

Dublin Diaries

A Study of High Technology Development
in Ireland



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Part 1:

Why Study Ireland?

“The past is indeed a foreign country. The Ireland of the early seventies was a very different place and in some aspects, when viewed from the perspective of the end of the century, almost unrecognisable.”

Ray Mac Sharry and Padraic White. *The Making of the Celtic Tiger: The Inside Story of Ireland's Boom Economy*. Cork: Mercier Press (2000), p. 153.

Introduction

I serve as President of Virginia Commonwealth University and President and Chair of the Board of Directors of the VCU Health System in Richmond, Virginia. From June to August 2002, I was a Visiting Professor at University College Dublin in Ireland. My purpose was to study economic development in Ireland with an emphasis on the role of Irish higher education.

As president of a research university that is oriented to local and regional economic development, I am interested in how other institutions of higher learning relate to their communities, governments and business leaders in developing an indigenous high-tech capacity to spur economic development. What can the experiences of institutions in other countries tell us about the future of our communities in the United States? What have we experienced that may benefit them?

In 1998, I conducted a study of high technology development in Cambridge, England, as a Fellow Commoner at St. John's College. The resulting report was titled *Richmond at the Crossroads: The Greater Richmond Metropolitan Area and the Knowledge Based High Technology Economy of the 21st Century*. That academic appointment gave me critically important access to university, business and community leaders working together to spur high technology economic development through research and development. It also provided insight into how localized, grass-roots efforts, like those in Cambridge, can produce big dividends in high technology development.

My appointment as a Visiting Professor at University College Dublin was for the same purpose and advantage. I interviewed nearly 70 individuals from academia, government, business and industry to learn more about Ireland's economic success. Higher education officials, university and technology institute presidents and faculty, leaders from IDA-Ireland, Enterprise Ireland and Science Foundation Ireland, representatives of foreign multinational industries with operations in Ireland, leaders in the media and a broad cross-section of individuals from Ireland's other professional, nonprofit, business and government sectors talked with me about Ireland's economic boom and the factors that have gone into it, as well as the challenges that the country now faces. There was among this diversity of leadership a common feeling about Ireland's tremendous potential in information communications technology and the life sciences. All were in agreement as well that Ireland's story – the so-called “Celtic Tiger” – is unparalleled in the history of national economic development. Based on my own investigation, I would support that view.

Dr. Donald Fitzmaurice, Professor of Chemistry at University College Dublin, told me that his grandparents' generation helped build the social and political foundations of the modern state; his parents' generation made Ireland economically self-sufficient. What will his generation contribute to Ireland's economic future? The 21st century has opened to astonishing change in the basis for economic development. Brendan Tuohy, Secretary General of the Department of Communications, Marine and Natural Resources, described this transformation succinctly: "The 19th century was steam. The 20th century was electric power. The 21st century is knowledge." We live in a high technology era, dependent on a well-educated workforce and continuous research and development that can be translated into useful applications for industry and society. Studying Ireland allowed me to understand first-hand this phenomenon in action.

The Republic of Ireland has a population of nearly 4 million and covers 70,282 square kilometers (27,136 square miles). Virginia has a population of more than 7.1 million and covers 109,624 square kilometers (42,326 square miles). In many respects, Ireland has done more to advance its economy than Virginia (and some other states) – with fewer people and resources.

What is even more impressive is the distance Ireland has had to travel to attain that success. Ireland in the 21st century is the product of a long battle with severe economic peril that, in the 19th and 20th centuries, produced one of the most massive diasporas in world history. According to the Irish Embassy in Washington, D.C., between 1841 and 1851 Ireland's population declined from 8.5 million people to 5.5 million, owing to deaths from starvation and disease and large-scale emigration brought about by the great famine.

As a result of this and subsequent emigrations, there are now more than 45 million Americans of Irish descent. In a meeting with Dr. Pat Frain, Director of University College Dublin's University Industry Programme, I noted that Mrs. Trani has a great-grandmother whose last name was Frain. The message: everyone in Ireland is related to everyone else in the world.

Now, as Dr. Eamonn Walsh, Dean of UCD's Graduate School of Business, told me, the Irish diaspora is coming home. In 2000, Ireland had one of the highest rates of net-immigration among the European Union member states. And, they are

bringing with them significant overseas experience, particularly from U.S. and British universities and from such high-tech centers as Silicon Valley and the Boston/Cambridge region. Dr. Dermot Kenny, son of Dr. Ivor Kenny who is a Senior Research Fellow at UCD's Department of Commerce, spent 13 years at the Medical College of Wisconsin. Professor John Horgan of Beaumont Hospital in Dublin did his cardiology residency in the 1970s at VCU's Medical College of Virginia Hospitals. President Gerard Wrixon of University College Cork completed his Ph.D. at the University of California-Berkeley, where he met his wife Marcia, and he brought five years of experience at Bell Laboratories with him when the couple moved to Ireland.

From my interviews and experiences during my stay in Ireland, it became clear to me that the two most important assets that Ireland boasts are its people and its can-do attitude. As Sean Dorgan, Chief Executive Officer of IDA-Ireland, the agency geared to attracting inward investment, told me: "In Europe, you get bureaucracy and process. In Ireland, you get contacts." My own experiences proved this to be true; each contact I made in Ireland led to another contact.

You also get a well developed sense of national identity. For a few days this past June, Ireland was deserted as its soccer team went up against Germany in the World Cup. I tried to hail a cab on the day of a tight match, when the entire country seemed to have come to a halt. The Irish are puzzled by why we in the United States do not take soccer more seriously.

Mrs. Trani and I also went to see a play at the Abbey, Ireland's national theatre, called "That was Then." The play followed the falling economic fortunes of a British couple and the rising fortunes of an Irish couple – a metaphor not only for the rise to global prominence that Ireland has achieved but also the respect that the Irish are demanding since its days of political and economic dependence on Great Britain. The Irish have an extremely confident outlook about themselves and their nation, and this is perhaps one of the most important things to understand about the country's past, present and future.

It is equally important to realize that, notwithstanding Ireland's strong national identity, it also sees itself as European but with a strong U.S. orientation. This came home most forcefully for Mrs. Trani and me when we took a short trip to France during our stay. In traveling from Ireland to the continent, it was

remarkable to us how much Ireland has come to identify itself with Europe, a function no doubt of its striving over the years to come out from under the shadow of Great Britain. Ireland's identification with Europe should be of interest to us in the United States as we seek to maintain our hegemony in the knowledge economy.

About Virginia Commonwealth University

VCU enrolls more than 25,500 students and employs more than 15,000 faculty and staff at the University and the VCU Health System. VCU offers 164 undergraduate, graduate, professional and doctoral degrees through the Schools of Allied Health Professions, the Arts, Business, Dentistry, Education, Engineering, Medicine, Nursing, Pharmacy and Social Work, and the College of Humanities and Sciences, which includes the School of Mass Communications. We are an enterprise worth more than \$1.4 billion in annual revenues, which include \$169 million in annual research funds, ranking VCU as a Carnegie Doctoral/Research University-Extensive, the top category for higher education in the United States. Additionally, 16 interdisciplinary Centers and Institutes of Excellence support our research mission. These centers encompass the areas of public policy, health research and technology applications in the life sciences, such as bioengineering.

The VCU Health System comprises the clinical activities of the teaching hospital, the faculty-physician practice plan and VCU's School of Medicine. The Health System has more than 30,000 inpatient admissions, 542,000 outpatient visits and 82,000 emergency room visits each year and supports more than a dozen satellite health-care facilities in the Richmond area.

I have enjoyed 12 years to date serving as President of one of the most dynamic institutions in the nation. VCU has sought collaborations with business, community, academic and government leaders to develop such initiatives as the Virginia Biotechnology Research Park and an innovative School of Engineering with a biomedical focus, both key economic development initiatives benefiting the Richmond region and the state. VCU also has worked closely with the community on projects ranging from campus construction planning to community policing. The neighborhoods we serve are as close as Carver next to our campus and as far away as Doha, Qatar, where we have established the VCU-Qatar College of Design Arts.

The University's most recent initiative is VCU Life Sciences, a comprehensive program dedicated to understanding biocomplexity in the post-genomic era. It brings together the VCU Health System, our Rice Center for Environmental Life Sciences and our academic programs in medicine, the sciences, engineering, business, the humanities and education. VCU Life Sciences is uniquely focused on undergraduate education beginning with Life Sciences 101, the curriculum's "gateway" course where freshmen are introduced to the life sciences through lectures from our top, nationally recognized researchers. As a measure of the importance of integrating the physical and life sciences through creating an environment that fosters such integration, Dr. John Fenn, Research Professor in the Department of Chemistry, won this year's Nobel Prize in chemistry, an honor he shares with a scientist from Japan and a scientist from Switzerland.

VCU is becoming a national model of the impact of higher education on urban and economic development. In relation to that increasing recognition, I was appointed Chair of the Metropolitan Richmond Chamber of Commerce in 1997-98. I am now serving as Chair of Richmond Renaissance, a major organization devoted to downtown revitalization. VCU also was one of two national case studies, along with Columbia University, in the spring 2002 report, *Leveraging Colleges and Universities for Urban Economic Revitalization: An Action Agenda*, a joint project of CEOs for Cities and the Initiative for a Competitive Inner City (ICIC). This report offers a concise review of the different ways that higher education in America's metropolitan regions is contributing to their economic revitalization.



Part 2:

From “Brawnpower To Brainpower”: The Celtic Tiger

There are numerous good reasons to study economic development in Ireland. The primary focus of my report is how Ireland can show the rest of the world the importance of investing in human capital and, more specifically, how Irish higher education can, in the future, enhance the nation's prospects for becoming a fully integrated knowledge society. United States Ambassador to Ireland Richard J. Egan stated that from his perspective, education has been the most important element in Ireland's economic success.

The phenomenon of the “Celtic Tiger” has inspired numerous books, reports and scholarly and popular articles from experts and observers from all over the world. And, it is no wonder: In the years following Ireland's independence from Great Britain in 1922, virtually every aspect of the Irish economy – from unemployment to national debt — was a measure of fiscal failure. In the 1950s, Ireland's economic growth rate was less than 1 percent annually; at the end of the 20th century, it had risen to 10 percent. What Ireland accomplished in the recent decades and most especially since the mid-1990s is nothing short of a miracle. Ireland's growth is, as Brian Sweeney of Siemens Ireland described it, a story about a transition from “brawnpower” to “brainpower.”

The individuals I interviewed for this report were unanimous in identifying Ireland's climb to global economic renown as essentially a function of national will, through a series of national economic recovery strategies and social partnerships that would, over the

course of three decades, make Ireland attractive to the two major elements that set the stage for Ireland's economic success in the 1990s: membership in the European Union (EU) and foreign direct investment.

EU Structural Funds and Social Partnership: Developing National Cohesion

After joining the European Union in 1973 (then known as the European Economic Community), Ireland became eligible for EU “Structural Funds” – a series of programs that provided support for social and industrial infrastructure development as well as funds under the Common Agricultural Policy (CAP). The EU Structural Funds did much to bolster the nation's recovery efforts. These funds helped Ireland and the other new underdeveloped member states make the transition to the union, which subjected them to increased competition but, in the long run, provided them access to greater markets for their goods and services.

As Dr. Tom Higgins, a consultant with Circa Group Europe, pointed out, however, where other nations invested in roads, Ireland invested in people. In combination with efforts from the late 1960s to focus on the condition of schools, Ireland used EU funds to significantly increase the participation of its citizens in all levels of education. Dr. John Hayden, Secretary and Chief Executive Officer of Ireland's Higher Education Authority (HEA), noted that only 15 percent of Ireland's young people were attending a college or university in 1973; that figure is now 50 percent.

Ireland's social partnership was equally important to its ultimate success in becoming a global economic presence by making the country financially capable of retaining its workers and attracting overseas Irish nationals back home. Initially, as I learned from talking with Professor Rory O'Donnell of the National Economic and Social Council and reading some of his scholarship, the social partnership was a strategy between the government, employers, unions, workers and farmers to establish wage controls in exchange for income tax breaks. Over time it would come to include such non-pay elements as child care, social equity and worker retraining. As Professor O'Donnell has observed, the social partnership was important to the “dramatic opening, Europeanisation, commercialisation and democratisation of Irish Society.”

“Ireland Inc.”

With secondary schools graduating more students and third level education expanding, Ireland was preparing to exploit one of the most important forces in the making of the Celtic Tiger: foreign direct investment, particularly in high technology industries. As a result of this investment, Ireland ranks first in the world in terms of software exports; the United States ranks second.

Owing again to Ireland’s well-educated, English-speaking workforce and its can-do attitude as well as one of the lowest corporate tax rates in the European Union, Ireland now serves as the gateway between the United States and Europe in the export of manufactured goods and services. Ireland has, for example, attracted the operations of nine of the world’s top ten pharmaceutical companies and ten of the world’s top 15 medical products companies. The pharmaceutical sector was one of the few high technology industries that did not suffer from the dot.com collapse and remains the backbone of the Celtic Tiger economy. Viagra, manufactured in Cork, is the single biggest contributor to Irish exports. According to IDA-Ireland, total investment in Ireland by the overseas pharmaceutical sector is estimated to be \$7 billion.

In all, more than 1,200 overseas companies – in areas ranging from electronics to health care products to financial services – have established bases in Ireland and are employing more than 138,000 people. They account for €47 billion worth of exports and spend €14.2 billion in the Irish economy annually. Last year, these companies created 13,500 new jobs in the pharmaceutical and health care sector, the electronics sector, the financial services sector and other industries. Ireland has virtually become the European launching pad for multinational exporting and is the most export-dependent nation in the world.

Since the mid-1990s, the United States has been the primary source of foreign direct investment in Ireland. About 70 percent of current investment projects, representing over 80 percent of foreign capital, are from American firms. Ambassador Egan described for me the 585 American companies that have manufacturing operations in Ireland, and the more than 100 in Northern Ireland, with names like Intel, Microsoft, Sun Microsystems, Wyeth Medica, IBM, Gateway, Hewlett-Packard, Dell, EMC Corporation and Johnson & Johnson. Bobby O’Connor, General Manager of Field Boxmore, a subsidiary of Chesapeake, expressed to me his pride in the 600 Irish the com-

pany employs at four different sites. Ann Fitzpatrick, Director of Sun Microsystems Ltd., bragged about the 240 employees working at its operation in Ireland with another 800 working for Sun Microsystems throughout Europe.

One of the most impressive examples of U.S. investment is a new project called the Wyeth BioPharma Campus at Grange Castle, in the suburbs of Dublin, an initiative of Wyeth Medica, which has substantial operations in Ireland. This past July, Dr. Reg Shaw, Managing Director for Wyeth Medica Ireland, and Declan Ryan, Engineering Projects Director, talked with me about the campus’s plans. The 90-acre Wyeth BioPharma Campus will represent an investment of approximately \$1.7 billion and consist of 1.2 million square feet, becoming the largest integrated biopharmaceutical facility in the world.

In addition to manufacturing, Wyeth BioPharma will undertake research and development (R&D) in drug development and design, working closely with the surrounding institutions of the National University-Maynooth, Dublin City University, Trinity College Dublin, University College Dublin and the Institute of Technology Tallaght. By 2007, more than 1,300 highly skilled employees are expected to be working at Wyeth BioPharma, bringing Wyeth’s total employment in Ireland to more than 3,000. Already, 10,000 job applications have been received for the new campus’s manufacturing jobs.

Citywest, a 300-acre campus located about a half hour from Dublin International Airport, is a business park that was achieved through a partnership with the government and IDA-Ireland. It is geared to supporting foreign-owned and Irish-owned businesses with a modern telecommunications and financial services environment. I met with Brendan Hickey, Managing Director of Davy-Hickey Properties, the developer of Citywest, and was impressed by the park’s mix of small and large firms as well as the government’s decision to establish the National Digital Park there, which currently employs more than 5,000 people.

One of the most important benefits of foreign direct investment, as Brendan Hickey pointed out to me, is that Ireland is becoming more entrepreneurial – a necessity if its indigenous industry is to “move up the value chain,” as he explained. This new entrepreneurialism is coming not only from the return of Irish nationals but also the Irish working in foreign-owned firms who have amassed experience in such areas as engineering,

computer science and software development. Among the objectives of Enterprise Ireland is to build up Ireland's indigenous multinational sector using this growing base of entrepreneurial experience. All-Irish companies such as Iona Technologies, a Dublin-based software firm specializing in eBusiness that was developed in Trinity College Dublin's mathematics department, are being established for the global marketplace. In 2000, *Time* magazine named that firm one of the top ten fastest growing companies in Europe.

Becoming a World-Class R&D Center: National Development Plan 2000-2006

Ireland's most recent comprehensive national development strategy is the National Development Plan 2000-2006, involving more than €52 billion (\$51.3 billion) of Irish public and EU funds to be invested through 2006. The NDP stands as an international model of the importance of bringing together leadership from all sectors – both public and private, from government, business, universities, research institutions and trade unions — to develop the infrastructure in order to attain global leadership in the knowledge society.

A major agency overseeing the industrial development component of NDP is Forfas, the National Policy and Advisory Board for Enterprise, Trade, Science, Technology and Innovation, which operates under the aegis of the Department of Enterprise, Trade and Employment. Forfas, together with a number of other national agencies, plays a vital role in supporting or implementing Ireland's national development objectives. These include IDA-Ireland, Enterprise Ireland (the agency focusing on indigenous industry development), Science Foundation Ireland, the National Accreditation Board, the National Competitiveness Council and the Expert Group on Future Skills Needs.

NDP funds are targeting such infrastructure needs as roads, services, social housing, education, transportation, rural development, industry, child care and local development, some of which are being addressed through public-private partnerships. The National Development Plan also is focusing on supporting Ireland's comparatively underdeveloped rural areas, with a focus on the Border, Midlands and Western (BMW) Region.

Where NDP differs from past national recovery and development programs is its significant investment in R&D through some €2.5 billion over the life of the plan. This new direction in government policy is critically important to Ireland's ambition

to become a knowledge society. As Dr. Pat Frain told me, ten years ago University College Dublin had no research office. It reflects the remarkable agreement around the desire to invest in Ireland's potential in information communications technology (ICT) and the life sciences that I found among the leaders I talked with this summer.

These funds are being administered primarily by Science Foundation Ireland (SFI) and the Higher Education Authority through the Programme for Research at Third Level Institutions (PRTLTI). SFI is modeled after the National Science Foundation in the U.S. – understandable in great part since Dr. William Harris, SFI's director, worked for NSF for many years before coming to Ireland — and represents Ireland's largest-ever investment in research in ICT and biotechnology. In 2001, SFI provided five-year grants to ten researchers totaling €50 million. By 2006, SFI will have granted €635 million through a variety of programs supporting both individual researchers and joint research efforts.

Where SFI provides grants for research projects, PRTLTI provides funds for infrastructure needs that support research and development. PRTLTI has to date awarded approximately €605 million to Irish universities and institutes to establish postgraduate and postdoctorate fellowships and new academic slots as well as pay for modern facilities and equipment. The examples of new projects coming out of this funding are quite impressive and range across such disciplines as communications engineering, biomedical engineering, immunology research, genetics, advanced materials, nanotechnology, food science and biopharmaceutical research. The institutions developing these projects include, among others, Dublin City University, National University of Ireland-Galway, National University of Ireland-Maynooth, Trinity College Dublin, University College Cork, University College Dublin, the University of Limerick and the Royal College of Surgeons. The technology institutes, such as the Dublin Institute of Technology, Athlone Institute of Technology, Institute of Technology-Carlow and Cork Institute of Technology, also are receiving funding.

PRTLTI funds also are supporting research partnerships — a major need in the development of Ireland's R&D base identified by the Irish academic leaders I interviewed. One of the most significant examples is the Dublin Molecular Medicine Centre (DMMC), which is being established through a

partnership between Trinity College Dublin's Institute of Molecular Medicine and University College Dublin's Conway Institute for Biomolecular and Biomedical Research. Called an unprecedented coming-together of researchers and their institutions, this project is helping to establish the all-important "critical mass" of researchers working in interdisciplinary fashion on the processes occurring at the molecular level, which could ultimately result in new therapies and diagnostic tools. DMMC draws on a number of basic science disciplines at both institutions and conducts clinical investigations in Ireland's teaching hospitals.

With the assistance of Enterprise Ireland, the universities also have been implementing a number of important strategies to connect faculty with industry leaders and instill a greater sense of entrepreneurship in their academic cultures.

University College Dublin's University Industry Programme (UIP); its new innovation center, NOVA; and the Campus Company Development Program, a joint initiative between UIP and Enterprise Ireland, are among several such recent innovations in the third level sector. UCC President Wrixon and John Hayden of the HEA pointed to the newer universities, the University of Limerick and Dublin City University, as having been developed with an entrepreneurial approach to their curriculum and research development. DCU's President Ferdinand von Prondzynski talked with me about Invest, the university's commercial arm, among other DCU initiatives designed to foster university-industry ties.

These academic leaders, along with President Cosgrove, Dr. Frain, Dr. Tony Glynn of Dublin City University's Office of Innovation and Business Relations, President Brendan Goldsmith of the Dublin Institute of Technology, Provost John Hegarty of Trinity College Dublin and leaders from Ireland's multinational sector, noted that Irish higher education still must focus on broadening its traditional focus. This is, in fact, a continuing issue confronting higher education in Ireland, particularly in terms of how its role in R&D and technology transfer will ensure the best use of what are currently short-term R&D funding programs.



Part 3:

Ireland's Future Economic Challenges

"Ireland's problems are now the problems of success," said Turlough O'Sullivan, Director General of the Irish Business and Employers Confederation, in an interview this summer. Professor Kevin Whelan of the University of Notre Dame Centre in Dublin posed the question uppermost in the minds of my interviewees: "Ireland cannot rest on its laurels. Will the economic growth of the last two decades continue in the next 20 years?" Ireland has a history of coping with economic distress as well as oppression. How can the country now "cope" with success – that is, usher in a period of moderate growth while, at the same time, implement its ambitious national development goals to become a world-class center for R&D excellence?

These are urgent considerations. Global economic demand during the boom 1990s provided Ireland the right environment in which to invest in becoming a high technology presence. Now, within the global economic downturn following the terrorist attacks in America on September 11, 2001, in America, the government is facing a growing budget crisis and a marked slowdown in growth, with some forecasts ranging from 3.5 to 5 percent growth in the GDP over the next several years. Ireland also faces increases in wages and the cost of living, which will begin to drive foreign manufacturing overseas; and, as Gavin O'Reilly, Chief Operating Officer of Independent News and Media, PLC in Ireland, noted, with the recent increase in domestic consumption there has been a corresponding explosion in the use of credit. Dr. Liam O'Reilly, Assistant Director General of the Central Bank of Ireland, questioned whether Ireland could maintain its competitive edge in the high technology area if skill shortages continued to bid up wages. In this regard, the social partnership, which was a major force in wage moderation, faces significant challenges.

All these issues combine to work against the desire among Irish nationals abroad to return to Ireland.

In fact, Ireland is experiencing shortages in skilled labor and an insufficient critical mass of scientists and researchers to fuel the investment that Ireland has been making in the R&D infrastructure for foreign investment and indigenous industry development. The return of the Irish diaspora can help only so far. In 2000, there were 78,000 job vacancies in Ireland, an increase of nearly 17 percent from the previous year. Attracting overseas workers, thus, has become an additional national priority, and the Irish government is holding job fairs in western and eastern European cities to attract more foreign workers.

A major issue that could exacerbate this problem is the declining interest among young people in science and math. As many of my interviewees told me, not enough students are studying these subjects at the secondary level, which in turn is affecting the number of students going into these subjects at the college level.

Currently, science, engineering and computing account for less than a quarter of all applicants for degree programs in Ireland's universities. The drop in interest is especially acute in computer studies. The number of students opting for computer science as their first preference for a degree declined by half from last year's showing. This is especially a challenge for Ireland's objective to integrate more women in industry. Less than 10 percent of engineers in Ireland are women, not surprising considering that only 17 percent of those studying engineering are women. With a sharp decline in the birth rate dating from 1980, demographics also is having its say about the supply of young people going into science and math.

In relation to these current economic issues, my interviewees cited the three major areas of both concern and opportunity for Ireland's future as a knowledge society: Ireland's dependence on foreign direct investment compared to indigenous-industry development, the impact of economic growth on the environment and the need to reevaluate the curricula and mission of its system of higher education.

The "51st State"

Many of my interviewees raised the large question of whether Ireland has become too dependent on foreign direct investment, particularly that from the United States. After all, foreign multinationals have been employing about half of Ireland's workforce.

There is every reason to worry about the future of foreign direct investment. According to Forfas, although exports by foreign firms in Ireland increased last year, foreign direct investment in Ireland dropped by 60 percent (from \$24 billion in 2000 to \$10 billion in 2001); and the downward trend has continued into 2002. Multinational firms are feeling the economic pinch that is driving up costs in national economies, causing the firms to seek lower-cost countries for their manufacturing operations.

The obvious answer to this situation is to push forward in developing Ireland's indigenous industry. But Ireland's industry and business R&D investment has slowed in recent years. Notwithstanding programs under Enterprise Ireland and Science Foundation Ireland that have strengthened technology transfer at the academic institutions and fostered university-industry ties, Ireland's indigenous firms still engage in comparatively little R&D and, as Frank Barry has observed, patent almost nothing internationally. Furthermore, as he writes, "[o]nly 26 per cent are in medium or high-tech sectors, compared to 76 per cent of Ireland's foreign-owned industry. Less than 30 per cent of indigenous output is exported, compared to over 90 per cent of foreign-sector output, and the UK remains by far the most important export market for indigenous firms."

Economic Growth and the Impact on the Environment

Ireland also must confront the impact of economic growth on the quality of urban and rural environments, a problem it shares with developed and developing nations the world over. Virtually all areas of the environment are feeling the impact. Fertilizers have been responsible for the rise of phosphorous and nitrates in Ireland's surface waters. The amount of household and industrial waste that Ireland is generating has increased by over 60 percent in the last five years. Road traffic is now considered to be the greatest threat to air quality in Dublin. In rural regions, Ireland's biodiversity - from the decline of peatlands to the disappearance of flora and fauna - is in peril.

Several strategies have been initiated, particularly under the Department for the Environment and Local Government, to support national and regional efforts toward attaining what is called "eco-efficiency," the process of decoupling economic growth from environmental degradation. Another strategy, the proposed Rural Environment Research Centre, a consortium that would involve

University College Dublin, Teagasc and NUI-Maynooth, would integrate environmental research, education and training and extension services around achieving sustainability. This is a major global emphasis; eco-efficiency was the theme of the September 2002 World Summit on Sustainable Development in Johannesburg, South Africa. As a “problem of success,” Ireland now faces serious threats to its natural habitats, especially its rural heritage.

Catching the Tail of the Tiger: Issues for Higher Education

Ann Fitzpatrick noted the good relationship that Sun Microsystems has established with the undergraduate programs in Ireland’s colleges and universities. But, as she pointed out, technical depth remains a problem among the workforce, and the third level sector is still somewhat insular in terms of its R&D relationships with industry.

Both the technical depth and sufficiency of the talent pool are challenges that all Ireland’s sectors must face, but it is specifically within the jurisdiction of the higher education sector. It is not only R&D that the universities must contribute to economic development; it also is greater access for traditional and nontraditional students to education and training and greater opportunities for career development for scientists and researchers.

If it is to address issues ranging from the country’s skilled labor shortages to filling the pipeline with future scientists and researchers, Ireland’s third level sector must become more open to enrolling nontraditional students. A 1995 report by the Steering Committee on the Future Development of Higher Education, under the aegis of the HEA, recommended the need for the third level sector to diversify the system to accommodate nontraditional populations, such as adult and part-time students as well as those socially or economically disadvantaged and, thus, traditionally left out of higher education. As Dr. Don Thornhill, Chairman of the HEA, told me, the days of Irish universities being composed of homogenous student bodies and carrying out education in traditional modes are gone. Ireland’s third level sector cannot insulate itself from change.

The implications of Ireland’s economic future for higher education were most recently galvanized in a study released in November 2001 by Professor Malcolm Skilbeck, *The University Challenged: A Review of International Trends and Issues with Particular Reference to Ireland*, which was cosponsored by the HEA and the Conference of Heads of Irish Universities (CHIU). Called a “wake-up call” for

Irish universities by many of the academic leaders I interviewed, Professor Skilbeck’s report captured the fundamental issue facing higher education in Ireland — that with Ireland’s rapid transformation toward a knowledge society, university reform and development are essential in terms of both the curriculum for all levels of students and the development of an entrepreneurial culture to ensure the transfer of new knowledge.

The 1990s have seen a dramatic transformation in academic program access and delivery thanks in great part to the impact of information technology. This transformation has been coupled with greater competition among institutions for the highest quality students. Now, as Professor Skilbeck observes, “[c]ompetition comes increasingly not only from other higher education institutions within the same jurisdiction but from beyond national borders through the internationalisation/globalisation of higher education”— as well as from a growing presence of such nontraditional educational organizations as “virtual” universities. Thus “[t]he ability to connect students with sources of knowledge and to enable them to acquire and use advanced knowledge through the new technologies is sometimes seen as a fundamental challenge to the substantial monopoly enjoyed for centuries by higher education institutions.” In other words, the “higher education cartel,” as he terms it, is beginning to fragment.

Up against these developments is the growing competition in research and development between universities and other industrial, public and private sectors. Universities have never monopolized research and development, as Professor Skilbeck writes, and will not assume dominance in R&D in the future. But their function as the site for basic research and, thus, technology transfer activities is compelling academic leaders all over the world to seek linkages with business, industry and other R&D organizations. Professor Donald Fitzmaurice remarked that in addition to education as the universities’ indirect contribution to the economy, their direct influence must be developed through commercializing their discoveries: “Universities,” he said, “have to become comfortable with owning knowledge.”

Within this global ferment of significant change in the delivery of education and the role of universities in economic development, Irish higher education finds itself having to catch an economic tiger by its tail while also facing competition in the international arena for a world-class research niche. Said Dr. Edmond S. Molloy, Director of Ireland’s Advanced Organisation and Management Development Ltd.: “It is time for Ireland’s universities to become international.”

Dr. Whelan pointed out another issue confronting higher education in Ireland. There is no strong tradition of philanthropy among Irish colleges and universities. In the United States, philanthropy has played a tremendously important role, dating to the founding of Harvard University, in the development of American institutions.

All these considerations have implications for Ireland's third level leaders, but as University College Dublin proceeds to find a new president following the retirement of President Cosgrove next year, they offer a particularly compelling agenda for the future recruitment of the next leader for Ireland's largest university.

The "Fourth Level"

The expansion of R&D in Irish higher education has created the problem of "brain" shortage, one that would not be solved even if all Irish scientists and researchers overseas were suddenly to return home tomorrow. Higher education observers realize that there will be an increased demand for employees trained at the graduate level and beyond, particularly in the fields of information communications technology, biotechnology, health care and the agri-food sector. A "fourth level" of enhanced postgraduate, doctorate and postdoctorate opportunities must be developed within the third level university sector.

Even as the country is drawing more Irish nationals from abroad, the relative lack of postgraduate educational and research opportunities in Ireland, especially when compared with the U.S. and the U.K., are still driving some of them away, particularly those from the medical professions: "Today, the Emerald Isle is sending Boston some of its best and brightest – doctors who traveled to get state-of-the-art training, then stayed because they couldn't find jobs back home," writes Larry Tye in the *Boston Globe*. These "medical emigres" are increasing ". . . at the very moment when Ireland's 'Celtic Tiger' economy is enticing back engineers, computer analysts and other professionals from across the Irish diaspora. Now, Ireland's small-town hospitals are so short of interns and residents that they are importing them from places like Pakistan." Ireland's medical schools have graduated some of the best physicians and health specialists in the world who are delivering top-quality health care and health research everywhere but in Ireland. According to the Irish Medical Association, more than 60 percent of the interns and residents at its hospitals were Irish nationals in 1990 but only 39 percent

are Irish nationals today. The lack of a career structure for researchers in Ireland also exacerbates the problem of the declining interest among young people in science, engineering, computer and mathematical fields.

The trend of "brain drain," of course, affects most of Europe, and it is compounded by academic traditions that favor senior faculty members over junior members. Many European nations have undertaken steps to retain their young researchers through creating new positions aimed at junior professors as well as luring their own scientists back to the fold. They also are going after overseas experts. Science Foundation Ireland, among other organizations, has adopted this as one of its objectives in awarding grants. Bill Harris of SFI called this "Sputnik" time in Ireland in its need for more graduate-level programs. Where Ireland is now is where the United States was in the 1950s when the former Soviet Union launched the first spacecraft and the U.S. had to reevaluate its priorities for research and postgraduate training if it was not to fall behind the U.S.S.R. in the space race.

The Embark Initiative under the Irish Research Council for Science, Engineering and Technology will assist Irish higher education leaders in expanding this "fourth level sector." The council will oversee an investment of approximately €95 million for students completing their postgraduate and postdoctoral work throughout the period of the National Development Plan. PRTLTI funds for such positions also will help address this need.

There is a growing need as well for scientists to become well versed in business management, including planning, financial management and human resource development, comparable to the skills needed by business leaders in the private sector. Dr. Breffni Tomlin, Operations Director of the National Institute of Technology Management at University College Dublin, and Dr. Eamonn Walsh, Dean of the Smurfit College of Business at UCD, noted that doctoral education needs to include courses on the management of research and technology and on the fundamentals of entrepreneurship. Programs at UCD have been established that are geared to this new educational dimension for Ireland's budding scientist-entrepreneurs, including an M.B.A. program at Smurfit designed for scientists.

Women in Academe

An additional problem facing Ireland and other European countries related to the size of the talent pool is the continuing low participation rates of women in academe. As reported in the *Chronicle of Higher Education*, a study published in November 2001 by the Helsinki Group, a research organization within the European Union, called the under-representation of women in European faculties “massive,” particularly those in the fields of life sciences and engineering. The average share of full professorships held by women in the EU is only 11 percent overall, with lower rates of participation in the engineering and scientific disciplines. Most tellingly for Ireland, only five percent of women hold full professorships in its universities, the lowest average among the EU countries. In the United States, slightly less than a quarter of full professorships are held by women.

Interestingly, another small EU nation, Portugal, showed the highest rates of female participation in the life sciences, engineering and technology, with 48 percent in the life sciences and 29 percent in engineering and technology as well as 46 percent holding medical posts. According to the report, Portugal’s spending on science and technology has been increasing since the mid-1990s with a corresponding increase in the number of Ph.D.s awarded in these fields, which has translated into higher levels of participation among women.



Part 4:

Establishing A Global Niche: Health Care, Agricultural and Environmental Research

Discussions related to future directions for Ireland’s R&D objectives should include advancing health research, health care delivery and agricultural and rural development. These areas offer a tremendous opportunity for Ireland to establish itself as a world leader in the knowledge economy as a formula for sustaining the country’s success throughout the remainder of the decade. They not only suggest niches in which Ireland can attain international prominence but also opportunities for the nation to address its developmental challenges in terms of the supply of highly skilled workers and researchers as well as opportunities to apply research innovations in information communications technology and biotechnology to critical areas of social concern. My observations are founded on the ideas and issues that arose in the course of my interviews for this report.

Overview

What strikes me, as well as a number of the individuals with whom I talked for this report, is the danger of a fragmentation of R&D effort and money dispersed among a number of institutions and organizations as well as a lack of overall cohesion and critical mass. The question is important for a host of reasons, most especially the future availability of public funds to sustain Ireland’s development goals. In a speech last April, Bill Harris pointed out that “[w]e presently have at least a dozen State agencies investing

in education, science, and technology through four departments. We also have seven national universities pursuing general curricula as well as research in numerous, frequently overlapping areas. And we have 14 Institutes of Technology that seem to want to do the same thing.”

In considering the question of R&D resources, it is useful to recall the vision of the PRTL program: “Traditionally Ireland has taken a view that spending on research was not a policy priority. This stemmed from a perception that as a small country with a relatively low national income we could not afford the investment necessary to make major advances in basic research and that in any event our small size meant that it was unlikely that research in Ireland could make a ‘significant difference.’ It seemed to be more sensible to take on board technological advances made in other countries. The thinking was that it was a luxury which could wait for better times. This line of thought is no longer valid. We will not be able to sustain our hard won potential to join the leading wave of advanced economies without developing our research capacity.”

But, with respect to Ireland’s size, is that line of thought really invalid, at least in part? The question is not whether the talent and strategic thinking exist in Ireland to pursue a world class research agenda or to commercialize its own ideas. Obviously, they do. The question, rather, is whether Ireland is getting the best bang for its buck – that is, whether, as I heard from a number of individuals, Ireland is leveraging its R&D investment for its most urgent social, as well as industrial, needs.

Moreover, UCD’s Eamonn Walsh expressed the skepticism of several interviewees when he asked the larger question of whether Ireland could really expect to compete on the global level in the life sciences. It is a good question. Notwithstanding the country’s recent infusion of R&D funds to the third level sector, the percent of Ireland’s GDP going to research is among the lowest of the EU countries. In terms of R&D expenditures in the public sector, Ireland ranks close to the bottom of the OECD (Organisation for Economic and Co-operative Development) countries. Ireland also is the only OECD country without a system of R&D tax credits. Brendan Butler, Director of ICT Ireland, a trade group representing the technology industry, has called on the government to introduce tax credits for firms that undertake R&D in an effort to arrest the nation’s “decline in competitiveness.”

Against other developed nations, Ireland is, of course, facing some terrific odds in the competitive life sciences arena. The United States leads the world in biotechnology and life sciences industrial development; the U.K. and Germany lead Europe. The U.S. expends a considerable amount on R&D in these disciplines. Last year’s federal R&D budget exceeded \$103 billion, with more than \$24 billion allocated for life sciences research. More than \$22 billion of that allocation comes from the National Institutes of Health, which funds nearly 70 percent of research at American universities. Another \$5 billion comes from the National Science Foundation for research and training programs.

At VCU, our annual research budget is nearly \$170 million, about two-thirds of which is dedicated to life sciences research. That is about a third of the funds currently allocated to support the mission of Science Foundation Ireland and about ten times the size of the Irish Health Research Board’s annual research budget.

This is not to suggest that Ireland cannot participate in the big leagues in advancing information technology and life sciences research. Rather, it is to point out that in very practical terms, regardless of the availability of public funds to sustain its national R&D goals, it will have difficulty competing in a general way with the likes of the U.S. and other developed nations. This same issue of prioritizing R&D expenditures to achieve greater competitive advantage faces a number of other smaller nations in Europe as well, and the question is the same: What are the particular advantages of small countries that can be exploited to further the knowledge and development of new information and life sciences technologies?

Given these circumstances, it would be worthwhile for academic, government, business and public-sector leaders to reassess the priorities it has so far established for R&D under the National Development Plan and in other arenas, with a view to consolidating and prioritizing Ireland’s R&D expenditures on high-potential niches within the ICT and life sciences arenas. The mechanism for that reassessment now exists. As an important step toward evaluating how Ireland is spending R&D funds, the Irish Council for Science, Technology and Innovation recently announced the formation of a commission to recommend to the government an over-arching framework to coordinate national research and innovation efforts. The NDP’s aim to facilitate greater joint efforts and collaborations, captured in the missions of PRTL, SFI and Enterprise Ireland, already provides an important conceptual basis on which to undertake this reassessment.

Imbalance in R&D Funding: Health Research and Research for Agriculture and Environmental Sustainability

What must be recognized is that Ireland continues to devote a disproportionate level of R&D expenditures on information communications technology and biotechnology, compared to health and agricultural research. It is in the latter areas, however, where Ireland potentially has the best chance of achieving international stature within the broad fields of information technology and the life sciences. To understand the context of why Ireland should consider prioritizing R&D funds in these areas, it is important to understand the condition of these two sectors within the overall context of Ireland's infrastructure development goals.

Ireland's Health Care Needs

Ireland's health system has a budget of approximately €8.5 billion a year and is managed by ten regional health boards, which oversee local hospitals and clinics. More than 87,000 people work in the health services.

Ireland's system of health care has come under fire in the last few years. Several of my interviewees pointed to structural problems in the health services that have produced an ineffective allocation of resources. The result is a growing public dissatisfaction with the quality and responsiveness of the health services, particularly in delivering specialized services in areas such as mental health, aging and breast cancer treatment. A report published last year by Deloitte & Touche identified the significant demand on the system as a main source of trouble: "No assessment of the Irish health system can overlook the serious capacity limitations in bed numbers and medical manpower, which limit the attainment of value for money from a patient perspective and which lie behind the pressure points in the system."

In addition to problems in the health care delivery system, Ireland has faced significant problems in the country's capacity to address deficiencies in the diagnosis and treatment of its leading causes of death. Cardiovascular disease accounts for 65 percent of deaths every year and cancer for 23.5 percent (up from 11 percent in 1950). In recent years, the Department of Health and Children has launched different strategies to address the condition of health care for its citizens, including a plan to address the high incidence of cardiovascular disease. A new strategic plan, called *Quality and Fairness – A Health System for You*, an €8-billion, ten-year effort, and a separate plan focusing on research for health, called *Making*

Knowledge Work for Health – A Strategy for Health Research, also have recently been released.

Yet, funds that would support health care delivery and treatment advancements within these strategies are now being delayed or cut, an indication of the impact of the global economic slowdown on Irish public revenues. In particular, the health services' plan to implement a new patient technology system, amounting to €254 million, may not materialize. This plan would provide a single confidential patient identifier – a "smart card" — to every person in the country, which would greatly support enhancements in the quality and scope of health care services. Budget woes also are requiring significant cuts in health services jobs. All these factors are contributing to a growing concern among numerous Irish leaders regarding not only the current structure of the health system but the availability of money to invest in research for health.

Research for health is an area of tremendous potential for enhancing Ireland's R&D goals and one in which Ireland's small size can work to its advantage. Professor Hugh Brady of DMMC (who is the new chairman of the Health Research Board) put it succinctly when he noted that Ireland has the right (small) size, encompasses a genetically homogenous population and suffers from the right diseases. But, Dr. Ruth Barrington, chief executive officer of HRB, Provost Hegarty of Trinity College Dublin, Dr. Frank McCabe, former vice president of Intel in Ireland and a member of the boards of IDA-Ireland and SFI, among other interviewees, all pointed out that there is no organized approach to research for health and very few linkages among the universities, the health services and the health care industry that could facilitate greater activity in clinical investigations and related technology transfer.

Through the national health strategy, the government has planned to spend approximately €150 million on research in the health services, which will include establishing research officers within the health boards. It also has plans to allocate another €90 million to the Health Research Board, based on the recommendations of *Making Knowledge Work for Health*. This year, the HRB is providing €15 million in grants for health research. But are these funds enough? The money devoted to various strategies for health research would still pale by comparison to research funding going toward other disciplines. Expenditures through SFI and PRTL currently exceed \$1 billion out of the NDP's six-year, €2.5-billion R&D spending plan. Granted, some of the SFI and PRTL projects address basic and applied research that would lead to advances in health care. But, among European nations, Ireland ranks last in terms of its health research expenditure.

In September, the Health Research Board called for new arrangements to better coordinate health research policy, including establishing a National Research and Innovation Committee. In addition to better coordination and funding of health research, the HRB is calling for clarification in the missions of various research bodies to include strengthening the infrastructure for research in the health system; focusing on measures to encourage and facilitate the protection of intellectual property and technology transfer to the bioindustry and health care sectors; and addressing the chronic underfunding of health research. The HRB's recommendations should be put at the top of the agenda of any future effort to reassess how the nation is spending R&D funds.

The Future of Rural Development

In an August 2001 national survey of Ireland's citizens, conducted under the auspices of the Agricultural Awareness Trust, virtually all respondents rated agriculture as important to Ireland, and three-quarters rated agriculture as vital to the economy, especially for the continued vitality of rural areas. Demographics and the departure of Ireland's rural young people for the cities, however, are complicating the nation's efforts to achieve regional balance in economic development and, thus, capitalize on the vital importance of agriculture to Ireland's economic and national development.

Only 27 percent of the national population lives in the Border, Midland and Western (BMW) Region, the least urbanized and most disadvantaged of Ireland's rural communities, while the remainder resides in the Southern and Eastern (S&E) Region. About a third of the population lives in the Dublin area. Moreover, as Jim Maloney, Chairman of IAWS Group PLC, told me, too many young people are being lured away from Ireland's farms by better job opportunities in Dublin and the other cities. As reported in the *Irish Times*, the Western Development Commission found that last year only 6.6 per cent of all new graduates found work in Sligo, Leitrim and Donegal while 38 percent of graduates from the western region found their first job in Dublin.

These are among the major factors that have been contributing to a steady decline in agri-food production in Ireland. Professor Maurice Boland from UCD's College of Agriculture pointed out the fact that in the 1960s the agri-food industry, as measured by the number of farmers, was three times the size it is now. In 2001, primary agriculture accounted for a little more than 3 percent of GDP and agri-food production less than 10 percent.

This decline means that more than a third of Ireland's farmers now have to supplement their incomes with off-farm employment. Galway, Mayo and Roscommon have the highest level of off-farm employment, where nearly half of these counties' farmers combine farming with another job, compared to about 80 percent of farmers in southeast Ireland who can make their living exclusively from farming. Overall, employment in agriculture in Ireland as a percentage of total employment declined from 23 percent in 1975 to 10 percent in 1997 and is projected to fall to four percent in 2010.

The recent *Foresight of Rural Ireland* report has identified several other trends for the agri-food sector for the remainder of the decade. There will likely be a little more than 10,000 full-time commercial farmers by 2010 and 25,000-35,000 farmers deriving a portion of their income from cattle and sheep production and farm-forestry enterprises. Most of the commercial farming and associated food processing sectors will be concentrated in East Munster and South Leinster, putting increased environmental pressures on these regions. The decline of farming in other regions will adversely affect the environment of the upland and wetland areas and, thus, the possibility of enhancing tourism.

Macro-economic forces will continue to have an impact on the ability of Ireland's agri-food industry to sustain, if not increase, its role in the economy. As part of the European Union, Ireland is subject to the impact of the EU's enlargement process, which will mean much greater competition for Irish agri-food exports as will the prospect of more liberal world trade in agriculture during this decade. These forces will combine with the economic impact of reduced price supports for EU members through the CAP as well as the greater expense associated with building environmental sustainability into farming practice. This is, in other words, another situation crying out for a reevaluation of how Ireland is allocating R&D expenditures.

The National Development Plan's funding of approximately €5.5 billion for rural development, including agriculture, is directed toward the revitalization of the rural economy. The government's *National Spatial Strategy: Indications for the Way Ahead*, developed under the aegis of the Department for the Environment and Local Government, as well as programs targeting the development of alternative enterprises in rural areas under Enterprise Ireland, also are designed to address rural economic imbalance as well as the role of rural areas in tourism. The Ireland we commonly think of, with its thatched houses and unspoiled scenery, is a significant draw for tourism and is part of various strategies designed to

address the enhancement of rural Ireland in the nation's overall economy. And, most recently, IDA-Ireland has identified regional balance as a major objective in its future plans toward attracting and developing foreign direct investment in Ireland.

The key to Ireland's development objectives, of course, is maintaining the continuing importance of Dublin in the country's economic future while also promoting greater economic activity in rural areas and, thus, more reason for Ireland's rural families and college graduates to remain in their home regions. The other key is the extent to which Irish leaders reassess how limited R&D funds are currently being spent, with a view toward reallocating more funds to Ireland's most urgent rural development and environmental sustainability requirements.

Recently, the Department of Agriculture, Food and Rural Development announced funding of €122 million for research and advanced training for farmers in the context of the impact of the EU's CAP reform. Currently, some PRTLTI funds are supporting projects in food science, environmental biotechnology, ecotoxicology, environmental management and sustainable energy. In addition to NDP funding for biotechnology, a significant share of which the Agri Food 2010 Committee of the Department of Agriculture, Food and Rural Development recommended be dedicated to funding the agri-food sector, a €39-million Technology Capability Fund has been allocated to Teagasc for food-related biotechnology research. As the government's national advisory authority on agriculture, food and rural development, Teagasc is a major site for agri-food R&D, with about €33 million currently devoted to agri-food research. The agriculture faculty at University College Dublin, the only agriculture faculty in Ireland, receive approximately €8.7 million in research contracts annually.

Even with this funding, as Professor Liam Downey, former head of Teagasc, stated in a lecture at University College Dublin: "Science Foundation Ireland is investing substantial funds in upgrading Ireland's biotechnology and information technology infrastructure . . . This investment strategy, which aims to embed and attract multinational companies, does not address the needs of Ireland's agriculture and food industries." In addition to a greater dedication of biotechnology research to crops, livestock and food products, Professor Downey has called for the need to address Ireland's very weak research activity in animal breeding and diseases. He also has pointed out the relative dearth of information technology applications to farming. Just recently, however, Science Foundation

Ireland announced the funding of animal research projects at University College Dublin and a food science project at Teagasc.

In terms of the nation's overall investment in R&D at the third level, Ireland's rural universities and technology institutes are losing out. In an interview in the *Irish Times*, Dr. Richard Thorn, Director of the Institute of Technology in Sligo, noted that counties in the Sligo region received €1.38 million from the total R&D budget of higher education of more than €631 million during the period 1999-2001. Two-thirds of all university R&D funding is spent in the Dublin region.

Apart from the obvious benefits of more R&D funds, why should Ireland focus its resources on enhancing its R&D infrastructure for agriculture, allied to the economic and environmental sustainability of rural Ireland? As Professor Downey explains: "We must have the capacity to fully understand and appreciate what is going on abroad and cherry-pick international breakthroughs of direct relevance to Ireland. Otherwise, we will be 'importing biotechnology in the dark.'" This is the same observation that economic experts have made about the capacity of the country to absorb new technologies generally. As Kenneth Arrow wrote in Alan Gray's *International Perspectives on the Irish Economy*, "[k]nowledge developed elsewhere is not made useful to Ireland automatically; it takes effort and understanding Among other factors is the presence of scientists and technologists who are up-to-date with new developments elsewhere. It is hard to have this domestic capacity to absorb foreign knowledge without a domestic ability to perform research and development at high levels."



Part 5:

Models for Creating Critical R&D Mass for Health and the Agri-Food Industry

To support new directions for health and agri-food research, there may now be an opportunity for Ireland to enhance the value of its R&D efforts by creating an institutional “critical mass” of research activity. The aim would be to consolidate some of Ireland’s R&D activity toward higher priority areas in the health and agri-food sectors and enhance linkages between that activity and the R&D needs of both foreign and indigenous industries.

In offering models for how to achieve that objective, I draw from my experiences in academic-community leadership in working to create opportunities for development through the mission of higher education. At Virginia Commonwealth University, we have undertaken more than a decade of strategic planning in a number of areas supporting our own potential to apply public policy, life sciences, bioengineering and clinical innovations to the enhancement of our region and the state. I also have been fortunate to participate with my colleagues in Virginia on various governors’ commissions regarding the future of high technology and life sciences development as well as joining with national leaders in organizations devoted to urban revitalization.

When we think of critical mass, we usually think of individual scientists and researchers coming together in areas of mutual interest. Critical mass also can be created by bringing together institutional missions from the academic, governmental, nonprofit and industrial sectors in areas of vital national importance. Certain initiatives,

like the new Wyeth campus, are partly designed to bring together such activity on the institutional level. The mission of Enterprise Ireland is devoted to the idea of creating linkages among different sectors for mutual ends and, thus, in its way embodies this institutional concept of critical mass. The *Foresight of Rural Ireland* proposal for a Rural Environment Research Centre, a model center of excellence for research on the environment calls for an integration of different public sectors toward advancements in this area and, thus, exemplifies the idea of creating a critical mass of inter-institutional collaboration.

Ireland now has a real opportunity, again owing to its relatively small size, to consolidate its R&D infrastructure into a total national center of excellence. Ultimately, creating a broader foundation for critical mass might make Ireland more attractive not only to foreign manufacturing operations but also foreign R&D operations. As Frank Barry told me, multinationals are starting to become “transnationals,” that is, looking to locate R&D operations near manufacturing plants rather than maintaining these in proximity to headquarters. A major objective of IDA-Ireland is to foster the development of R&D from foreign companies through incentives and other strategies, and developing a critical mass of foreign-owned and indigenous companies working together to foster R&D.

Partnerships with Foreign Institutions and Nations

Instead of dispersing funds over a range of similar projects at a number of institutions and agencies, Ireland could enhance its knowledge base by establishing partnerships and consortia with foreign academic research institutions in the same way that it has so successfully attracted foreign direct investment. This R&D resource would come from overseas universities and centers of excellence as well as the R&D operations of multinational firms.

One existing collaboration along these lines is the Ireland-Northern Ireland-National Cancer Institute Consortium, established in 1999 by the Irish, Northern Irish and U.S. governments. The island of Ireland has one of the highest incidences of cancer and cancer mortality rates in the Western world. The three governments’ health agencies – the Department of Health and Children in Ireland, the Department of Health, Social Services and Public Safety in Northern Ireland and the National Cancer Institute in the U.S. – are working to further cancer research and

cancer clinical investigations, facilitate interaction among the three countries' research communities, share resources and technology and develop joint and exchange programs ultimately aimed at improving cancer care.

Another important initiative providing a model of institutional critical mass is the FAPRI-Ireland partnership in economics involving the University of Missouri and all of the major research institutions on the entire island of Ireland. Through this partnership, an economic projection model for the Irish agri-food industry has been developed. Related to this project, Ireland also is leading a major EU project aimed at developing an econometric model for European agriculture.

In the last few years, the Massachusetts Institute of Technology has established Media Lab Europe in Dublin, an extension of MIT's Media Lab, which promotes research and education for the digital age. Media Lab Europe supports researchers at Ireland's universities toward the development of new technologies and includes funding for establishing post-graduate and post-doctoral research positions. Through the Department of Communications, Marine and Natural Resources, €130 million in public funds has been committed to Media Lab Europe and the affiliated Digital Hub.

An example involving Virginia Commonwealth University and Ireland is research into the role of genetics in alcoholism and schizophrenia. Dr. Kenneth Kendler, VCU Professor of Genetics and Psychiatry and co-director of the Virginia Institute for Psychiatric and Behavioral Genetics, has been working with Irish researchers in this important investigation. An international team of researchers, led by Dr. Kendler, has identified a gene that appears to be strongly associated with schizophrenia and related mental disorders. The team includes psychiatrists and geneticists from VCU, Queens University in Belfast, and the Health Research Board.

For a model of how an entire nation is developing institutional linkages abroad, the government of Qatar offers an interesting study. Qatar has made the educational and career development of its citizens a national priority, much like Ireland's national development plan, and has set up a foundation to fund and implement it. The primary strategy of the Qatar plan is to devote funding to importing excellence in disciplines from other nations that the country lacks, rather than trying to create that excellence from scratch.

As one example, the Qatar Foundation chose VCU's School of the Arts to establish a design arts college in the capital city of Doha. The college is a formal campus of VCU with authority to grant bachelor's degrees in graphic arts, fashion design and interior design. The VCU-Qatar College of Design Arts is especially beneficial to enhancing the educational and career opportunities for Qatar women; it also fulfills VCU's objective to internationalize its campuses and students. The Qatar Foundation is developing agreements with other American universities to promote the education and training of Qatar citizens in medicine and science with institutions like Cornell University.

Would the Irish government benefit from further expanding its efforts to develop collaborations with other institutions, industries and nations? This approach could provide a vehicle for reassessing and reallocating funds toward more urgent R&D requirements for direct support, while releasing funds to attract existing expertise from other countries via memoranda of understanding and other like agreements.

The Research Park Model

In my discussions this summer with Pat Frain and other academic entrepreneurs, I became aware of efforts undertaken about ten years ago to develop a science park in the Dublin region, involving a number of organizations and the major universities and institutes. This idea deserves renewed attention.

To further facilitate the transfer of new discoveries and applications from the universities and as a complement to future linkages with foreign R&D operations in corporations, universities and other centers of excellence, Ireland needs to develop a critical mass of commercialization activity. One of the most efficient and effective ways to achieve that objective is a research park. A research park would be especially beneficial for consolidating life sciences activities, as well as agri-food research and related rural development initiatives such as Teagasc's agricultural and food resource campus. It also could consolidate what one interviewee called "dueling entrepreneurial efforts" among such entities as Citywest, DCU's Ryan Academy and the Irish Entrepreneurial Development Centre, not to mention the numerous independent incubation activities under the auspices of Enterprise Ireland and the universities themselves.

In fact, it may be feasible to consider locating Enterprise Ireland within a new research park as a major anchor tenant, given that perhaps the most important benefit of research parks is the extent

to which they promote the development of indigenous industry. In the United States, high-tech industries cluster around research centers and parks and their partner research universities. Silicon Valley, the Boston/Cambridge region, Research Triangle Park in North Carolina and the growing mid-Atlantic biotech corridor encompassing Virginia, Maryland and Washington, D.C. are just a few examples of the kind of clustering activity occurring across the United States. The American Association of University-Related Research Parks now boasts nearly 300 members.

The Virginia Biotechnology Research Park next to VCU's health sciences campus is serving as a catalyst for life sciences development throughout the state of Virginia. Space for start-up and mature companies; major state laboratories, including the Virginia Department of Forensic Science, the Office of the Chief Medical Examiner, Virginia's Consolidated Laboratories and the Virginia Department of Agriculture and Consumer Services; and faculty-founded research institutes in such areas as drug discovery and behavioral and psychiatric genetics are located at the Research Park. At full development, it will be spread over 34 acres in a formerly abandoned area of downtown Richmond, be worth more than \$500 million in capital development and employ 3,000 highly skilled technical and research personnel.

In fact, a worthwhile proposal for a Cork science park already exists and contains many of the key elements that would go into a reassessment of such an initiative. As currently proposed, this project would be established through a collaboration between IDA-Ireland, University College Cork, the Cork Institute of Technology, the Cork Chamber of Commerce and local government. Adapted to the Dublin region, it could also include Enterprise Ireland and agencies within other Irish ministries devoted to R&D in such areas as agriculture, the environment, industry development and rural development. Existing PRTL-funded collaborations, such as DMMC, could be consolidated and relocated to a Dublin research park, particularly to further encourage the sharing of equipment, laboratory facilities and other resources.

Another major advantage of a research park is the extent to which it could facilitate the application of Ireland's considerable information technology base to health and agri-food research. A key need to underpinning investigations in health research, for example, is the application of information technology to health care, but again funds for a patient identifier system may be in jeopardy. The existing PRTL-funded joint research program in health informatics between the Dublin Institute of Technology and Trinity College Dublin, called the MediLink Programme, is

designed to apply information technology to support health care delivery innovations. This initiative offers a foundation on which to further develop Ireland's potential to make significant advances in the application of information technology to health, not to mention a prospective tenant.

Enterprise Ireland's ITS 2007 plan, geared to developing indigenous firms in informatics, digital media and e-Business, is another effort that could be incorporated into this direction for R&D development. It includes strategies for health start-ups in such areas as therapeutics development, toxicology testing and bioinformatics. Through this plan, EI envisions providing an environment that would attract regulatory authorities to Ireland, such as the new EU Food and Drugs Authority or the European office of the U.S. Food and Drug Administration. This plan also would establish an indigenous international capability in protein drug manufacture, which according to EI could be outsourced to large pharmaceutical firms, thus exploiting the opportunity to accelerate linkages between academic and industrial R&D activities.

ITS 2007 also focuses on enhancing information technology applications to agriculture and rural development along with organizations such as the Irish Society for Information Technology in Agriculture and Teagasc. The Department of Agriculture, Food and Rural Development also has proposed and implemented several applications that would provide hardware and software support in such areas as financial reporting, animal health, tagging and registration of animals and the development of databases as well as expand e-Government for farmers. Distance technologies would certainly benefit farmers and rural communities in accessing the expertise and resources located in urban centers; such access also would provide an incentive for indigenous and foreign firms offering services and products for the agri-food industry to consider locating their operations in rural communities. Bringing these initiatives into the research park environment would promote that all important "cross-pollination" of ideas and activities.

Ireland as a Leading Site for Genetics Investigations: the Framingham Model

The opportunity for Ireland to focus on research into the genetics of disease is tremendous, again owing to the small size of its country and its homogenous population. Indeed, one could argue that Ireland is among the best locations in the world to undertake a large-scale investigation into the genetic basis for cardiovascular disease, cancer and other genetically based disorders that dispro-

portionately afflict the Irish. Some collaborations are underway toward this end, particularly under the aegis of the Royal College of Surgeons, Trinity College Dublin's Smurfit Institute for genetics and UCD's Conway Institute. Considering the objective of Ireland's national health strategy to address these major causes of death, a consolidation of these and other investigations in genetics is an idea whose time has come.

This consolidation requires a conceptual framework within which to develop a much broader genetics effort under one health research objective with one funding stream. In 1998, the Framingham Heart Study, sponsored by the National Heart, Lung, and Blood Institute of the National Institutes of Health, celebrated its 50th anniversary of studying cardiovascular disease among residents of Framingham, a small community in Massachusetts. The Framingham study is the single most important epidemiological study ever conducted in the history of medicine and offers an ideal model for developing Ireland's potential to become a world-class leader in genetics research and applications. The phrase "risk factor," in fact, comes from the Framingham heart study as over the years researchers began to realize that heart disease was not inevitable — that lifestyle, high cholesterol, cigarette smoking and other controllable factors could affect its incidence.

It was at the beginning of the 1980s that Framingham researchers began to focus on the role of genetics in cardiovascular disease. By studying offspring of the original participants, researchers could begin to get a picture of how some people might be predisposed to the risk factors that cause cardiovascular disease or to the disease itself. The study has amassed a DNA library of blood samples from more than 5,000 participants.

Framingham has offered what Ireland can: a small, cohesive population. More than 10,000 Framingham citizens representing three generations have participated in the study, which continues to this day. More recently, minority members of the community have been recruited for a separate "Omni Study," and a focus on women and heart disease also has become a part of the study.

Today, "Framingham" is automatically associated with advances in cardiovascular disease. In what way could "Ireland" become automatically associated with medical advances in genetics through the deployment of clinical studies, outcomes research, medical informatics, bioinformatics and epidemiological approaches to generating new knowledge and advancing health delivery?

CEOs for Rural Regions

Like the consolidation of research funds and activities toward health research, there is an opportunity for a similar consolidation to address the country's underfunded activities in agriculture, sustainability and rural development.

As I noted in the introduction to this report, Virginia Commonwealth University was one of two national case studies, along with Columbia University, of the impact of universities on urban revitalization in a joint study undertaken by CEOs for Cities and the Initiative for a Competitive Inner City (ICIC). CEOs for Cities is a national, bipartisan alliance of mayors, corporate executives, university presidents and other nonprofit leaders, who have come together to develop strategies using the strengths of all these sectors to revitalize the nation's major urban cores. Its mission is to help cities achieve and sustain their economic potential and to influence policies to reflect and build upon the fact that cities are fueling the national economy. The CEOs organization works to develop and commission new research and to study best practices in urban economic competitiveness. It also works with ICIC, a national, nonpartisan organization geared to research about the potential for business development in inner cities.

What about a CEOs for Rural Regions for Ireland? If cities are the engines for economic growth in the United States, can rural regions become more important engines for economic growth in Ireland's future? National sentiment among the Irish, who hold their agricultural and rural heritage dear, certainly would indicate public support for creating a broader, more cohesive approach to all the issues facing rural Ireland.

Like Ireland's National Development Plan, CEOs for Cities puts a premium on the central role that universities play in economic development. As we have seen, however, the NDP disproportionately favors R&D development among Ireland's urban universities. "Unleashing the local economic development capacity of [urban] institutions should be a national priority," for urban revitalization in the United States, according to the CEOs/ICIC report; unleashing the local development capacity of Ireland's rural third level sector in conjunction with Teagasc should likewise assume prominence in future discussions about rural revitalization. Collaboration, of course, is the key: "In instances where universities, local governments, and communities have developed an integrated approach to economic development, the results have generated substantial impact," which is the major finding of the CEOs/ICIC study.

The threads of agricultural competitiveness, sustainability and rural development are interwoven. The independent efforts among the academic, government, business and nonprofit sectors in Ireland could become interdependent within the CEOs model with the shared aim to enhance farming methods, incorporate new environmental processes into agriculture and seek alternative businesses and industries for rural regions. As important, such an organization would be in a position to lobby for greater R&D support as well as greater educational investment in rural communities.

Public Education in the Life Sciences

I would like to conclude this discussion with some ideas that leaders in Ireland may want to consider for increasing young people's interest in going into science and math and fostering greater public awareness of both the discoveries and implications of the life sciences. We have found the following initiatives to be successful for us.

Life Sciences for all Ages

The Irish Department of Education and Science along with other organizations, such as SFI and the Institution of Engineers of Ireland, are focusing on attracting greater numbers of young people to science and math. To complement such efforts as well as to raise public awareness of the discoveries and implications of life sciences discoveries, Irish universities should join in by applying their considerable scientific, public policy, sociology and humanities expertise toward developing new outreach educational efforts. In this way, Ireland's universities could better integrate themselves into the communities that support them.

A model for this idea is VCU Life Sciences, whose objectives include enhancing public education for people of all ages. Programs through VCU's Rice Center for Environmental Life Sciences, the Governor's School of Life Sciences (for high school students), Maymont Park (a local nature center) and the Science Museum of Virginia, which is located in Richmond, are all geared to engaging schoolchildren, school teachers, educational administrators, professionals working in the field and the general public in the discoveries coming from academia.

The Governor's School for Life Sciences is especially important in attracting young people to science. VCU Life Sciences and the VCU School of Medicine sponsor approximately 30 high school students from across Virginia for a summer of working alongside VCU life science researchers through the Governor's school and,

in this way, provide young people first-hand exposure to not only university-level science but also the excitement of being a scientist.

International Public Education: An Invitation to Ireland

One of the most important reasons to pursue an aggressive agri-food research agenda, according to Professor Liam Downey, is to enhance public education and understanding of biotechnology innovations: "To provide society with scientifically-based confidence in biotechnology, Ireland must have trustworthy, credible and impartial research information in relation to the environment and food safety risks that may be associated with developments in biotechnology. If this is not done, and done rapidly, the fate that befell food irradiation may be repeated with biotechnology."

The same can be said for new life sciences and biotechnology innovations in medicine, particularly in such areas as human cloning or fetal stem cell research. According to a VCU Life Sciences Survey recently conducted in collaboration with the VCU Center for Public Policy, Americans value the contributions of science to society but remain wary of cloning and other new life sciences technologies. Economic development through biotechnology – in health and agriculture – depend on continued R&D activities by public institutions in these areas, which in turn depend on public acceptance.

Recently, The Irish Council for Science, Technology and Innovation issued a report on biotechnology and public education designed to promote and achieve a dialogue between experts and the public, particularly in addressing public concerns about modern biotechnology. The report recommended the establishment of an independent bioethics committee to help address public concerns about the impact of biotechnology on health practices.

Extending awareness of life sciences issues to as much of the general public as possible may require an additional step. VCU has recently undertaken an initiative, called *Secrets of the Sequence*, with an international scope, inspired by the planning that led to the establishment of VCU Life Sciences' local public education initiatives. *Secrets of the Sequence* is a weekly public television program being produced by Ward Television in Washington, D.C. The program's purpose is to inform the public about the latest discoveries occurring in the life sciences as well as offer a forum for public debate about their implications, with a view to enhancing the participation of the public in policy-making in the life sciences.

Six institutions have come together as the advisory group to *Secrets of the Sequence*: Harvard University, the University of California-San Francisco, the University of Michigan, the University of Wisconsin-Madison, Virginia Commonwealth University and the Medical Research Council/Laboratory of Molecular Biology in Cambridge, England. The program now reaches 80 percent of the public television viewership in the United States as well as public television audiences in other countries. Topics range across the spectrum – from the concerns surrounding genetically modified crops to the genetics of aggression.

As part of its public education mission, VCU also is working in partnership with the National Academy of Sciences and the National Association of Biology Teachers, among other organizations, to develop educational materials around the program’s segments for high school and university students. These materials are being designed specifically to excite young people in considering a major in science, mathematics and other related fields in college.

The invitation is open to Irish universities and other Irish agencies to join this advisory group, not only to advance public education in the life sciences in Ireland but also to provide a vehicle for showcasing Irish science and the scientists behind it. Marketing Ireland’s R&D capacity is one of the major objectives of a number of organizations, such as Enterprise Ireland and IDA-Ireland. Involvement in this advisory group would offer an effective vehicle for supporting this critically important objective toward enhancing Ireland’s international stature in research and development.



Part 6:

Lessons for Home

“Virginia Inc.”

The single most important lesson that one can take away from a study of Ireland is the importance of a nonpartisan, socially cohesive national development objective to overcome significant fiscal odds and look to the future. This is an especially timely lesson for Virginia as it faces an unrelenting revenue crisis that is requiring massive cuts in the budgets of all state agencies, including public colleges and universities.

As much as the experiences of other countries and institutions can suggest new models for Irish national development, Irish national development has much to teach the rest of the world. This lesson is impractical for applying to the United States as a whole, but it certainly makes sense for individual states that share the same characteristics of small size and population as Ireland. In this respect, Virginia needs a “Commonwealth Development Plan” to create its own “Virginia Inc.” phenomenon.

Other states have begun to implement initiatives designed along the same lines as Ireland’s National Development Plan. More than 40 states are involved in some way with establishing strategies to invest in their infrastructures for bioscience and information technology development involving the academic, government, business and nonprofit sectors. Examples include Michigan’s 20-year, \$1-billion effort to develop a Life Sciences Corridor; Illinois’s five-year, \$2-billion VentureTech Initiative; Texas’ \$800-million commitment to commercialization activities and the R&D infrastructures of its colleges and universities; and Wisconsin’s ten-year, \$317-million BioStar development strategy. States also are undertaking strategies to use funds, which the tobacco industry agreed in 1998 to provide states in compensation for treating ill smokers, to develop technology transfer venture funds as well as revamping state tax policies that impede bioscience growth and establishing networking organizations. Virginia’s Commonwealth

Technology Fund was recently established and funded at \$13 million, but that may now be on the chopping block.

Some universities in Virginia, including Virginia Commonwealth University, have developed their own strategic plans to contribute to the bioscience infrastructure in our state. And, there have been some initiatives toward promoting more inter-institutional collaborations, such as the Virginia Bioinformatics Consortium between VCU, the University of Virginia, Virginia Polytechnic Institute and State University and George Mason University and a new consortium devoted to genetics research between VCU, George Mason and the Inova Health System in Northern Virginia.

The Commonwealth also has made some recent efforts toward establishing “Virginia Inc.” In 1995, the Virginia General Assembly created the Virginia Economic Development Partnership to advance the state’s goals to become more attractive for business relocation and trade. The partnership is guided by a board of business leaders from throughout Virginia, and it can be credited for raising awareness of Virginia’s need to improve its attractiveness to inward investment from U.S. and overseas companies. More recently, Governor Mark Warner announced the “One Virginia – One Future: A Strategic Plan for Economic Development” to serve as a guide for the Commonwealth’s growth over the next few years. Virginia’s Department of Commerce and Trade has established a steering committee to seek input and feedback as part of the development of that plan.

Compared to Ireland and other states, however, Virginia is continuing to pay scant attention to the future role of its public colleges and universities as part of a comprehensive Commonwealth development initiative. Meanwhile, these institutions are facing severe cuts that will seriously impede not only their ability to continue serving students but also to contribute in a significant way to a statewide economic development effort in the future.

Moreover, like Ireland, Virginia faces the problem of regional imbalance in the distribution of economic development support. Northern Virginia – like the Dublin region – has been the beneficiary of a good deal of development support; South Central and Southwestern Virginia (read Ireland’s Border, Midland and Western Region) have not been as fortunate, even within the all-Virginia framework of the Virginia

Economic Development Partnership. To his credit, Governor Warner has focused attention on the problem of disparities in the development of the technology and R&D infrastructure across the state.

Members of the Governor’s economic development planning team should consider putting together a mission to go to Ireland to study its approaches to creating economic growth out of economic crisis, with a view to reassessing how our state should best use increasingly limited state funds. Much like CEOs for Cities, this effort should involve academic, local government and nonprofit leaders in a broad-based determination of the role of higher education in Virginia’s future as the means by which Virginia may not only hope to crawl out of the fiscal hole it is now in but also instill the same sense of can-do spirit, shared identity and confidence that are so prominent in Ireland today.

We should be asking ourselves: do we risk creating a Virginia diaspora if we lag in the development of our R&D infrastructure? And, with what advances can the name “Virginia,” like “Framingham,” become associated in this new millennium? To answer these questions, we must strive for that common feeling – that cohesive sense of destiny – that I found so striking among the diversity of individuals I interviewed for this report.

Ireland, Europe and the United States

I was fortunate to have the opportunity to attend a session on the European Union’s 6th Framework Research Programme on July 12, 2002, at Dublin Castle. There, I heard Deputy Prime Minister Mary Harney raise the question that all my interviewees asked: Will a progression of a genuine knowledge society occur in Ireland? As I hope my report has demonstrated, there is every reason to believe it will – and that Ireland will achieve the international preeminence for using research and development to turn around the economy that it so richly deserves.

In 1984, the European Union established the Research Framework Programme, the EU’s main instrument for allocating research funds to its member nations. The Frameworks are effective for five-year overlapping periods; the 6th Framework will be fully operational on January 1, 2003. Each five-year period has established priorities by which EU monies are distributed to researchers and institutions among the EU membership. The 6th Framework’s goal is to create a more

cohesive, collaborative environment through the creation of a “European Research Area” (ERA). The ERA is essentially the vision of R&D in Europe, with the goal to foster scientific excellence, competitiveness and innovation through collaboration and partnership among the member nations. The 6th Framework will allocate €17.5 billion toward this end, which is 4 percent of the EU’s overall budget. The lion’s share of funding will go toward the life sciences (including genomics and biotechnology) and information technology.

Irish leaders see the 6th Framework as a vital component in its goal to enhance its R&D prowess. Within the EU’s aim to become the most advanced R&D center in the world, Ireland finds itself in a position, as Deputy PM Harney described, to show how small nations with small economies can have a big impact on advancing the knowledge society of the 21st century.

Nevertheless, Ireland has historic ties to the U.S., which also prompted Deputy PM Harney to remark: “Ireland has more in common with Boston than Berlin.” Through Enterprise Ireland and some of the universities, efforts are underway to enhance U.S. collaborations with universities and Teagasc as well as investment in the United States to tap our markets for Irish goods and services. But, are we really taking advantage of Ireland’s ties to and interest in us? If we do not, will we lose Ireland to the EU — to our detriment in several respects, not least the achievement of a lasting peace in Northern Ireland? We should reexamine our R&D relationship with Ireland in the context of our foreign policy goals.

Seeking to strengthen and enhance our ties to Ireland, particularly through R&D partnerships, also would go a long way toward helping to internationalize our own system of higher education. Apart from the contribution such ties would make to the quality of the educational experience and to R&D innovation in the United States, there is some urgency in this consideration. Although the U.S. continues to attract more foreign students to its universities than any other nation, competition from abroad for foreign students is growing. According to the *Chronicle of Higher Education*, in 1982 the U.S. held 39 percent of the foreign-student market. By 1995, the most recent year with available figures, that had dropped to 30 percent. Ireland, Britain, several European nations and Australia are among those countries devoting more time and resources to programs designed to recruit foreign students. Some countries, like Canada, are focusing recruitment efforts

on such regions as Asia. One of the best ways to solve the problem of brain drain in academe is to recruit the foreign students who would then consider staying on as scientists and researchers. Over the past 30 or 40 years, the U.S. has shown the world exactly how this dynamic operates, and it is certainly one of Ireland’s objectives.

The United States is still, in its own way, an insular nation. We do not realize the extent to which other nations like Ireland are moving rapidly ahead with innovation and development in areas in which we have enjoyed dominance and leadership. The European Union’s ambitions through the 6th Framework, combined with Ireland’s ambitious goals and can-do ethic, should be a wake-up call to the U.S. that it also can no longer rest on its laurels.



Interviewees

From June to August 2002, I met with the following individuals to discuss the economic story of Ireland, its future and the role of higher education. I am indebted to them for their time and expertise and grateful for the review and advice provided by a number of these individuals on the draft stage of this report, although I take full responsibility for any errors that it might contain.

Dr. John F. Atkins, Director, Biology and Biotechnology, Science Foundation Ireland

Dr. Ruth Barrington, Chief Executive Officer, Health Research Board of Ireland

Dr. Frank Barry, Professor of Commerce, University College Dublin

Dr. Maurice P. Boland, Professor of Animal Husbandry, University College Dublin

Dr. Hugh Brady, Acting Director, Dublin Molecular Medicine Center and Chair of Health Research Board; Professor, Mater Misericordiae Hospital, University College Dublin

Brendan Butler, Director, Irish Business and Employers Confederation, and Director, ICT Ireland

Tom Carroll, former Secretary General, Department of Communications, Marine and Natural Resources

Enda Connelly, Divisional Manager of Human Resources, Education, Research & Skills Development, Investment and Development Agency-Ireland

Dr. Art Cosgrove, President, University College Dublin

Carmel Coyle, Executive Director, Irish-US Fulbright Commission

Professor Gabriel M. Crean, Director, National Microelectronics Research Centre

Dr. Martin Cronin, Chief Executive, Forfas

Sean Dorgan, Chief Executive Officer, Investment and Development Agency-Ireland

Dr. Liam Downey, Former Head, Teagasc, the Agriculture and Food Development Authority of Ireland; Honorary Professor of Agriculture, University College Dublin

The Honorable Richard J. Egan, U.S. Ambassador to Ireland, Embassy of the USA

Dr. Donald Fitzmaurice, Professor of Chemistry, University College Dublin

Ann Fitzpatrick, Director, Software Development Centre, Sun Microsystems Ireland Limited

Dan Flinter, Chief Executive Officer, Enterprise Ireland

Dr. Pat Frain, Director, University Industry Programme, University College Dublin

Dr. Tony Glynn, Director, Office of Innovation and Business Relations, Dublin City University

Dr. Brendan Goldsmith, President, Dublin Institute of Technology

Dr. William Harris, Director General, Science Foundation Ireland

Dr. John Hayden, Secretary and Chief Executive, Higher Education Authority

Professor Frank Hegarty, Vice President for Research, University College Dublin

Dr. John Hegarty, Provost, University of Dublin, Trinity College

Brendan Hickey, Managing Director, Davy-Hickey Properties, Citywest

Dr. Tom Higgins, Consultant, Circa Group Europe

Dr. John H. Horgan, Consultant, Cardiology, Beaumont Hospital

Dr. Christopher Horn, Executive Chairman of the Board, Co-Founder, Iona Technologies

Brendan Keenan, Group Business Editor, the *Irish Independent*
Patrick Kelleher, Director, Cork Institute of Technology
Dr. Dermot Kenny, Director, Clinical Research Centre, Royal College of Surgeons-Ireland
Dr. Ivor Kenny, Senior Research Fellow, Department of Commerce, University College Dublin
Dr. Brian MacCraith, Director, National Centre for Sensor Research, Dublin City University
Dr. Frank McCabe, Former Vice President, Intel Corporation; member of the boards of IDA-Ireland and SFI
Dr. David J. McConnell, Professor of Genetics, University of Dublin, Trinity College
Patrick McDermott, Special Adviser to the President, Dublin City University
Joe McGarry, Secretary General, Council of Directors, Institutes of Technology
Dr. Michael McGrath, Director, Conference of Heads of Irish Universities
Dr. Edmond S. Molloy, Director, Advanced Organisation and Management Development Ltd.
Mr. James Moloney, Chairman, IAWS Group PLC
Martin Naughton, Chairman, Glen Dimplex
David Neville, First Tuesday, First Biotech
Dr. Conor O'Carroll, Assistant Director, Central Universities Research Office, Conference of Heads of Irish Universities
Bobby O'Connor, Director, Field Boxmore Ltd., Dublin
Dr. Rory O'Donnell, Director, National Economic and Social Council
Dr. Daniel O'Hare, Founding President, Dublin City University
Dr. Eoin P. O'Neill, Director of Innovation Services, Innovation Centre, University of Dublin, Trinity College
Gavin K. O'Reilly, Chief Operating Officer, Independent News & Media PLC
Dr. Liam O'Reilly, Assistant Director General, Central Bank of Ireland
Michael O'Sullivan, Vice President, Planning, Communications and Development, University College Cork
Turlough O'Sullivan, Director General, Irish Business and Employers Confederation
Dr. Eva Paus, Professor of Economics, Mount Holyoke College
Greag Purcell, Chief Executive Officer, First Tuesday Ireland
Dr. Andy Robertson, Director, Conway Institute of Biomolecular and Biomedical Research, University College Dublin
Declan Ryan, Engineering Projects Director, Wyeth Medica Ireland
Dr. Reg Shaw, Managing Director, Wyeth Medica Ireland
Brian Sweeney, Chairman, Siemens Ireland; Head of the Board, Science Foundation Ireland
Dr. Don Thornhill, Chairman, Higher Education Authority
Dr. Breffni Tomlin, Operations Director, National Institute of Technology Management, University College Dublin
Brendan Tuohy, Secretary General, Department of Communications, Marine and Natural Resources
Peter Vallely, Sales and Marketing Manager, Kilsheelan Technology International
Dr. Ferdinand von Prondzynski, President, Dublin City University
Dr. Eamonn Walsh, Dean, Graduate Business School, University College Dublin
Dr. Edward M. Walsh, Chairman, Irish Council for Science, Technology and Innovation; Founding President, University of Limerick
Adrian Weckler, Editor, the *Sunday Business Post*
Professor Kevin Whelan, Michael J. Smurfit Director, Keough-University of Notre Dame Centre
Dr. Gerard Wrixon, President, University College Cork

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PHOTOGRAPHS ON FRONT COVER

Archive photograph of scientist at work in laboratory;
Georgian doors of Dublin on Merrion Square, Dublin 2;

Rowan Gillespie's *Famine Memorial* sculpture,
powerfully depicts gaunt, wraith-like figures, carrying their few possessions towards an unseen coffin ship. They stand
in telling juxtaposition to the power dressed blocks of the Irish Financial Services Centre - Ireland's Wall Street.

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