statements point to the growing acceptance that the key to economic growth and competitiveness will be the ability to identify, create, attract and sustain the new industries and jobs which flow from the market application of scientific research, technology transfer and technical innovation. In order for Ireland to compete in that scenario, investment in all aspects of the National System of Innovation - from fundamental research and training to technological capability, skills and innovation in firms - is necessary. The 1996 White Paper on Science, Technology and Innovation depicted the National System of Innovation as follows:

Figure 1: Diagram of the National System of Innovation



It is expected that in a new National Development Plan, priority will be given to investments that make the greatest contribution to sustainable economic growth and employment - in the areas of infrastructure (e.g. transport), human capital (education and training), and productive investment particularly in research and technological development.

In May 1998 the EU Commission published a communication suggesting guidelines for structural interventions in the area of RTI and as a reference for evaluation of RTI strategy proposed in regional development plans. The communication entitled "Reinforcing Cohesion Through Research, Technological Development and Innovation" says that the objective is to reinforce the competitive capacity of less favoured regions by ensuring that RTI policy is integrated within the productive fabric of the region. RTI strategy should contain "certain key activities which no Member State can afford to ignore. Innovation promotion, industrial co-operation and networking and strengthening of human capabilities will be common to all the strategies."

2. Economic Rationale: Research Technology and Innovation (RTI) and Economic Growth in Ireland

2.1 The Link between RTI and Economic Growth

There is clear evidence that the strong growth in the Irish economy over recent years is linked to the performance of the high-tech sectors. Between 1990 and 1996 manufacturing output grew by 75.5%. The two highest performing industrial sectors by far were Chemicals (157.8%) and Metals & Engineering (92.4%) over this period and much of the overall growth in the manufacturing sector as a whole was driven by the very strong performance of these two sectors. The Chemicals sector includes pharmaceutical companies, while the Metals & Engineering sector includes the electronics industry.

Employment growth in manufacturing was approximately 10% between 1991 and 1996. The vast majority of employment growth in manufacturing came from the Chemicals and Metals & Engineering sectors and indeed most of the growth in the manufacturing sector is accounted for by the growth in electronics. A noticeable feature of this period is the exceptionally strong performance of the non-manufacturing grant-aided sector, pointing to the important role of the services industry. Much of this is accounted for by financial services, the software sector and also by technical support facilities for technology industries.

The high-tech sectors and sub-sectors referred to above are also among the highest investors in R&D in this country. Against a national average R&D spend of 1.7% of sales, these sectors invest as follows:

Computers/Office Machinery	**4.3%**
Software	**9.6%**
Electronics/Communications	**2.0%**
Pharmaceuticals	**4.6%**

Source: Forfás Survey of Innovation 1993-95

More specific evidence of the connection between R&D and employment growth is contained in the analysis of the performance of R&D active and non-active firms in the period 1986-1995.

The contrast is quite stark. In Irish-owned firms, while overall employment fell by over 18%, this decline was only 5% in the R&D active firms compared to 31% in the non-active firms. In relation to foreign firms the contrast is even more extreme, with the non-R&D active firms suffering an employment loss of 25% compared with an increase of 16% in the R&D active firms.

Employment Growth 1986-95 in 1986 Cohorts of Irish-owned and Foreign Firms

	Non-R&D Active	R&D Active	Total
Irish-owned firms	-30.6%	-5.1%	-18.4%
Foreign Firms	-25.2%	+16.3%	-1.0%

Source: Kearns and Ruane, 1997

2.2 Conclusion

It can be concluded that the high tech sectors, which by definition also have the highest investment in R&D, are the main source of output and employment growth in the economy. In particular, looking at the total growth in Irish manufacturing employment, one can say that in effect the net job creation for Irish manufacturing firms is a result of the increase in employment of the R&D active firms more than offsetting the employment decline in the non-R&D performing firms. For Ireland to sustain this growth over the long-term, therefore, the challenge is to invest in the "raw materials" (researchers, research, expertise, technology and innovation capability in firms) so as to be able to identify, create, attract and sustain indigenous and overseas companies which will flow from the application of research and technology. In terms of future RTI investment, the question is what new technologies will emerge to drive the next generation of industries and firms and what levels of infrastructural and human investment will Ireland need to exploit those technologies to the full.

3. TRI Structural Funds Investment over the period 1989 - 1999

3.1 Structural Funds 1989 - 1999

Ireland will have invested some £620 million pounds of public and private monies in RTI programmes over the period 1989 to 1999 as part of the Industrial Development Operational Programme.

This investment was made through a number of measures. The original Programme from 1989 to 1993 involved expenditure of £200 million and contained six measures. These were refined into four measures for the second round, 1994-1999, involving planned expenditure of £420 million.

Summary of Planned Expenditure on RTI 1994-1999 under the Operational Programme for Industry

Measure	Total Programme Spend (Public and Private)
I Industtry RTI Initiative	£179m
II Industry/Third Level Co-operation	£204m
III Training for Innovation	£15m
IV Third Level Research Support	£22m
Total	**£420m**

Source: Industry Operational Programme Monitoring Unit, Department of Enterprise, Trade and Employment.

3.2 Other RTI Measures supported by Structural Funds

In addition to the RTI sub-Programme for Industrial Development, other areas supported by Structural Funds include RTI activities ranging across sectoral areas such as Human Resources, Agriculture and Food, Marine and Natural Resources, Environment and Energy. A total of £200 million is expected to be invested in these activities over 1994-1999.

This would bring total Structural Fund spending on RTI programmes to some £620 million over the six year period or just over £100 million per annum of public and private co-financing over the period.

3.3 Future of Current Measures

The extent of the dependence of these programmes on EU Structural Funds is significant. Out of a total expenditure of £420 million in the 1994-99 Programme for Industry, some £200 million will have come from that source and approximately £30 million from the Exchequer. The balance is private sector co-financing of projects to the extent of £190 million over the period.

Clearly if the specific Measures are to continue, either ongoing Structural Funds support will be required over the medium-term, or the Exchequer (or tax relief measures) and other sources will have to contribute to meet the shortfall. Failing that, the schemes will have to be prioritised and cut back or closed down.

3.4 Overview of Performance

With the aid of EU funding and the performance of the economy generally, Ireland's overall RTI performance has improved substantially over the period. The two primary international indicators of RTI performance are Gross (ie Total) Expenditure on R&D (GERD) and Business Expenditure on R&D (BERD). From 1989 to 1995 (latest available year), GERD increased from 0.87% of GDP to 1.4% and BERD increased from 0.51% of GDP to 1.0%.

The Mid-Term Review of Structural Funds in 1996/97 remarked that:

"a series of careful official analyses with a clearly supportive government policy stance has begun to move Ireland from close to the bottom of some R&D "league tables" in recognition of the crucial importance of this dimension to competitiveness and growth. The demonstration and catalytic effect of official commitment will have contributed to the recent acceleration in business R&D expenditure, now running well ahead of the CSF target and ahead of the growth in CSF co-financed R&D spending. The challenge for R&D policy is to keep ahead of the curve…".*

3.5 Convergence and Constraints

Despite these improvements, however, generally speaking, Ireland continues to lag behind our competitors in the level of resources that are devoted to RTI.

In relation to BERD Ireland has made significant strides in the ten years to 1995, with BERD as a percentage of GDP rising to 1.0%. This is due in large part to the significant high tech content in Irelands industrial structure. At the same time the EU average has fallen from 1.25% to 1.15%.

The significant degree of convergence between Ireland and the EU average reflects both Ireland's increase and the EU decline. Yet this is not to say that BERD in other European countries has been reduced as a matter of policy. Rather, the European average has been falling as a result of a general reduction in government spending on defence R&D (i.e. contracts to industry) and a downturn in the European economy activity. Ireland remains considerably below the leading investing nations as regards business R&D i.e. Sweden (2.68%), Japan and Korea (1.95%) and the US (1.83%).

Gross Expenditure on R&D (GERD) includes R&D expenditure by government, business and higher education. Looking at Ireland's performance in a comparative context here, the overall level of investment in RTI is very low when compared with best international practice. While GERD as a % of GDP in Ireland increased to 1.4% in 1995, this still compares very poorly with an average EU level of 1.91%, (one third as great again as the Irish level). If we take best international practice as the benchmark, then the Irish performance looks even worse, with GERD as a percentage of GDP in Sweden and Japan over twice the Irish rate. Furthermore some comparable countries such as Finland and Taiwan have set targets to achieve GERD/GDP ratios of around 3% in a drive to become leading knowledge-based economies.

3.6 Government Financing of GERD

A major concern is the amount of financing which Government provides for R&D regardless of whether it is performed in the business sector, higher education or by public sector organisations. This indicates the level of Government investment designed to support and stimulate R&D in all sectors. It also indicates the level of public investment relative to that of private investment in R&D. Such financing is used to support measures from basic and applied research in universities, to infrastructural projects such as research centres of excellence, to the stimulation of R&D in firms.

While there has been an increase in public funding for R&D in recent years in absolute terms (mostly as a result of Structural Funds), the % of GERD financed by Government in Ireland

has fallen to 23% in the most recent year for which data are available. This leaves government expenditure funding a significantly lower proportion of total R&D in Ireland than is the international average (the EU average is 39%).

This situation is, in fact, highlighted in the EU's Second Report on S&T Indicators (1997) which states;

"The cohesion-4 countries include Portugal, Spain, Ireland and Greece. Except for Ireland, these countries uniformly have very weak R&D systems. Ireland has a very strong private sector, however, with 69% of its R&D investment carried out by enterprises, the second highest percentage in Europe after Sweden. At the same time, the Irish government gives relatively little direct support to R&D activities. After Greece, Ireland has the lowest level of GBAORD at less that 1% of total government expenditure. The Irish R&D system seems to rely very much on the presence of foreign multinationals."*

3.7 Conclusion

With the aid of EU Structural Funds, Ireland has invested substantially in RTI since 1989 and the overall performance in that regard has improved significantly. The Council believes that the funding has been wisely invested, has achieved significant advancement in a number of specific aspects and therefore augurs well for investment of Structural Funds in RTI programmes under a new round.

However, examination of some of the principal RTI indicators shows clearly that in most respects RTI in Ireland still lags some way behind our competitors. Even in the case of business spending on R&D, which has seen the greatest degree of convergence towards EU average levels, the apparently better comparative performance reflects the fact that a higher proportion of industrial firms in Ireland operate in high tech sectors, including IT, chemicals and pharmaceuticals. It should also be borne in mind that this convergence has to an extent been driven by a small proportion of firms and by incentives introduced as a result of the availability of EU Structural Funds. To maintain the desired growth in business R&D and to encourage a higher proportion of firms to engage in RTI activities that will sustain future growth and competitiveness will require ongoing public support in the future.

It is unsustainable to argue that the continued growth of private sector spending alone can lead Ireland to a more competitive position vis-a-vis RTI spending internationally. Private spending cannot compensate - nor should it be expected to compensate - for the underpinning investment by government in RTI activities. There is a correlation between public investment in RTI and the quality and quantity of business spending, just as there is in other human and physical infrastructural areas e.g. skills and telecommunications. In most advanced countries the ratio of Government to private spending is 1:2. In Ireland it is 1:3 and has been deteriorating. Furthermore, as in the case of public support for business R&D spending, this relatively low level of public investment in RTI is heavily dependent on EU Structural Funds.

The issue is whether the growth in business sector spend can be sustained if adequate public investment is not in place. R&D spend by companies is invested mainly in personnel and equipment (and to a growing extent in extramural R&D support). The quality of the personnel available is a function of the training and research activities in the higher education system and the availability of an international-standard research infrastructure. These points were highlighted in a recent Forfás study of the R&D performance of multinationals in Ireland. The other significant area of public investment in RTI is in the stimulation of R&D investment by smaller firms and first-time R&D players, in order to get a greater number of firms involved in RTI activities.

Overall, therefore, public spending or other forms of State support, targetted at underpinning the needs of indigenous firms and attracting and sustaining high-tech multinational companies, as well as stimulating new firms into the R&D net, must keep ahead of private

sector demand, if we are not to face longer term "shortages" in either people, knowledge or facilities which these sectors will require. Without the necessary RTI investment, Ireland is destined to lag behind our competitors and the long-term competitiveness of the economy will suffer as a result.

* Community Suppory Framework
* Government Budget Appropriation or Outlays on R&D (incl. Higher Education R&D Allocations and Government-Funded R&D performed by the private sector)

4. The Challenges Ahead

4.1 Introduction

In terms of domestic and international economic development, there are a number of challenges ahead for Ireland. This Section looks at the contribution which investment in RTI can make in addressing these challenges as an intrinsic part of the range of necessary actions.

4.2 Sustainable Employment

Two of the largest economic and social problems facing Ireland today are the levels of unemployment (particularly long-term unemployment) and the related issue of social exclusion. While the unemployment rate in Ireland has decreased sharply in recent years, it remains a very serious issue for Irish policy makers.

At the same time recently we have been faced with the phenomenon of "skills shortages" in particular areas, including in areas of technical qualification. There has been much comment from business that the supply of technically skilled employees does not match their ever-increasing demands and that the cost of recruiting or retaining technically skilled workers is rising significantly. Furthermore there has been growing emphasis, notably from trade union representatives, on the need for continuing education and training to keep pace with technological developments in the workplace and the changing nature of work.

As was shown in Section 2, the vast majority of employment growth in the period 1990-1996 came from the high tech manufacturing sectors as well as in technologically-based services. Furthermore the net job creation by Irish manufacturing firms is a result of the increase in employment of the R&D-active firms more than offsetting the employment decline in the non-R&D performing firms.

As regards the employability of S&T-skilled people this can be illustrated by looking at the success of science and technology graduates in achieving employment. In 1996, 65% of S&T graduates entered employment compared to 48% of other graduates. Similarly, 52% of S&T graduates go to work in Ireland, compared to 38% of other graduates. Some 34% of S&T graduates had a starting salary of more than £15,000 compared to only 8% of other graduates.

Clearly investment in industrial R&D and in the human resource aspects of the National System of Innovation provides dividends to the economy in terms of the quantity and quality of job opportunities. This includes the need for continuing education and training to ensure that the flow of skills is not subject to interruptions or that skills acquired do not become outdated.

4.3 Regional Development

The new National Development Plan and Structural Funds must aim to ensure that all of the regions of the country are developed in a balanced way. Currently in Ireland all of the regions have, to a greater or lesser extent, some RTI infrastructure, as well as particular industrial clusters, and are thus able to absorb and benefit from public investment in RTI. The Forfás Survey of Innovation 1993-1995 shows that the spread of innovative firms is consistent around the regions. On average throughout the country some 64% of firms describe themselves as innovative, ranging from 51% in the North-West to 71% in the Midlands.

The effort to locate hi-tech industry in the regions is one policy approach to regional development. Thus, investment in regional RTI infrastructure such as Research and Technology Centres or Technology Parks can promote industry/college collaboration,

encourage the development of industry clusters and help to attract hi-tech industry because of the advanced skills/expertise available. The new knowledge-based industries (particularly the sectors based on information and communications technologies) can operate effectively from any location if they have access to technically skilled graduates, advanced technical knowledge and internationally competitive communications infrastructure.

In the context of North-South co-operation, there has been a great deal of co-operation in RTI at various levels. At the policy level there has been frequent interaction between Departments and Agencies and in particular there is a shared perception of the importance of RTI for economic development. Operationally RTI has received dedicated funding from programmes such as the International Fund for Ireland and INTERREG. There has also been good research co-operation between colleges in both parts of the island and companies have interacted with the colleges regardless of location. The Council believes that there is scope for, and advantages to be gained from, enhanced co-operation among policymakers and practitioners in RTI in both parts of the island, especially in the area of pre-competitive research. For example, there could be more research collaboration between universities, joint participation in international programmes, shared objectives for similar support programmes and combined public awareness promotion. The Council urges that future public investment programmes should seek to promote co-operation in this field.

4.4 Sustainable Development

Over the past number of years, the challenge of managing the environment has become broader and more acute and has led to the concept of "sustainable development" i.e. development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This links the more traditional concerns about physical pollution to wider concerns about the conditions under which we can sustain long-term growth without threatening our environmental welfare.

To date, the principal policy response to environmental issues has been to rely on regulatory measures. On the whole, there has been relatively little publicly funded research and technological innovation aimed specifically at environmental sustainability objectives. The challenge is not only to develop prevention policies and their implementation, but also to develop the required supporting technologies, including cleaner production technologies in all sectors, and technologies supporting environmental and natural resource management. This will involve a major science and technology effort and consequential public investment in environmentally-oriented RTI capabilities. Such investment presents particular opportunities for long-term global competitiveness, not only of our natural resource-based industries i.e. agri-food, marine, forestry, but for industry generally and will help to secure internationally mobile investment in areas such as pharmaceuticals and chemicals.

4.5 Globalisation

Over the past three decades Ireland has become increasingly exposed to global competition as a result of the changing nature of international trade and the speed of advances in technology. Ireland, as a small open economy, has deliberately pursued the path of internationalisation, concentrating its industrial policy for many years on the twin tracks of attracting foreign multinational investment and export-led growth. The arrival of European Monetary Union will see an end to the use of interest rates and exchange rates as tools of national economic policy which can be used to protect domestic industry. And from 2003 limits on the extent of State Aids are to be introduced, which will see the removal of one of the few remaining tools left to government to bolster domestic industry.

Without the protections and aids formerly available to the government, the fundamentals of the economy are increasingly vital, for it is on this basis that we must now compete. It is essential that the State provides the best possible environment for industry to operate in. This involves, crucially, the provision of the best possible physical infrastructure and human resources. It also requires an effective National System of Innovation whereby the investment

in, and the output from, its various components - educational, industrial, financial - provide firms with the capability to become internationally competitive through world class innovation.

4.6 The Information Society

The opportunities to be had for countries, firms and citizens from quickly and successfully participating in the Information Society have been well heralded.

As described in "Information Society Ireland Strategy for Action"(1996)

"The speed and scale of the revolution now under way demands that Ireland responds with urgency to the challenges that lie ahead. The impact at national and regional levels will depend on whether or not countries and regions have in place the attitudes, infrastructure, institutional arrangements, enterprises and educational standards that will harness the potential which the Information Society offers for the achievement of social and economic objectives."

The immediacy of the Information Society is without question. The potential benefits of early and full participation are huge. The role of RTI investment in preparing our infrastructure, our enterprise, our workforce, and our entire attitude is vital.

5. International Benchmarks

5.1 Introduction

According to the National Competitiveness Council, Ireland is an emerging knowledge-based economy and our future depends on the capability of our enterprises to compete in the global technological environment. What we do in this country in terms of enterprise performance and the performance of education, infrastructure and public resources has to be measured against the best practice elsewhere, wherever that may be.

If Ireland is to develop a successful RTI policy, it is essential that it sets clear targets and draw up a well developed plan to achieve these objectives. Other countries, which in a variety of ways are in a position similar to Ireland, have done this and are utilising RTI policy as an engine for economic growth in the future. We have chosen to focus on three examples: Finland, Taiwan and New Zealand.

5.2 Finland

Like Ireland, Finland is an isolated economy. It has a population of five million. Finland also faced unprecedented unemployment at the start of the 1990s, and pursued a policy of export growth to escape a recession. Recovery began about 1993 and growth had reached 5% by 1996. Finland is one of the richest countries in the world, ranking 12th in terms of GDP per capita in 1996. Finland has a level of RTI investment far ahead of the Irish level and considers RTI policy to be of central importance. Total R&D spend is currently 2.8% of GDP (compared to 1.4% in Ireland).

The Science and Technology Policy Council (chaired by the Prime Minister) explicitly stated that the knowledge base is more important to Finland than it is to other developed countries because Finland has to compensate for its geographical isolation, and that the creation of a sound knowledge base and a well-functioning system of innovation is the only way to accomplish sustainable economic growth.

In September, 1996, the Cabinet Economic Policy Committee took a significant policy decision to raise research expenditure to 2.9% of GDP by 1999. As regards government financing of research this will mean an increase of 1.5 billion marks (£200 million) per annum over the 1997 budget level. The aim is that GERD will be funded 40% by the public sector and 60% by the private sector. The new funding is being raised through the sale of State-owned companies.

5.3 Taiwan

Taiwan was one of Asia's four original tiger economies built largely on the basis of labour intensive industries. However, due to problems such as the cost of land and the rising cost of labour, these traditional industries experienced a decline in output and export volumes. Thanks to strong industrial policies, high-tech exports are gradually increasing and now represent one-quarter of total exports and Taiwan is the leading producer of several high-tech products. The country is currently growing at a healthy rate of 6% per year. The population of the country is 21 million.

Taiwan produced its first White Paper on Science and Technology in December 1997, with the desire to rely on the development of Science and Technology to drive the nation's modernisation and raise international competitiveness. Technology is considered to be the most important factor in raising Taiwan's industrial competitiveness by continuously investing in R&D and introducing new products and technologies faster than their competitors.

Taiwan's industrial base, however, is too heavily dominated by small companies incapable of achieving rapid innovation on their own. Hence the State will invest in national projects (e.g. telecommunications and biotechnology) to reduce the dependence of small firms on imported technology.

The broad objective is to steadily increase R&D expenditures and raise the quality of R&D personnel. Through both public and private investment, it is expected that R&D expenditure will rise to 2.5% of GDP in 2000 and 3% in 2010 (the current rate is 1.8%).

5.4 New Zealand

New Zealand introduced radical reforms of the public sector in the late 1980s with a general thrust of the public sector becoming less interventionist in the economy. While output in the manufacturing and services sectors has grown, there is still a significant dependence on the agricultural-based sectors and, even though these sectors have become globally competitive, there is concern that the economy is reliant on a very narrow base for growth.

One of the consequences of the public sector reform was the introduction of the "Public Good Science Fund". This fund, which is overseen by the Ministry of Research, Science and Technology is by far the single biggest source of public funding for Science and Technology in New Zealand. The fund was generated by amalgamating funding from across a range of sectoral departments and is used to channel research funding into areas of national priority. In particular it seeks to target research into new or emerging technologies and sectors which are not funded by other departments. The Public Good Science Fund amounts to $NZ282 million (c.£140 million), compared to a total spend of $NZ90 million by other departments.

Following the last review of priorities for Science and Technology in 1995, the Ministry of Research, Science and Technology identified the need for an improved priority setting process. As a result they are engaged in a technology foresight exercise which links government investment in research, science and technology with New Zealand's development as a knowledge society. According to the Ministry "the focus on the future must not be constrained by what we have been doing in the past".

5.5 Conclusion

If these countries see the need to further develop their RTI competencies, and choose to do this through setting explicit targets and drawing up clear plans, then the implications for Ireland's competitiveness in the globalised economy are obvious. If we wish to exploit the advantages which RTI offers to small open economies such as Ireland's we must significantly increase our level of investment in all aspects of RTI, including R&D, manpower, infrastructure and the innovation capability of firms. This should be done in a focused and co-ordinated way, concentrating on the particular needs, strengths and opportunities of our own position, as has happened in the countries mentioned above.

6. The Future - a Vision for RTI in Ireland

One question which is raised by the foregoing analysis is whether our ambition should be solely to converge towards the EU averages in our RTI performance, and to tackle particular deficiencies through particular schemes, or whether our ambition should be to invest at the same levels as the leading RTI nations. ICSTI believes that realistically, only through investment at the level of the leading nations, in an effective manner which achieves the desired impacts in the economy, will Ireland achieve long-term and sustainable global competitiveness.

6.1 The Vision

Ireland for most of this century has been an agricultural economy seeking competitive advantage on the basis of factor costs. In more recent decades, and particularly with the inflow of European Structural Funds, there has been considerable investment in infrastructure, often associated with the attraction of foreign mobile investment into the country.

The White Paper on Science Technology and Innovation (1996) set out the following vision of the Irish economy and the role of STI.

"STI policy must therefore work to create an economy characterised by sustainable high employment, high living standards, competition and innovation in an enterprise sector:

- featuring growing use of skilled and qualified staff and rising systematic expenditure on R&D;
- engaged in trading products and services using processes and technologies all of which continuously improve to meet the highest international competition;
- generating and enhancing, as well as absorbing, new technology and new techniques;
- placing particular emphasis on raising the competence of indigenous companies.

The approach taken in this White Paper is one that locates S&T firmly within the framework of wider industrial, economic and national development and therefore into the areas of jobs and living standards. This White Paper is about the kind of jobs - indeed the kind of society - we want for the future.

An advanced economy which seeks to achieve its full innovation potential, must develop and create linkages between a number of components as part of a National System of Innovation. These components are:

- universities and similar institutions providing basic research and the development of high levels of knowledge and skills;
- business firms, especially those investing in change-generating activities;
- public and private institutions providing general education and vocational training;
- the Government sector, financing and performing a variety of activities that both promote and regulate technical change;
- a venturesome financial sector committed to funding innovation activities."

The challenge now, therefore, is for Ireland to become an innovation-based economy and society where leading-edge products, processes and services are created on foot of market demand and technological superiority and where scientific research is utilised and adapted for the betterment of the quality of life for all. Ireland has a unique opportunity through the next National Development Plan and Structural Funds Programme to put in place the investment needed to realise the vision of an innovation-based society.

6.2 The Scope of the Investment Required

Mission Statement and Objectives

The Mission Statement for a programme of investment in RTI should be

"To underpin Ireland's economic and social development and the generation of skilled employment through planned and sustained investment, ranking with the leading countries in the world, in all aspects of the National System of Innovation, embracing S&T-related education, skills, research, technology and firm-level innovation and leading to a sustained increase in output and quality of goods and services."

To achieve that mission Ireland must invest substantially and widely in the RTI base of the country over the next ten years as a means of enhancing innovation and competitiveness. A new programme of investment in RTI should aim to increase output and employment by:

- Helping firms to develop new products, services and processes that help them to maintain and grow market share
- Increasing the number of companies performing effective R&D in Ireland
- Increasing the scale of RTI investment by companies in Ireland
- Encouraging firms to access and exploit R&D and technology from international sources
- Increasing the numbers of researchers and technicians employed in Irish industry
- Strengthening the research capability in the third-level and State research institutions, in particular to meet the R&D and skills needs of the economy
- Increasing the quantity and quality of the R&D linkages between institutions and companies
- Increasing the amount of public investment in RTI in identified priority areas for national economic and employment development and by allocating State/EU support for these areas on a competitive basis
- Promoting private investment in R&D and in new technology-based firms.

Principles Governing RTI Investment

The approach advocated by the Council is based on the following principles:

- the need for greater prioritisation of public funding for RTI in line with national development policy objectives
- the need to promote greater competition for public funding in line with those priorities
- the need to support the key technologies for economic development that will be identified in the Technology Foresight Initiative currently being conducted by the Council
- the need to conduct RTI projects on a scale which will have the necessary impact
- the need to promote more collaboration between components of the National System of Innovation especially between companies, colleges and State research institutes.

Targetting and Measuring the Impact

In the context of (i) the role of public RTI investment in enhancing the productive sectors of the economy, (ii) the objective of simplifying measures for the benefit of both the providers and users and (iii) ensuring that national priority needs are being addressed, the Council recommends that:

- all RTI measures under the National Development Plan/Structural Funds should be brought together under a single programme
- there should be a reduced number of measures, thus promoting maximum competition for public funding.

In order to demonstrate the effectiveness of substantial investment as part of a new round of Structural Funds there is need to develop a set of national indicators to measure the outputs

and the impact of the investment. The quality of the impact needs to be evaluated, particularly in terms of industrial competitiveness and performance, and needs to be benchmarked against our international competitors. ICSTI is currently undertaking an examination of RTI indicators and benchmarking of Ireland's RTI performance.

6.3 Outline of a New RTI Programme

Measures under a new Programme should focus on the following four areas:

RTI for Industry

Measures should include

- Support for in-company R&D (a) to provide for the development of the indigenous sector and (b) which would further embed the multinational sector in the economy. The continuing emphasis should be on promoting strategic R&D activity by encouraging first-time R&D performers and helping smaller firms to achieve critical mass. It should not be a subsidy scheme for business R&D in general. For the more established R&D players, ICSTI has previously recommended the introduction of a tax credit, as part of an increased Government contribution to support in-firm R&D. This would help to embed multinational firms in Ireland which are deterred at the moment by more tax efficient options in other countries. It would thus make Ireland more attractive in R&D terms and more competitive as a location for strategic investment.
- Training in the management of innovation in firms.
- There should also be provision for a "Technology Intelligence" measure to help non-R&D firms define and access their technology needs. This could incorporate different actions such as international technology "watch" and technology transfer; dissemination of results of international programmes; industry RTI networks; continuation of the successful Techstart Programme which places graduates in small firms or introduction of a "Teaching Company" approach to the enhancement of RTI capability in firms; necessary technical services and information, etc.
- There should be a Measure to provide capital and other support for the establishment of technology-based firms e.g. campus companies.

RTI Collaboration Networks

This would provide for collaboration among and between different elements of the National System of Innovation and foster regional development. This approach is emphasised by the EU Commission as a means of transferring research and technology into industry.

Activities could include:

- Strategic RTI collaborative partnerships involving industry and third-level/State institutions
- Industry-institution applied research
- international collaboration to encourage Irish access to research and technology developed outside of Ireland.
- collaboration between institutions
- collaboration across research disciplines
- continuing education and training.

As indicated in Section 4.3, there should also be an emphasis on promoting North/South collaboration in the area of RTI.

RTI Infrastructure and Human Resources

If Ireland is to sustain current levels of economic growth, it will have to continue to develop the technology-based sectors of indigenous industry and to attract the new generations of high-tech, high-growth multinational firms. To enable it to do so, it will require a significant increase and focus in investment in the national RTI infrastructure of the economy in order to ramp-up the quality and quantity of research, transfer of technology and expertise especially in areas which are key to development.

- This Measure would provide for a substantial national innovation fund for investment in strategic R&D priorities. This should include, for example, areas emerging from the Technology Foresight exercise currently being conducted by ICSTI. It would focus on R&D in areas of emerging sectors/technologies, as distinct from existing expenditure areas of Government Departments and Agencies.
- There should be a specific RTI measure for investment in the research requirements to allow us to take full advantage of the Information Society.
- There should also be a measure to support RTI infrastructure in the form of national or regional science/technology parks, strategic research centres of excellence, targeted institutional research and advanced communications links between institutions and such centres throughout the island. (This is in line with the needs identified by a Forfás study of the R&D performance and infrastructural support needs of multinationals.) To allow the third-level colleges to develop their capability in strategic areas of research and to collaborate more with industry, there is need to ensure that research equipment and facilities are of an internationally competitive standard. Investment would be aimed at establishing a capability and reputation for research in technologies and sectors which are key to future industrial development, facilitate the transfer of technology to industry, retain the best research personnel in Ireland and ensure the continued flow of skills and learning.

The type of research (e.g. basic, strategic or applied) is not the issue here. To a growing extent these titles are becoming blurred and, depending on the research area and sector of industry involved, can mean the same thing. The only issue is whether the research contributes to the underpinning of industrial competitiveness in terms of skills, knowledge or innovation potential.

RTI for Natural Resource-Based Enterprise

The natural resource-based sectors of the economy, principally agri-food, marine and forestry, make a significant contribution to the nation's wealth and employment. These sectors are coming under growing market pressures with the liberalisation of world trade, product innovation and advances in process and service technologies. Investment in the relevant areas to promote greater innovation and to match the technological competitiveness of leading players in the market will be critical to the survival and development of Irish firms in these sectors.

6.4 Sustainable Development

The Council strongly advocates that the sustainable development of resources and protection of our environment should be an intrinsic part of a programme of investment in RTI. They merit R&D investment as issues in their own right and should be key objectives of other RTI measures. Greater investment is essential across all sectors to ensure sustainable development through rational management of natural and environmental resources and maintenance of the integrity of ecosystems. By investing in the research and technology transfer activities to promote sustainable development and environmentally-friendly technologies (e.g. cleaner production, catchment management, coastal zone management, transport logistics), Ireland is not only maintaining environmental integrity but also conferring a long-term competitive advantage on the sectors concerned.

6.5 Balance of Investment

The foregoing is a framework to describe the approach to RTI investment in a new National Development Plan and round of Structural Funds. The Council believes that in deciding the balance of investment in the above areas there should be a strong emphasis on building up the performance, capability and skills of the business sector in terms of R&D and innovation and in promoting industry/institution collaboration. Only in this way can Ireland effectively reap the benefit of investment in research and human resources in the education and State sectors.

6.6 Scale of Investment

The Council is conscious of the fact that since the first round of Structural Funds began in 1989, Irelands RTI performance has improved considerably and moved closer to the EU averages. We have pointed out though that there are still gaps in our performance relative to our EU partners and there remain specific issues which need to be addressed in a new round of funding.

Moreover the Council is strongly of the view that RTI performance in Ireland must not simply be benchmarked against that of other EU countries. It must, increasingly, be benchmarked against that of leading RTI investors and emerging economies in other parts of the world including for example, Sweden, Finland, Israel, Taiwan, Singapore, New Zealand and Malaysia.

Within this wider comparative framework available data would suggest that Ireland should aim to achieve a level of spending on R&D equivalent to 2.5% of GDP (Ireland's current level of investment is of the order of 1.4 %). The Council believes that this gap is a reflection of the competitiveness deficit in the area of RTI which Ireland is facing in this age of economic revolution founded on scientific discovery and technological application.

In proposing such a medium-term objective, the Council strongly emphasises that it does not advocate an increase in public expenditure on R&D simply in an effort to meet some artificial statistical norm. Such an approach would be imprudent, would be likely to result in the inappropriate use of the scarce resources available for R&D purposes and would lack credibility. Future public sector R&D expenditure profiles, including both increases and decreases, should be developed on a sector-by-sector basis as an intrinsic part in achieving the development objectives for each sector and the prioritisation of resources for this purpose. The Council has set out how this could best be achieved in its report entitled " Mechanisms for the Prioritisation of State Expenditures on Science & Technology" (June 1998).

As mentioned earlier, a new programme of RTI investment should contain very specific indicators to measure the investments and the impacts they achieve. The Council, particularly through the Technology Foresight Initiative, will continue to promote the targeting of RTI investment into areas which address specific deficiencies or provide the greatest opportunities.

Based on the above there are three options open to Government in determining the level of investment in RTI under a new National Development Plan and related EU Structural Funds package.

If Government wishes to merely maintain the Measures, Programmes and Schemes currently funded out of Structural Funds, as set out in Section 3, these would require ongoing public and private investment of the order of £100 million per annum.

If Government wishes to support the strongly growing private sector efforts in R&D by maintaining the current ratio of Government-financed R&D to Business R&D over 2000-2006 (in line with expected growth in GDP) it would need to invest an additional £130 million of public monies per annum over the period above the current spend (approximately £150

million per annum). This is based on Business R&D continuing to grow at current rates of 10-15% per annum, (i.e. higher than projected GDP growth).

However, if Ireland is to become an innovation-based economy - and one of the leading RTI investing nations in the world - there should be a target for investment in R&D of at least 2.5% of GDP by the end of a new round of Structural Funds (Ireland's current rate is 1.4%.). It is estimated that a target of 2.5% in 2006 would require additional public investment of the order of £200 million per annum over the period above the current spend.

This assumes a graduated rate of increase in order to reach a level of 2.5% in 2006. It also assumes that BERD continues to grow at rates of 10 to 15 % per annum (i.e. higher than projected GDP growth) which would see business spending treble from £400 million in 1995 to almost £1.3 billion in 2006.

Using current data for comparison this would place Ireland above the EU and OECD averages (1.9% and 2.1% respectively), on a par with the US but behind the leading investing nations such as Sweden (3.0%), Finland and Japan (2.8%) and the ambitions of nations such as Taiwan.