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The Focas Institute at DIT : Origins and Development of a Research Institute

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facility for optical characterisation and spectroscopy

Origins and Development of a Research Institute

The Focas Institute at DIT

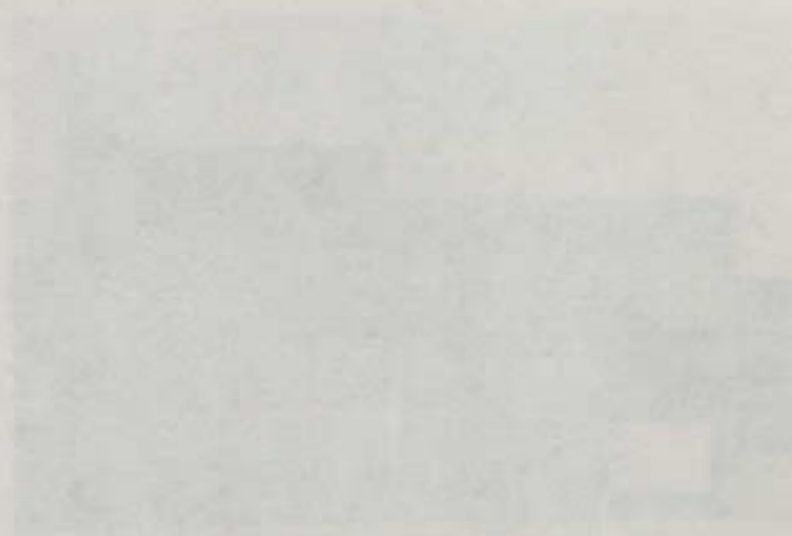
HUGH J BYRNE
MARY McNAMARA
MATT HUSSEY



THE FOCAS INSTITUTE AT DIT

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By J. J. BYRNE, JOHN KOTAMARA
AND MARY SHERRY

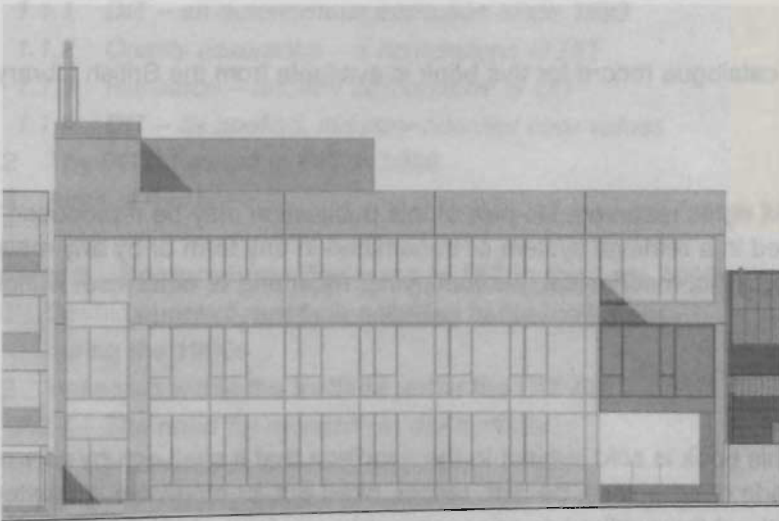


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THE FOCAS INSTITUTE AT DIT

ORIGINS AND DEVELOPMENT OF A RESEARCH INSTITUTE

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Dedication

This book is dedicated to the twenty-two members of the academic and research staff listed below to acknowledge their achievement in winning the Higher Education Authority (HEA) Programme for Research in Third Level Institutions (PRTL) Cycle 1 award in 1999 that helped to fund the Focas Institute as well as raising the profile of research in Dublin Institute of Technology to new heights.

Hugh J. Byrne

John Cassidy

Siobhán Daly

Mick Devereux

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James Walsh

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The foresight of the HEA in introducing the PRTL scheme was pivotal to the high academic adventures and achievements recounted in this book.

The fine work of Robert Payne of the architects of the new building, and the design team, in listening to the researchers and delivering a building that well represented their aspirations, is also acknowledged.

All the undergraduate project students and especially the UREKA summer students must be thanked for making Focas a really 'fun and engaging' institute to work in.

And finally we sincerely thank all the research staff, postdoctoral researchers and postgraduate research students who, over the years, provided the impetus to drive and help to build a vibrant research facility for the future generations of researchers at the Focas Institute and DIT.

Réamhrá

Gan sárobair na múinteoir-thaighdeoirí go léir a leag bun-chloch Institiúid Fócas a laghdú oiread ar bith, rinne beirt go háirithe, Hugh Byrne agus Mary McNamara, an t-iarratas don bhun-mhaoiniú (agus, cinnte, don ghála mor is déanaí de mhaoiniú) a spreagadh, a chruthú agus a threorú, agus choinnigh siad coimhlint ocht-mbliana gan staonadh ar siúl le deimhin a dhéanamh d'aontacht, d'fhuinneamh agus d'inmharthanacht na gníomhaíochta. Chuidigh siad le Fócas a choimeád le chéile le linn oíche fhada an anama, le linn na mblianta ag feitheamh do thógáil agus seoladh an fhoirgnimh, ag idirghabháil go cruthaitheach le comhleacaithe agus leis na h-aitirí agus na tógálaithe chun an foirgneamh álainn, praiticiúil, a bhfuil an Institiúid Fócas lonnaithe ann anois, a chur ar fáil. Tá brod thar na bearta agam astu beirt.

Chuidigh gach aon duine de bheirt ar fhiche múinteoir-thaighdeoirí, ar ndóigh, leis an bhfís, arbh é an foirgneamh a samhail fhisiciúil. Agus tá comhleacaithe nua tar éis teacht ar bord le tuilleadh fuinnimh a chur leis an bhfís.

Mo bhuíochas agus mo mheas ó chroí dóibh go léir.

Tá súil in airde agam go leanfaidh siad agus Institiúid Fócas ag dul ó neart go neart.

An tOllamh (emeritus) Matt Hussey
iarStiúrthoir, Dámh na hEolaíochta
Márta 2008

Preface

Without diminishing in any way the superb work of any of the teacher-researchers who laid the foundation stone for the Focas Institute, two in particular, Hugh Byrne and Mary McNamara, inspired, created and shepherded the application for the original funding (and, indeed, for the most recent major tranche of funding) and maintained a relentless 8-year struggle for the unity, vitality and sustainability of the whole enterprise. They helped to maintain and hold it together during the long night of the soul, the years of waiting for the building to be constructed and launched, interacting creatively with colleagues and the architects and builders to bring forth the beautiful but practical building that now houses the Focas Institute.

Of course all the twenty-two teacher-researcher colleagues contributed vitally to the vision, of which the building is the physical embodiment. And new colleagues have come on board to add further vigour to the vision.

My deepest thanks and appreciation to them all.

I have every hope that they and the Focas Institute will continue to go from strength to strength.

Professor (emeritus) Matt Hussey
former Director, Faculty of Science
March 2008

Chapter 1

Introduction

This book outlines the roots and development of a new scientific research institute, the Focas Institute, within the Dublin Institute of Technology (DIT). While the new Focas Institute was formed by the creativity and initiative of talented members of staff, who grasped the opportunity offered by the PRTL (Programme for Research in Third Level Institutions) scheme of the Higher Education Authority (HEA), it also arose from the history and ethos of DIT and its 120-year drive to provide an applied, industry-oriented educational service of the highest quality to students from Dublin, from across Ireland and from abroad.

1.1 Origins and emergence of the Dublin Institute of Technology

The Dublin Institute of Technology traces its origins to the foundation by Dublin Corporation of the Technical School at Kevin Street in 1887. In 1890 the Corporation founded the Municipal School of Music at South William Street. A Technical Education Committee (TEC) was formed in 1900 by Dublin Corporation to manage Dublin's growing technical education provision that came to include the Technical School at Rutland (later Parnell) Square in 1905, the relocation of the Municipal School of Music to Chatham Row in 1907 and a Technical Institute at Bolton Street in 1911. Another original strand of DIT was the Rathmines Municipal Technical Institute founded by the local Urban District Council in 1901, and the relocation of this Institute to a building that also accommodated the Rathmines Public Library in 1913.

The City of Dublin Vocational Education Committee (CDVEC), an amalgamation of the TEC and other committees in Rathmines, Ringsend and Pembroke, was established under the Vocational Education Act 1930. Under this jurisdiction the sixth college that would form DIT was established at Cathal Brugha Street in 1941.

Until the 1960s, most of the educational provision in the colleges was on a part-time basis for students in employment. By that time the need for a skilled workforce was becoming increasingly apparent, particularly in the areas of science, technology and business, to support the Government's industrial development plans being implemented by the Industrial Development Authority (IDA). In 1963 the CDVEC established a formal full-time academic and administrative structure in each of the six colleges to pioneer the technician-level education and training of young people in Ireland to prepare them for careers and leadership roles in this new phase of economic development.

Since the 1960s there has been rapid physical and academic expansion in the six colleges. The Academic Council was founded in 1967 to enhance academic cohesion, quality and relevance. In 1976 a Partnership Agreement between the CDVEC colleges and the University of Dublin (TCD) was signed, based on wide cooperation and commonality of interests. In 1978 the Dublin Institute of Technology (DIT) was established on an ad hoc basis by the CDVEC to coordinate and unify the work of the six colleges. There followed a quarter century of rapid growth in full-time student numbers within the colleges, paralleled by a similar rapid growth in degree programmes leading to joint DIT diploma and TCD degree awards, in diploma and certificate programmes leading to DIT awards and in postgraduate research activities leading to M.Phil. and Ph.D. awards from TCD and other universities.

The integration and consolidation of the Institute continued in the 1980s. The strong identity of the individual colleges and their reputation in their specialist areas continued to influence the externally perceived image of DIT. An increasing number of DIT students were pursuing postgraduate research, although registering and graduating in TCD, DCU or one of the other Irish universities or even in universities abroad.

1.1.1 DIT – an autonomous institution since 1993

DIT was statutorily established as an autonomous institution, independent of the CDVEC and under the auspices of the Dublin Institute of Technology

Act 1992, on 1 January 1993, 'to provide vocational and technical education and training for the economic, technological, scientific, commercial, industrial, social and cultural development of the State'.

1.1.2 Quality assurance – a cornerstone of DIT

Since 1993 establishing and implementing advanced academic quality assurance procedures has been a major priority of the Institute and its Academic Council. During the 1995/1996 academic year the Higher Education Authority (HEA) commissioned an international review team of eminent academics and industrialists to carry out an institutional and systems audit of the quality assurance procedures and the effectiveness of their operation. The main outcome was a report acknowledging the high quality of the learning, teaching and research within the Institute together with a series of suggestions and recommendations for improvements. In consequence of this favourable report a ministerial order was issued by the Minister of Education and Science in 1997 granting DIT the authority to award degrees to the highest postgraduate level from 1998 onwards. All graduates of the Institute have been awarded degrees of DIT since that year.

1.1.3 Research – another cornerstone of DIT

In December 1993 a key white paper, 'Growth, Competitiveness, Employment: the Challenges and Ways Forward into the 21st Century',¹ was issued by the Commission of the European Communities to orient the European Union (EU) to the reality of the emerging globally competitive economy, where knowledge and its creation, organisation and dissemination would be dominant aspects. The dawning of the information age required increased investment in education and training and increased involvement in these activities by citizens throughout life.

Raising the level of research would be vital for sustaining growth, competitiveness and employment. Through research, the higher education institutions, in Ireland and other countries of the EU, could and would play a central role in providing leadership in the processes of reconstructing

¹ *Growth, Competitiveness, Employment: the Challenges and Ways Forward into the 21st Century, A White Paper*, Commission of the European Communities, Brussels, 1993.

the basic knowledge of society, educating and training the knowledge workers, and evaluating and disseminating the latest developments. The white paper saw three necessary priorities in the development of research across the EU, and these clearly applied with particular relevance to Ireland:

- to increase the level of investment in research from 2 per cent of GDP, at least to the level in the main competitor economies: 2.8 per cent in the USA and 3 per cent in Japan
- to improve the coordination of the research, including the provision of research training at postgraduate level, within institutions and between institutions, driven by national research policies and coordinated with business strategies
- to develop the capacity to convert the scientific and other outputs of research into successful industrial and commercial enterprises, through better collaborative links – between the higher education institutions and businesses, through the provision of more risk capital, more research and development in enterprises, by facilitating researchers in starting businesses and much more.

The EU white paper coincided with the dawn of the period of unprecedented economic prosperity in Ireland, the Celtic Tiger, a development that facilitated and funded the PRTL scheme. It also stimulated the growing understanding of the fundamental need for research, most specifically at postgraduate level, to maintain Ireland's industrial and economic position. In time, this drive to grow postgraduate-level research activities came to be expressed in the term 'fourth level activities' within higher education.

The ideas in the white paper confirmed the validity of the orientation adopted by DIT to strengthen its emphasis on research, not only for the advancement of scientific and technological knowledge and application, but to underpin all its undergraduate education provision.

1.1.4 DIT – its applied, industry-oriented core values

DIT's drive throughout the 1980s and 1990s to develop research activities, mainly through applied postgraduate research, but also through development centres more oriented to industry needs in keeping with its long-established

industry-oriented values, correlated strongly with the ideas in the Commission's report. The developing strategy of DIT for advancing its research and postgraduate training activities continued to be imbued with these ideas.

1.2 The PRTL I award to DIT in 1999

The highlight of the development of postgraduate research at DIT was the award in 1999 of €10.4 million for the establishment and construction of the Facility for Optical Characterisation and Spectroscopy (Focas) involving teacher-researchers within the Faculty of Science.

The winning of the funding for the Focas project was particularly the achievement of the following teacher-researcher members of staff:

Hugh Byrne	Mary McNamara	John Cassidy
Siobhán Daly	Mick Devereux	John Doran
Clodagh Feely	Pat Goodman	Paul Horan
Tia Keyes	Maryanne Large	Maria Lyons
Fiona Lyng	Declan McCormack	Suzanne Martin
Carmel Mothersill	Des O'Mahony	Noel Russell
Sean Sheridan	Vincent Toal	Jack Treacy
James Walsh		

This award, made by the Higher Education Authority (HEA) under the first cycle of the Programme for Research in Third Level Institutions (PRTL I) scheme and funded by the National Development Plan 2000–2006,² was the largest single investment ever in research in DIT. The processes of preparing the application for this grant and implementing the plan allowed and stimulated a range of substantial qualitative and quantitative changes in the research effort in a number of areas in DIT.

The project addressed a range of common needs in the schools of Chemical and Pharmaceutical Sciences, and Physics, and in the Research Centres for Industrial and Engineering Optics, and Radiation and Environmental Science. It stimulated a major advance in strategic planning for

² *National Development Plan/Community Support Framework 2000–2006*, Department of the Taoiseach, Dublin, 2000.

the development of research across the Institute. It ultimately provided dedicated research space, access to common advanced measurement instrumentation, administrative and technical support and 24-hour access to research facilities. Among its aims, which have been achieved to a considerable extent, were the

- consolidation and development of existing expertise
- nurturing of developing research activities within DIT
- support for a range of postgraduate research advances and undergraduate project activities
- promotion of interdisciplinary collaboration within DIT and with other national and international bodies
- provision of a support service for national industry
- underpinning of postgraduate and undergraduate course curriculum development.

This work is now housed in the new dedicated research building of 2400 m², completed in 2004, located at Camden Row at the rear of the Faculty of Science, Kevin Street, and now called the Focas Institute. This institute is comprised of laboratories, desk space for postgraduate students, post-doctoral researchers, management, technical staff and administrators, meeting rooms and a large seminar room.

It has as its core a number of shared laboratories that supply a broad range of spectroscopic techniques, both steady state and transient, conventional and scanning microscopes, as well as sample preparation capabilities. Additional, more specialised, facilities are provided through the associated research groups, which cater for a number of postgraduate research students. Included in the grant was funding for dedicated technical personnel to service the core laboratories and also for postdoctoral researchers to coordinate both the core and group laboratories. Funding was also obtained for managerial and administrative support.

This facility has enabled a more professional, structured and coherent approach to research than had previously been possible. It has provided vitally needed dedicated research accommodation, without concomitant space loss in other areas, as would previously have been the case. It has provided accommodation for other new and related research groups. It has accelerated the development of a number of research teams carrying out world-class research. These groups have also made a major contribution

to teaching advanced topics within the Faculty and Institute as a whole. Focas has allowed an increase in the number of postgraduate students and research assistants, as well as postdoctoral researchers. The recruitment of some of these from abroad has contributed to developing a stronger international aspect to the research ethos.

Focas has had a major impact on postgraduate research in the Faculty of Science and as a result the Faculty has seen an increase in postgraduate research student numbers from thirty-five in 1999 to seventy-seven in 2006. In 1999 only eight students were registered for Ph.D. awards, but in 2006 there were forty-three Ph.D. students. Prior to the Focas project most students completed an M.Phil. project and there were only two Ph.D. graduations in 2000. In 2006 ten Ph.D.s were awarded in the Faculty. The state-of-the-art facilities have also contributed to improved completion rates.

The Focas Institute has also allowed the development of specialised management and administration for a number of research teams, facilitating synergy and cooperation among them as well as cooperation with external organisations.

The positive effects of research have long been evident in the undergraduate education provided in the Faculty – in final-year project research opportunities for undergraduate students and in advanced course materials reflecting new areas of staff research and expertise.

1.3 Aims of this book

It is mainly the academic aspects of this historical development that are summarised in this book, and principally those aspects that the teacher-researcher members of staff were able to participate in and pool their academic expertise, energy and creativity to make what has emerged as a dramatic contribution to the development of the Faculty of Science and DIT as a whole.

The book is dedicated to the achievement of these teacher-researchers, but it is also intended as an outline of the lessons learned in initiating and developing the Focas Institute, to assist others within DIT but also outside, to optimally marshal and consolidate their strengths and then realistically reach for and achieve extremely significant goals.

Chapter 2

Postgraduate Research in DIT in the Late 1990s

The changing and developing nature of the activities of the colleges of the Dublin Institute of Technology (DIT) presented increasing problems for them in the 1980s as they sought to operate as effectively as possible as higher education institutions. Problems often arose from the restrictions imposed by the Vocational Education Act 1930, which was primarily intended to encompass second level education provision. As the Institute began to engage in research and development work and what is now classified as fourth level education, difficulties arose that were highlighted in the study of the National Board for Science and Technology in 1981.¹ These included the ambiguous status of research activities under the governing legislation, the contract of employment of academic staff including the limited academic year and the recruitment and promotion policies, and the limited dedicated accommodation, facilities, equipment and technical support available for research.

2.1 Development of research activities in the Institute during the 1980s

From the early 1970s it was recognised, particularly in relation to science and technology disciplines, that as well as being important for the industrial and social development of the country, research was also a key activity to guarantee the relevance and vitality of undergraduate

¹ *Barriers to Research and Development in the Higher Education Sector*, National Board for Science and Technology, Dublin, 1981.

teaching and learning. A DIT Research Committee had been in operation under the aegis of the Academic Council since 1981, developing and monitoring research and development policies for the Institute, and promoting and encouraging these activities. Research had been a significant activity in a number of schools across the Institute, particularly in science and engineering in Kevin Street, but a plan was adopted in 1989 for its further development in these areas and its extension to other disciplines across the Institute.² The emphasis became concentrated on developing research in a number of broad strategic areas, based on national priorities that largely corresponded to the academic strengths of the Institute.

Just before that, the International Study Group on Technological Education in 1987 stated that it 'was impressed by the work of the colleges' and recognised 'the high standing which the colleges hold in their special fields of study'.³ It had found that the 'research activities of the DIT are wide-ranging, as would be expected in an Institute of such diverse character. Collaboration with other researchers and institutions both nationally and internationally is a common feature of much research carried out by the Institute.' The report of this group recommended that statutory provision be made for the Institute to engage in this type of work, and that it should be encouraged to make its expertise and facilities more widely available to industry and business as considered appropriate.

Over the years priority had been given in staff recruitment in many areas to established professionals in their specialist disciplines. Many of the Institute's permanent academic staff had, after recruitment, availed of facilities provided to enhance their qualifications and become involved in research and/or consultancy work.

Statutory provision was made in the DIT Act 1992 for the Institute to engage in research, consultancy and development work, either on its own or with other institutions, and to provide services in relation to such work and enter into arrangements, including participation in limited companies, to exploit the results of this work.

² *Research & Development 1988-1991, A Report and Review, Dublin Institute of Technology, Kevin Street, City of Dublin Vocational Education Committee, Dublin, 1992.*

³ *Technological Education, Report of the International Study Group to the Minister for Education, Oifig an tSoláthair, Baile Átha Cliath, 1987.*

2.2 Research within the Institute under the DIT Act

After the DIT Act came into force in 1993 the Institute undertook to develop the postgraduate research aspect of its work in a concerted manner.

2.2.1 *The need for research in the Institute*

Research work leading to the advancement of knowledge was recognised as a necessary element for underpinning education, whether at postgraduate or undergraduate level, to help ensure a lifelong learning approach to knowledge and skills.

Postgraduate research and development projects might be carried out in the wide areas of scholarship where the Institute had relevant expertise. These would involve areas of scientific, commercial, industrial, social, professional and artistic scholarship, as well as educational matters and academic management and administration. Interdisciplinary work and collaborative research projects with other organisations in Ireland, the European Union (EU) and further afield were especially encouraged.

The development of postgraduate research activities in the Institute was also encouraged because of the strong role of these activities in helping to maintain the standard, quality and relevance of the undergraduate and postgraduate programmes offered. Research, development and consultancy work came therefore to be viewed as essential in underpinning the key teaching functions of the Institute at all levels.

2.2.2 *Measures to develop research*

Involving and facilitating individual members of staff from schools across the Institute in research activities became a core strategy. There were a number of other key activities as corollaries to this – overcoming the severe problems of limited accommodation and scarcity of requisite equipment, managing each researcher's teaching timetable to facilitate their research work, exploiting the research activities to improve courses, and generally developing and spreading an intellectually challenging research ethos across the Institute. As an indicator of progress, postgraduate research student numbers across DIT grew from less than 150 in 1995 to over 190 in 1999, mostly on the M.Phil. register. Although the Institute was not allocated specific funding in its budget for research activities, the

Department of Education and Science acknowledged that under the legislation DIT would be expected to expend some of its income for this purpose, in contrast with the previous situation.

2.2.2.1 Management of research

Established in 1995, the Postgraduate Studies and Research Committee of the Academic Council was given responsibility for developing and assisting the implementation of policies in relation to postgraduate research. This committee comprised representatives of all the Faculty (Academic) Boards, the main staff grades and postgraduate students.

This committee subsequently formed four sub-committees, each with specific areas of responsibility and relevant representation from across the Institute, thus:

- Postgraduate Studies Committee (which predated the parent committee and was later renamed the Postgraduate Research Committee), to develop and monitor the implementation of quality assurance procedures in relation to postgraduate research
- Funding Committee, to manage the distribution of Institute research funding in different funding schemes
- Ethics Committee, to develop and administer policies relating to ethical and legal issues arising from research projects in the Institute
- Postgraduate Courses Committee, to oversee and monitor all taught postgraduate programmes in the Institute.

2.2.2.2 Postgraduate Studies and Research office

The Postgraduate Studies and Research office was established in 1996 as a central resource for postgraduate research and postgraduate courses across the Institute. It was given responsibility for the registration and monitoring of all postgraduate students, the general administration of the Institute's regulations for postgraduate study by research, and the monitoring of the quality assurance procedures in postgraduate work. It was to provide assistance and advice to postgraduate students and staff involved in postgraduate studies.

In relation to postgraduate research, the office also was given responsibility for organising and/or assisting in interviews of candidates for

registration, research seminars by students, training modules for students and supervisors, annual assessments, student and staff feedback workshops, and final thesis examinations.

2.2.2.3 Funding schemes

After 1993 the Institute initiated and developed a number of funding schemes to encourage and facilitate staff members engaging in research, including the following: a seed funding scheme, postgraduate scholarships, postdoctoral fellowships, a strategic research and development (SRD) programme funded by the Department of Education and Science in the regional technical colleges and DIT, and a DIT/Trinity College Dublin (TCD) joint research seed funding scheme.

Staff members of the Institute also competed successfully for Enterprise Ireland grants for Basic and Strategic Research, and for the Applied Research Programme (ARP), the Higher Education Industry Co-operation Programme, European Union (EU) Framework and other programmes, and grants from a range of other public bodies and private agencies.

2.2.2.4 Quality assurance in postgraduate research work

In 1992, Academic Council had established the Postgraduate Studies Committee to manage and oversee the academic quality assurance of the postgraduate research activities throughout the Institute. This committee established the first DIT register of postgraduate students in 1994, and drew up the quality assurance regulations and procedures for postgraduate studies by research. After discussion within Academic Council and throughout the Institute, the regulations were approved by the Academic Council in May 1994 and have been implemented throughout the Institute. They were substantially reviewed and up-dated in 1997 and twice more since then.⁴

The regulations describe the student application (including for transfer from one register to a higher one) and registration processes, the procedures for supervision, the reporting mechanisms for the postgraduate students, the training modules, the annual reporting and assessment

⁴ *Regulations for Postgraduate Study by Research*, 2nd Ed., Dublin Institute of Technology, Dublin, 1997.

for the students, the qualities required in the different theses and the final examination processes.

2.2.2.5 Research/development centres

Since 1993, the Institute had formally established a number of specialised development/consultancy centres and other units, principally to engage in desk research and development and consultancy work on contract for industry, but also to carry out some laboratory research.

Most of the centres were assisted in their initial phase by state agencies such as Enterprise Ireland, drawing on EU funds, but they were encouraged to earn income as soon as possible for the services they provided.

The Institute had to use rented premises, often some distance from the college sites, to accommodate most of these development centres and consequently they developed little, if any, direct relationship with the Institute's teaching and research within the schools.

2.2.2.6 Developing a research ethos – an ethos of scholarship

Institute policies sought to foster and develop a vibrant research ethos. This ethos and scholarly atmosphere would be manifested in the research activities themselves, in regular seminars and posters on work-in-progress, in conferences and conference reports, in visiting researchers from abroad and from other Irish institutions presenting the most recent developments in various fields, and in debates in corridors and common rooms. They were meant to inspire a drive towards academic excellence among staff as well as in undergraduate and postgraduate students.

2.2.3 Research evaluation

Since 1994 the Institute was informed and guided in its development by two major external reviews/evaluations of its activities, including its research activities:

1. The review of the quality assurance procedures in the Institute by the International Review Team led by Professor H. McGuigan on behalf of the Higher Education Authority in 1995/96.⁵

⁵ *Review of the Quality Assurance Procedures in the Dublin Institute of Technology*, Report of the International Review Team, Higher Education Authority, Dublin, 1996.

2. The evaluation of the Institute in the light of Section 9 of the Universities Act 1997 in response to the application by DIT for designation as a university under that Act,⁶ carried out by an International Review Group led by Mr D. Nally on behalf of the Higher Education Authority in 1997/98.⁷

These evaluations led to a clear conclusion, endorsed by the Directorate, that the Institute needed to develop research strategically along two complementary pathways:

- there was a continuing need to develop research and scholarly activity in a broad-based way across the whole Institute to ensure that it became a firmly embedded component of the ethos and culture of the Institute throughout
- a limited number of well-established areas of existing strength needed to be promoted to the level of self-sustaining critical mass, with high national and international profile and bidding to become genuine centres of excellence.

The first of these pathways was a broad-based developmental approach and had historically focused on areas identified by national development agencies as being of strategic importance for Ireland.

The second more focussed pathway aimed to develop niche areas of strength, some of them strongly interdisciplinary. Examination of the key research benchmarks – peer-reviewed publications, track record of research and grants – showed that the Faculty of Science accounted for some 25 per cent of peer-reviewed publications and 50 per cent of external grants won by DIT in 1997, continuing a trend already evident for some years. Within this faculty there were acknowledged international level strengths.

⁶ *Universities Act*, Oifig an tSoláthair, Baile Átha Cliath, 1997.

⁷ *Review of the Application by the Dublin Institute of Technology for Establishment as a University under Section 9 of the Universities Act (1997)*, Report of the International Review Group, Higher Education Authority, Dublin, 1998.

2.2.4 Productivity of research in the Institute

By 1999 DIT had won substantial external research funding, as shown in Table 2.1 below. Since the late 1980s such research funding had been running at over IR£1 million per annum and by the mid-1990s the amounts received were some IR£2 million in 1995, IR£2.6 million in 1996 and close to IR£4 million in 1997.

Publications, both peer-reviewed and other, constituted an important measure of the productivity and quality of the research. Table 2.2 summarises the scholarly output of Institute staff over the period 1993–1997. This scholarly productivity, by faculty, over the same period is shown in Table 2.3. The schools in the Faculty of Science contributed between 40 per cent and 50 per cent of the research-related output of the Institute as a whole over that period.

Table 2.1 Funding for research activities in DIT and numbers of researchers involved

Category	1995/96		1997/98	
	Amount IR£m	Researchers	Amount IR£m	Researchers
Development centres	1.2	19	1.5	63
SRD	0.5	60	0.5	60
Research grants	1.1	39	2.7	59
Total	2.8	118	4.6	182

Table 2.2 Summary of the Institute's scholarly output, 1993–1997

	1993	1994	1995	1996	1997
Peer-reviewed publications	123	126	137	124	161
Other publications	56	71	80	105	148
Consultancies	13	12	11	17	44
External grants	19	18	16	29	59
Exhibitions	47	44	82	55	73

Table 2.3 Scholarly productivity, by faculty, 1993–1997

	Applied Arts	Built Environment	Business	Engineering	Science	Tourism & Food
Peer-reviewed publications	96	19	69	91	260	69
Other publications	96	27	62	42	120	89
External grants	16	6	5	14	59	23

2.3 Impediments to the development of research in the late 1990s

These reviews as well as self-studies and student and staff feedback down the years had highlighted again and again a number of substantial impediments to developing research:

- lack of clarity on policy, indicated by long-term confusion that industry outreach centres were research centres, and unfruitful expenditure of limited Institute research funding, accommodation and other resources on these
- fragmentation of research responsibility, leadership, funding and resourcing between central functions and individual faculties and schools
- need to focus more resources on a limited number of potential and emerging centres of research excellence
- need to facilitate and support research-active staff to apply for and win research funding from the widest possible range of funding sources, nationally and internationally
- need to raise additional funding to develop the research infrastructure to underpin strategic priorities
- need to support research at management level in all schools and faculties
- lack of effort by the Institute to publicise and popularise research achievements by staff
- limitations of accommodation and support facilities for research, and lack of transparency in prioritisation and allocation of limited facilities for research
- staff recruitment not always prioritising research experience and track record
- staff contracts not reflecting well the important role of research or facilitating its development in the Institute, as set out in the DIT Act
- certain perceived bureaucratic arrangements affecting the morale of research-active staff
- perceived lack of recognition and/or reward for staff engaged in research, requiring the staff members to raise external funding themselves to support this work
- industrial relations issues – lecturers' contracts, technicians' contracts, porters' contracts, out-of-hours access to buildings, library access and use – tending to militate against research activities

- staff in general not persuaded of the key underpinning role of research to the total academic project, and even the future, of DIT
- postgraduate student contracts and payments needing to be raised often to remain competitive.

2.4 Overall strategic policies for research

By 1999, and particularly in the context of the need to present a comprehensive DIT strategy for the development of research as the underpinning motivation for an application to the PRTL scheme, the Institute decided to set an overall target that postgraduate research students would constitute up to 10 per cent of the full-time student body within ten years and that the approach to achieving this target would be two-pronged:

1. Research of the highest standard would be encouraged and developed in all schools of the Institute, preferably in collaborative groups that would cross school and faculty discipline boundaries, and based on locally available resources and grant aid won from outside. The development of teams of research-active staff would maximise the research effort and optimise the supervision service provided to postgraduate research students. This would also help further embed research as a vital and organic component of the ethos and culture of all the multi-level areas within the Institute.
2. It would be the policy to facilitate and resource the development, over time, of identified groupings of high-calibre researchers engaged in national and international level work in areas of opportunity, and with the potential in the medium term to construct centres of excellence capable of competing successfully for funding from major grant-awarding bodies in Ireland and internationally. This process might be viewed as a production line for centres of genuine research excellence, producing perhaps one such centre every two years during the period.

The processes of selecting the groupings within each prong of this strategic approach and allocating Institute resources to them to establish and develop centres of research excellence, would have to be transparent and widely acceptable across the Institute. The objective assessment of candidate groupings would have to have a strong peer review component, including authoritative external and internal peers.

In the light of the limitations referred to earlier and indeed of the relevant recommendations in the report of international peer-review groups, the Institute also incorporated the following measures into its strategic research policies:

- to shift the emphasis to postgraduate students working towards Ph.D. degrees rather than M.Phil. degrees, to give more depth and continuity and enhance the publications record
- in areas such as science and technology, where numbers of individual researchers are relatively high and growing, to immediately develop two or three collaborative groups/teams of genuine critical research mass (based on research strengths, solid track records and existing cross-disciplinary efforts and with the emphasis on long-term self-sustaining teams)
- to provide adequate consolidated and dedicated accommodation and equipment, through shared support facilities and administrative support
- to appoint a senior research fellow in each faculty with the brief of encouraging research across the faculty
- to seek to allow teacher-researchers additional time to do research, while not removing them from undergraduate teaching, allow sabbaticals, facilitate short visits to research laboratories, and provide additional administrative help
- to facilitate internal and external academic and industrial collaborations and to develop a range of telematic and video conferencing facilities.

Chapter 3

The Programme for Research in Third Level Institutions (PRTLII)

In the mid-1990s, the Higher Education Authority (HEA) commissioned a comprehensive investigation by the CIRCA Group Europe into university research in Ireland and its funding and performance in the wider European context. The wide-ranging CIRCA report, published in 1996 by the HEA, found 'chronic under-funding' of university research leading to piecemeal programmes of research and a lack of strategies in the higher education institutions to develop their research facilities and capabilities.¹ The direction of the research programmes in the institutions was largely determined by the funding won in an opportunistic and unplanned fashion from public and private funding agencies, with government science policy perceived as having no meaningful impact on it.

3.1 Programme for Research in Third Level Institutions, Pilot Cycle 1998

In the light of this report, and with strong government approval and support, the HEA devised the ambitious Programme for Research in Third-Level Institutions and announced it in 1997. A call for applications for grants under a pilot cycle of the scheme to allocate some IR£4.0 million

¹ CIRCA Group Europe, *A Comparative International Assessment of the Organisation, Management and Funding of University Research in Ireland and Europe*, Higher Education Authority, Dublin, 1996.

(€5.1 million) was made in 1997 and this fund was distributed in summer 1998.

The general aim of the scheme was to contribute to building a sustainable, broad-based and long-term research capability in the higher education institutions, based on individual institutional strategies. This would seek to help each institution to develop critical and self-sustaining research mass founded on existing strengths and developing new areas in keeping with its strategic perspective and plans. Inter-institutional collaboration would also be strongly emphasised as would promoting the linkage between research and enhancing the quality of learning and teaching at all levels in the institution.

3.2 PRTL Cycle 1, 1999–2001

The call for Cycle 1, the first full-scale cycle, of the scheme was made on 19 November 1998 to allocate some IR£180 million (€230 million) in competitive research grants to the higher education institutions. The closing date for the first phase of applications was to be 26 February 1999. At that stage a Cycle 2 was envisaged for 2000.

3.2.1 Objectives

The objectives of the competitive scheme for the higher education institutions were to:

1. enable a strategic, planned approach to developing research capabilities in the long-term, while being consistent with current strengths and capabilities
2. promote the development of excellent research capabilities and excellence in teaching, in order to improve the quality, relevance and skills of graduates
3. give support to highly talented individual researchers and research teams
4. encourage cooperation between researchers within and between institutions, especially both sides of the 'binary' system, in Ireland, the EU and further afield.

3.2.2 Characteristics of the proposals sought

The characteristics required in proposals for funding under the scheme were that they would:

1. promote excellence in research and teaching
2. help the participating institution to improve and develop research capability rather than near-market, short-term commercial applications and exploitation (possibly develop capability to later be involved in such commercially applicable research)
3. have project budgets for capital and/or current funding, giving a satisfactory outline and justification of the main costs, as well as detailed and verifiable building costs (building, fitting out)
4. contribute to, and be consistent with, the long-term research strategy of the institution
5. have accompanying documentation giving the institution's strategy statement on research, with details on procedures for internal evaluation of research, results of evaluation outcomes, copies of reports, research indicators, evidence of the impact on teaching and evidence of the ability to raise private non-exchequer matching capital funding (e.g. past experience)
6. include inter-institutional and/or interdisciplinary cooperation
7. not be too ambitious or unrealistic, with costs credible and not inflated
8. be fully integrated and coherent, justifying the capital/current costs, drawing the themes together, providing specific proposals, relating these to the institutional strategy and being credible and coherent with this strategy
9. be based on strengths, track records and firm long-term foundations, and not on aspirations alone
10. present one proposal/application per institution, based on the institutional strategic perspective.

3.2.3 Capital funding

Applications to cover the following costs would be considered for capital funding up to a maximum of IR£25 million for any one institution:

1. laboratories, associated facilities and equipment – exclusively (or largely so) for use of postgraduate students and researchers

2. non-laboratory workspaces
3. library developments, including space, information technology resources, reader services and others
4. land and property for these developments.

In the case of any such capital funding, 50 per cent would have to come from non-exchequer sources in a public-private partnership arrangement and this latter 50 per cent would have to be raised directly by the institution.

3.2.4 Funding of current expenditures

Applications for current funding, up to a maximum of IR£3 million (€3.8 million) for any one institution, could be made to cover the following activities:

1. postgraduate student and postdoctoral fellow support
2. equipment, consumables and supplies
3. travel, sabbatical leave and visiting researchers
4. books, journals, computer software and databases
5. publicity, promotion and communications
6. consultancy and other such services
7. conferences and workshops.

3.3 Application and assessment process

The application process would be a two-phase one: an initial preliminary screening and short-listing stage and a final assessment stage by an assessment panel of international experts appointed by the HEA.

3.3.1 Phase 1

In the first phase the detailed proposal, with capital and current costs, would

1. be prepared by the applicant institution(s)
2. contain full quantifications on all aspects and information/proof of success in raising funds from private sources to support the claim

that 50 per cent of capital funds can be raised from non-exchequer sources and

3. be submitted by the due date.

The applications would then be subject to:

4. a preliminary screening, to ensure they conform to the specifications and are consistent with the objectives of the scheme, to avoid duplication, and to assess the opportunities for inter-institutional cooperation
5. a preliminary assessment by the assessment panel to eliminate proposals with significant failings in quality of strategic planning, research or teaching contributions and then
6. a thorough assessment and short-listing by the assessment panel.

The assessment panel might then:

7. shortlist some of the proposals seeking some current funding only – such as for recruitment of research personnel and postgraduate students
8. or possibly provide some guidance on inter-institutional cooperation or joint submission of proposals, so as to eliminate duplication and seek synergies.

3.3.2 Phase 2: formal assessment

The definitive marking scheme to be used by the assessment panel would have three marking criteria or sets of desired qualities.

3.3.2.1 Criterion 1, strategic planning – 40 per cent

Under this first criterion the contribution to promoting the goals and objectives of the research strategy of the institution would be assessed. In the event of a tie, this criterion would be the determining one. The assessors would evaluate:

1. the evidence for and quality of strategic planning structures and processes
2. the quality of the presentation of the strategy by the institution in its research strategy statement, with evidence of prioritisation in respect

of key areas and activities and the quality of the prioritisation processes and outcomes

3. the effectiveness of the proposed arrangements for implementing the strategy
4. the consistency of funding proposals with the institutional strategy statement
5. the strength of proposals for integration and collaboration across and between institutions and fields of research
6. the emphasis of the proposal on establishing a critical mass of highest quality – research capabilities and facilities and, in particular, the support to be provided for talented researchers and research teams within the institution.

3.3.2.2 Criterion 2, research – 35 per cent

Under the second criterion the assessors would evaluate the merit and quality of the research project(s) proposed through the:

1. supporting data and indicators, the research publications of the teacher-researchers in international journals, the other scholarly publications of the proposers, research awards already achieved, the descriptions of the evaluation procedures already completed in the institution and their outcomes (evaluations of research proposals by named experts, independent of and external to the institution), and other relevant achievements in areas covered in the proposal
2. and the scholarly and research reputations/achievements of the teacher-researchers involved.

3.3.2.3 Criterion 3, teaching – 25 per cent

Under the third criterion the contribution of the proposal to the quality of teaching at all levels in the institution would be gauged by the assessors through examination of:

1. how, through formal procedures and arrangements, the research programme would interact with, inform and support the teaching

- programmes and curricula, and contribute to the quality of the teaching staff and their development
2. the quality of the evidence of how the proposed project(s) would improve the quality of the graduate output at all levels.

3.3.3 Formal assessment mechanism

The procedure to be used by the assessment panel to form the final consensus assessment would have the following steps:

1. general discussions among members of the panel on the assessment processes and the applications considered
2. individual marking or 'scoring' by panel members
3. obtaining expert advice and/or peer assessment of proposals or of aspects of the proposals, as required
4. specific discussion among members of the panel on each application, followed possibly by adjustment of individual marks
5. final totalling of the marks for each application to yield the panel's final decisions.

Failure on the part of any institution to procure private capital finance in line with previous undertakings to do so would lead to refusal by the HEA to release exchequer funding and withdrawal of exchequer moneys already spent under the programme.

3.4 Long-term sustainability

The scheme had one other new and highly significant feature. It gave no guarantee of further funding above any grants awarded or beyond the end of the grant period. The scheme, even though unprecedentedly large in the Irish context, was viewed as an initial stimulus to and foundation for a substantial research superstructure that the institutions would pledge to support and sustain into the future.

Indeed, the HEA required institutions awarded grants to provide assurances that the projects and infrastructural facilities provided under the scheme would continue to be sustained and developed after the scheme ended. To emphasise this key point, in the letter of offer to the

president of each successful institution, including DIT, the HEA reminded the 'head of each institution, in signing the institutional proposal (that they were) confirming that it will be the responsibility of each institution to secure and provide funding for the continued use (post-2001) of capital facilities'.

Accordingly the final DIT proposal gave the assurance that 'the additional activities (associated with the facility) will have an impact on running costs in terms of consumables and services. These additional costs, as well as any capital costs beyond the timeframe of the project, will be borne by DIT'.

This was clearly a new departure meant to re-engineer the higher education institutions so as to begin to ensure the sustainability of their research activities and move the research enterprise to centre-stage in the thinking and planning and work of the institutions.

3.4.1 A unique and original initiative

The scheme was announced by the Taoiseach, Mr Bertie Ahern, TD, as an 'historic initiative' that would 'reinforce future economic growth' in Ireland.

It was indeed historic and original on a number of scores. The amount of funding was totally unprecedented. It called for a single proposal from each institution. It placed a strong emphasis on the impact of the research work on learning and teaching at all levels in the institution and country. It placed emphasis on fundamental, 'blue-skies' research work and not on work that might be commercialisable in the near future. It posited a highly transparent assessment procedure and marking scheme that would be widely trusted and perceived as broadly fair and equitable.

The thrust of the scheme was in keeping with the drive towards a knowledge-based economy and society that the government saw as vital for the competitiveness and sustainability of the Irish economy.

Given the acknowledged need for sustainability in the national research effort, and the unspoken need for the institutions to re-think and re-focus their priorities broadly in the national interest, the scheme, while providing major help in the development of the physical and human infrastructure for a rapid advance in research, also strongly emphasised

longer-term strategic planning in the institutions as indispensable. It thus set a totally new agenda for the higher education institutions in Ireland, the details of which are still being worked out.

It was indeed, and remains, an 'historic initiative'. The challenge for DIT was to respond to this initiative in a positive, cohesive and strategic fashion.

Development of the Proposal

The proposal for the PRTL was developed over a period of several years. It was the result of a long and complex process involving many individuals and institutions. The proposal was first developed by a committee of the DIT, which was established in 1978. The committee's terms of reference were to examine the need for a national research programme in higher education and to make recommendations on the way in which such a programme should be developed. The committee's report was published in 1981 and was widely discussed. The report recommended that a national research programme should be established in higher education and that the DIT should be the lead agency in the development of such a programme.

The Director General called for any substantial written proposal for the PRTL to be submitted to the DIT by the end of 1982. The proposal was submitted by the DIT in 1983 and was approved by the Government in 1984. The proposal was then submitted to the Higher Education Authority (HEA) for approval. The HEA approved the proposal in 1985 and the PRTL was established in 1986.

The PRTL was established as a body corporate under the Companies Act, 1963. It was given a wide range of powers and responsibilities, including the power to raise and spend money, to enter into contracts, and to sue and be sued. The PRTL was also given the power to appoint and dismiss staff and to determine its own rules and regulations.

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Chapter 4

Development of the Proposal

Within the research committee of the Faculty of Science, as within the Directorate of DIT, there was fundamental recognition of the match between the thrust of the PRTL Cycle 1 scheme and the kinds of measures needed to reduce or remove the impediments to developing post-graduate research in the Institute. The scheme presented an unparalleled opportunity and challenge to the leadership of the Institute and to the leading researchers within it to make a leap forward in the development of DIT.

The Directorate decided to call for one substantial written proposal per faculty that would then be orally presented by the team of proposers for assessment by the Directorate. The decision of the Directorate would then be further developed for submission to the HEA by the due date.

However DIT had made an unsuccessful application for funding under the pilot cycle of the scheme in 1998 and it was important that weaknesses in that application not be repeated in the larger Cycle 1 scheme.

4.1 Lessons learned in the pilot cycle of PRTL

In putting the application together for the pilot cycle, proposals, including brief research plans and estimates of the funding required, were solicited from schools, individual researchers and groups of researchers across the Institute. Ten such proposals were received and these were then bound into an application document with no assessment or ranking of the quality or strength of the proposed research, the research track records of the proposers, or the match of the proposals to the requirements of the PRTL pilot cycle. The institutional strategy document attached was weak, being

a brief re-working of a document first drawn up some ten years before and not significantly updated. Most particularly the overall document was not shaped and re-shaped by input from the experienced researchers in DIT. There was little coherence or strategy in the proposal, which was essentially a compilation of discrete and disparate sub-proposals. As such it did not present a proposal for the strategic development of research capacity and capabilities within the Institute.

It was essential to avoid such weaknesses in the application for the much more significant Cycle 1, which had almost forty times the overall research funding on offer. These considerations certainly motivated the teacher-researchers in the Faculty of Science who became involved in drafting the proposal, initially for submission to the Directorate.

4.2 The immediate response within DIT to the call in 1999

Winning a substantial grant under this scheme would potentially resolve many of the impediments to developing research by providing new dedicated accommodation, including research laboratories, workshops, desk space for postgraduate students and postdoctoral fellows, seminar and meeting space, technical assistance in the laboratories, and managerial and administrative support. The possibility of reducing the administrative and monitoring burden on academic staff members to allow them a more strategic and core role in the research would be realistic and hence the possibility of drawing in more academic staff members into the research teams and so increasing the mass and creativity of the teams would also improve. It would facilitate the concept of the teacher-researcher underpinning the research and therefore the teaching functions of DIT at all levels.

The value of developing a strategic plan for DIT, and in particular for the development of research within the Institute, also struck a resonant note. Of course this would require an objective evaluation of the strengths and weaknesses of the Institute in its current stage of development, the determination of realistic but ambitious and even inspiring vision, aims and roles for the Institute in Irish society for the medium and longer term, and then the dynamic working out of the HOW, WHEN, WHERE, WHO and WHAT of the tactical steps and measures to traverse the roads from the NOW to the THEN.

It was apparent also that the PRTLl processes did not seek homogeneity amongst the higher education institutions in the country but saw that the individual institutions should develop their own strategic plans based on their niche strengths, for instance DIT's long-established orientation to industry, the synergistic interactions of research and learning/teaching, the emphasis on the teacher-researcher in its widest meaning, collaboration with other institutions and organisations in Ireland and internationally, cross-disciplinary cooperation and collaboration, quality assurance in taught and research programmes, a postgraduate research development model involving taught modules, active supervision and the induction and training of supervisors – all features that constituted strengths of DIT relative to many of the other higher education institutions.

It was equally apparent that, to be successful, the DIT proposal would have to be firmly founded on the Institute's greatest research strengths, such as the teacher-researchers in the Faculty of Science, the training of new supervisors, the formation of research teams drawing in new teacher-researchers, and the established institutional quality assurance procedures. A successful proposal would gradually assist the development of research strengths across the Institute as a whole. The proposal would have to be coherent and realistic, but ambitious and imaginative, and contribute to the development of DIT and of the country.

Another contribution a successful proposal would have for the development of research across the Institute would be to become an exemplar of a cross-school, cross-disciplinary research facility in DIT, conceptually, physically and administratively. Furthermore its use of resources to provide postgraduate scholarships, postdoctoral fellowships and visiting professorships, the integration of the research and the teacher-researchers into the local schools and faculties and into the wider functions and committees of DIT as a whole, its impact on the library, and its possible housing of the postgraduate office in the new research building to help drive the postgraduate research 'graduate school' model, all would propagate its benefits across the Institute.

4.2.1 Two key issues to be resolved

In the general welcome for the PRTLl scheme and in the preparation of an application, two points of weakness in the Institute's position would have to be urgently dealt with and resolved by the President of DIT, in the event

of the Institute being successful in obtaining capital funding under the scheme. These were:

- the procuring of the matching non-exchequer funds for any capital work
- the decision on the site for the new research building.

Because the capital grant required 50 per cent matching funds, the amount of such matching funds available would determine the upper limit to capital funds that could be sought and consequently the upper limit to the realistic ambition of the proposal as a whole. The amount of such matching non-exchequer funds available would need to be known at a very early stage in the creation of the proposal, particularly where the proposal needed to be cohesive and strategic. Fortunately the President, Dr Goldsmith, was able to procure a commitment for adequate non-exchequer funding for this purpose without too long a delay for the planning to proceed to apply for up to IR£6 million (€7.6 million).

The issues relating to the choice of the site for the building are discussed later in Chapter 7.

4.3 Consideration within the Faculty of Science

The research committee of the Faculty of Science initiated a series of extensive and intensive discussions to map out the best approach. It brought together all the teacher-researchers from all the schools of the faculty and from the School of Environmental Health in the Faculty of Tourism and Food with strong research track records – appreciable research grants, M.Phil. and Ph.D. graduates, experience of successful postgraduate supervision, external and internal research collaborations and a history of research publications – into a series of different discussion forums.

Collectively they studied the call for applications from the HEA and in particular the marking criteria to be used. The scheme posited a transparent process where the quality and cohesion of the proposal and the proposers, the strength of the Institute's strategic plan and its relevance to the priorities set out by the HEA, and the closeness of the correspondence between the proposal and the Institute's vision and plan, and the objectives of the HEA programme, would receive an objective assessment. The relative independence of the scheme from all of the main stakeholders in Irish higher education was particularly attractive and even inspiring.

From even a cursory review of the Irish higher education scene, it was clear that the competition would be extremely sharp and that only the strongest possible proposal that would score very highly in the PRTL marking scheme would have a chance of success.

Discussion sessions were organised where each research group presented their work and future plans to all the other researchers, and areas of commonality, complementarity and possible collaboration were probed. Different groups held numerous ancillary meetings to tease out issues of concern. The drive was to reveal the potential for common ground, shared facilities, shared research supervisors and external collaborators, and to agree on a plan to build on, exploit and develop this potential.

4.3.1 Background of research within the science schools

Over the previous twenty years, as outlined in Chapter 2, the Institute had increased and improved the level of research and postgraduate activities, and internationally recognised groups had evolved within the science schools. They had successfully won substantial external funding, supervised postgraduate students to M.Phil. and Ph.D. degrees in other universities and produced an extensive publication record. With the recent development of faculty structures within DIT, including the recruitment of a number of young talented researchers as members of staff, the position had emerged where a substantial improvement in the development of research in the Institute needed to, and could, be achieved.

Accommodation was severely limited and allocating dedicated space for research and staff offices was always difficult or impossible. Frequently, researchers had to share laboratory space and equipment with undergraduate students and programmes. Even though there are up to five months each year when undergraduate students are not timetabled in the laboratories, this sharing was not conducive to developing research to the highest levels.

Furthermore, access to laboratories and specialised equipment, whether dedicated or shared, was not as open or free as the demands of research would require. Access to facilities was possible only when the buildings that housed these facilities were generally open and when they were not required for undergraduate students. Special arrangements had to be made for overnight, Sunday and summer access.

The employment contract for lecturers stipulates a maximum of 560 timetabled hours per annum or sixteen hours per week for thirty-five weeks. In that the DIT Act 1992 made provision for research and for increased flexibility for heads of schools in determining how staff should be deployed, timetabled hours could include a small time allowance for the supervision of postgraduate students and pursuing funded research. Indeed the introduction of this allowance in 1995 played a positive role in encouraging the development of postgraduate research in the Institute. The resulting increased levels of activity had placed further strain on the already limited research facilities in the schools in the Faculty of Science.

Nevertheless there were a number of loosely collaborating researchers in the faculty, as well as two successful research centres, the Radiation and Environmental Science Centre (RESC) and the Centre for Industrial and Engineering Optics (IEO), which had developed around leading researchers in the ambit of the Faculty of Science during the 1990s.

A significant infrastructural development was that of the joint physics/chemistry spectroscopy facility which had been developed in Room 305 in the college since 1997. The two schools pooled their specialised spectroscopic equipment, a Shimadzu UV-2101PC Absorption Spectrophotometer, a Perkin Elmer LS50 Luminescence Spectrometer, an Instruments SA Raman Spectrometer Labram 1B (the first of its kind in the State) and a Mattson Infinity FTIR Spectrometer, and housed them in a dedicated room. This represented a 'one-stop-shop' for optical materials characterisation. They agreed to do so in order to:

- address areas of common research interest
- improve qualitatively the facilities available to the staff of both schools
- promote collaboration between the two schools
- enhance the expertise of DIT in the area of materials spectroscopy to provide leadership in this field
- improve undergraduate and postgraduate training
- open new fields of research in collaboration with other third level institutions and industries on a national and international scale
- offer a specialised service for industry to include materials analysis, characterisation and development, as well as problem solving.

The two-year experience of operating this joint laboratory showed many of the strong benefits of shared facilities – economy of space and

equipment, an environment of cross-disciplinary interaction and collaboration, joint involvement in industrial consultancy, joint supervision of undergraduate final-year projects and postgraduate research. The cohesive nature of the approach raised the profile of research in DIT and launched new internal and external collaborations on a scale that had not previously existed.

It was becoming evident that such a strategic approach would be appropriate for the PRTL scheme, and ultimately a combination of shared core facilities providing support for more specialised research groupings formed the fundamental concept of the proposal.

4.4 Review of DIT strategy for research

In working on the outline of the proposal it was obvious that DIT's research strategy also needed to be reviewed, up-dated and developed in the light of the obstacles to developing research and the opportunity presented by the new PRTL scheme to design and implement comprehensive solutions to these obstacles. The PRTL scheme was envisaged as becoming an annual competitive funding scheme and this underlined the opportunity for a major advance over a relatively short period of time.

The renewed expression of the Institute's research strategy was developed by the research leaders in the Faculty of Science along the following lines.

The proposal being developed aimed to address the pressing need to extend facilities and resources to exploit a range of research expertise and experience within the faculty. It was based on the strong track records of existing research groups and newly recruited research-active personnel.

Within many of the disciplines of science and, indeed, engineering, there are large thematic overlaps and common areas of requirement for facilities and services. DIT had long had an interdisciplinary approach to science, as evidenced by the long-standing policy, at the time, of two-subject applied science degree programmes. This had promoted strong academic interaction between the schools within science, which continued to postgraduate research level. This interdisciplinary and collaborative approach was also a strong element of the DIT policy for strategic development of research. The Institute encouraged and supported ventures involving collaboration and cross-fertilisation between schools and

faculties. This approach helped to make optimum use of available space and facilities, addressing areas of common research interest and promoting interdisciplinary collaboration. It also offered a fruitful learning ethos and experience for students.

Fundamental to the philosophy for further development was the need to target and nurture groups of staff members with research expertise. Further expertise might then be created through those expert staff members acting as mentors to encourage others less active to engage in research, and in particular acting in an advisory capacity for new post-graduate research supervisors.

The development of research collaborations between staff in different science schools in the mid- to late-1990s, and the development of a number of the interdisciplinary teams or groups involved in this proposal, particularly the joint chemistry/physics spectroscopy laboratory, reflected the Institute's new strategy to place an emphasis on promoting team/group research based on existing research strengths to a level of self-sustaining and self-funding critical mass. Furthermore these groups perceived a large degree of commonality in their measurement instrumentation and techniques. A fruitful synergy would be possible with common shared core facilities.

4.5 Internal DIT competition and assessment by Directorate

The eventual proposal outlined in Chapter 5 emerged over some months within the Faculty of Science and, at a relatively preliminary stage, was submitted to the Directorate assessment process. A number of other proposals were also submitted to this process at the same time.

The approval of this preliminary proposal by the Directorate for submission to the PRTL Cycle 1 funding scheme resulted from this open competition within the Institute and evaluation of the written and oral project briefs by the Directorate.

4.6 Further constructive aspects of the proposal

In this proposal a central element was a set of shared core laboratories that would facilitate the activities of the associated research user groups. This concept arose from the recognition that many of these areas of

research required the same basic tools and was based also on the positive experience of the joint physics/chemistry spectroscopy laboratory. The core facilities would entail large and expensive items of equipment relevant to many researchers, but not exclusively required by any one group. This sharing represented an optimum and cost-effective use of space and resources. The core facilities envisaged could ultimately support a number of other specialised research groups and themes not included in this proposal. Physical proximity of the groups could lead to cross-fertilisation and deeper collaborations between them.

Interdisciplinary expertise could then feed back into taught programme design and curriculum development, and strongly support undergraduate project work and postgraduate research. The establishment of a significant facility of this nature would allow the Institute to attract post-doctoral and visiting researchers from Ireland and abroad, further increasing academic cross-fertilisation as well as enhancing the profile of the Institute and indeed science and technology in Ireland.

Within DIT, this facility would enable more experienced researchers to encourage those less active to participate in research in their field and develop collaborative links with existing activities. This would be of particular benefit in terms of mentoring of less experienced postgraduate supervisors, even from areas outside the science schools.

The areas associated with this proposal had the added advantage of being closely related to the strategic areas identified by the Institute's research policy, and also those highlighted in a number of the Technology Foresight exercises (Materials and Manufacturing Processes, Chemicals and Pharmaceuticals, Energy, and Health and Life Sciences) and the EU Framework V programmes (Life Sciences, Competitive and Sustainable Growth, Energy and Environment, Innovation and Participation of SMEs, and Human Potential and the Socioeconomic Base). These were areas where industrial growth remained a projected outcome of concerted research activities. The establishment of the facility would enable DIT to contribute the expertise of its research staff to national and European efforts in these areas.

4.7 Comments

The process of putting the proposal together was an inspiring and creative collective intellectual endeavour. There was not always complete harmony,

but as time went on and the proposal took shape, a collective conviction of the excellence, rationality, cohesiveness, rightness and potential of the concept took hold.

The whole process was conditioned and facilitated by the objective terms of the PRTL scheme itself. From the start there was considerable consensus that the terms of the scheme were tailor-made for DIT and particularly for the researchers in the Faculty of Science, with its specifically detailed marking scheme covering three aspects or requirements:

- promoting a strategic approach to research – corresponding to the need in the Institute at that time to strategically develop from relatively scattered individual teacher-researchers to self-sustaining, self-funding groups of greater value and impact than the sum of the individual members or parts
- developing high quality research capabilities – helping the Institute to set as a first priority, building research enterprise on the foundation of its highest quality, most experienced and most productive teacher-researchers
- contributing to teaching – almost second nature to DIT staff to root the research firmly in the Institute's teaching mission and historical teaching strengths, to in turn enrich and enhance these, as sought for in the Institute's quality assurance policies and procedures.

These criteria allowed the proposal to arise logically and organically from the strengths of the staff members.

Chapter 5

Details of the Proposal

The extended research committee of the Faculty of Science considered in detail the call for applications to the PRTL Cycle 1 scheme published by the HEA. They reviewed the research strengths, research areas and track records, as well as the teaching experience, of the research-active staff members of the faculty. They also reviewed DIT's strategic plan and policies for developing the research ethos and profile of the Institute and proposed amendments that were approved. Finally the integrated proposal for a facility for optical characterisation and spectroscopy, as outlined in this chapter, drawing together twenty-two of the most research-active teacher-researchers from the schools of Physics, Chemical and Pharmaceutical Sciences, and Food Science and Environmental Health as well as the centres for Radiation and Environmental Science, and Industrial and Engineering Optics, was drafted and re-drafted for submission to the Institute selection process.

5.1 General objectives

The objectives of this proposal were to:

- underpin the development of research in a number of strategic areas and reduce the impediments to the advancement of research in DIT and in its Faculty of Science in particular
- extend the capabilities of the existing research groups and possibly form other new groups
- provide support for the developing activities of many highly talented and motivated researchers

- encourage the development and growth of research groups that might achieve the critical mass to become self-sustaining
- make optimally efficient use of new space though shared core laboratories
- provide advanced facilities in a cost-effective fashion
- develop a unique national resource which could be used to
 - lead the development of research within DIT
 - develop national and international collaborations
 - interface with industry to continue to ensure relevance of research and taught programmes
- strengthen the interdisciplinary ethos which underpins the major applied science undergraduate honours degree and diploma (ordinary degree) programmes in the Faculty
- enhance the research base to underpin the relevance of undergraduate and postgraduate programme design and curriculum development
- provide a range of state-of-the-art equipment for postgraduate research and undergraduate projects.

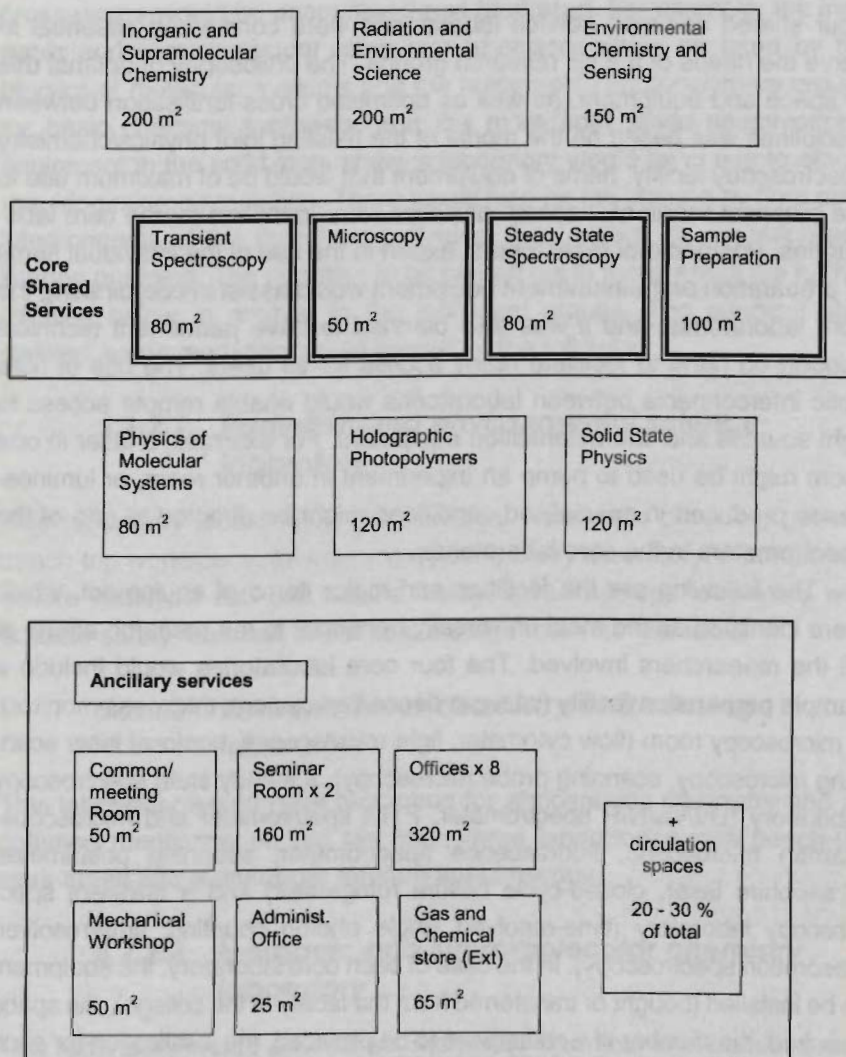
5.2 Elements of the proposal

The proposal sought both capital and current funding.

The capital funding was required to build and equip an extension to or a separate building close to the existing DIT Kevin Street buildings, amounting to some 2,400 m² of floor space. The building would house a suite of core shared laboratory facilities, surrounded by individual laboratories housing specialised facilities for the six research groupings involved. Also included under the capital funding required were major items of equipment to supplement existing facilities that would be transferred to the new accommodation. In addition there would be supporting infrastructure including a mechanical workshop, sample preparation areas, seminar rooms, research and administrative staff offices, communications and IT support, gas supply and storage, chemicals store, and circulation and common areas. A summary of the space requirements envisaged for each of the laboratories and support infrastructure areas is given in Figure 5.1.

The recurrent funding sought would be required over the initial three years of the project to cover postgraduate (30), postdoctoral (10), technical

Figure 5.1 Summary of space requirements envisaged



(4) and administrative (1) personnel, a dedicated facility/project manager, some additional less expensive equipment costs (<IR£10,000 per item), a communications/IT infrastructure, and consumables and ancillary administrative supports. The main requirements and rationale were as outlined below. Costings are not considered in any detail here but had to be set out in considerable detail in the original proposal.

5.2.1 Core shared laboratories

Four shared common service laboratories were considered essential to serve the needs of the six research groups. The philosophy of optimal use of space and equipment, as well as optimised cross-fertilisation between disciplines was based on the model of the existing joint physics/chemistry spectroscopy facility. Items of equipment that would be of maximum use to the broadest range of research activities were identified for the core laboratories. Postdoctoral researchers, expert in the use of the individual items of preparation or measurement equipment would assist in coordinating the core laboratories, and it was also planned to have permanent technical support on hand to facilitate ready access for all users. The use of fibre optic interconnects between laboratories would enable remote access to light sources and characterisation equipment. For example, a laser in one room might be used to pump an experiment in another room, or luminescence produced in specialised conditions might be directed to one of the spectrometers in the core laboratories.

The following are the facilities and major items of equipment, which were identified as the most universally beneficial to the research efforts of all the researchers involved. The four core laboratories would include a sample preparation facility (vacuum deposition system, thickness monitor), a microscopy room (flow cytometer, light microscopes, confocal laser scanning microscopy, scanning probe microscopy), a steady state spectroscopy laboratory (UV/vis/NIR spectrometer, FTIR spectrometer and microscope, Raman microscope, fluorescence spectrometer, scanning polarimeter, Ti:sapphire laser, closed-cycle helium refrigerator) and a transient spectroscopy laboratory (time-resolved single photon counting, time-resolved absorption spectroscopy). In the case of each core laboratory, the equipment to be installed (bought or transferred from the facility in the college), the space required, the number of workstations to be provided, the justification for each such major item of equipment in terms of its relevance and service to the six research groups, and the detailed costings had to be provided in the proposal.

5.2.2 Specialised research laboratories

The six specialised laboratories housing the six research groupings would be clustered around the core laboratories. While the facilities in each of these specialised laboratories would be specific to the needs of the

research activities of the group assigned to it, a significant amount of cross-usage would be encouraged and facilitated. For example, the inorganic and supramolecular chemistry laboratory would be used by the physics of molecular systems and the holographic photopolymers groups for basic chemical synthesis, and the more specialised spectroscopic equipment in the solid state physics laboratory would be of use to others requiring micron resolution. There would also be the sharing by fibre optic interconnects of the light from individual fixed lasers for excitation and Raman pumping. The activities to be carried out in these areas are further detailed below in relation to the individual groups. The principal specialised accommodation would consist of the following:

5.2.2.1 *Radiation and environmental science laboratory*

This laboratory would have six individual workareas providing general bench-top workspace, an immuno-cytochemistry laboratory, a human cell culture facility, a fish cell culture facility, a radioisotope laboratory with suitable safety features, and a cold storage room for fish tanks.

5.2.2.2 *Environmental chemistry and sensing laboratory*

This laboratory would have two areas for atmospheric chemistry and air pollution monitoring on the top floor, three laboratories with bench-top work areas and a darkroom for fibre spectroscopy.

5.2.2.3 *Inorganic and supramolecular chemistry laboratory*

This laboratory would provide six individual chemical workbenches with fume extraction, power, water, gas and nitrogen supplies, a glove box for work in an inert atmosphere, purified water supply and appropriate glass-ware facilities and supplies.

5.2.2.4 *Physics of molecular systems laboratory*

This laboratory would feature a separate optical darkroom with two optical tables, individual benches for physical/electronic characterisation of materials and structures, and a third area for general instrumentation.

5.2.2.5 Holographic photopolymers laboratory

This laboratory would be subdivided into two optical laboratories with optical tables for making and testing holograms in photopolymers, associated power and cooling requirements, and a small darkroom.

5.2.2.6 Solid state physics laboratory

This laboratory would include three independent optical darkrooms with optical tables and associated power and cooling requirements, a room to accommodate a UHV rig, and project bench space for electrical and mechanical equipment handling and maintenance.

5.2.3 Additional spaces

In addition to the laboratory spaces the proposal included a range of ancillary and support services. These included a mechanical workshop, a sample preparation facility, gas handling stores, open-plan office space for research students and post-doctoral and administrative staff, seminar and meeting rooms, and a lobby, corridors, stairs, lifts and toilets as determined by detailed architectural design.

5.2.4 Personnel

In addition to buildings and equipment a range of personnel was requested.

It was proposed to create thirty postgraduate research scholarships, each to last for three years with a view to significantly increasing the number of students working towards a Ph.D. degree.

It was proposed to employ ten postdoctoral fellows on a 3-year contract basis, distributed amongst the core laboratories and the six groups. These would provide expertise and day-to-day supervision and assistance in the laboratories.

A facility manager would be recruited on a 3-year contract to act as overall project manager and to cover the construction, commissioning and implementation phases.

An administrative assistant would be recruited on a 3-year contract to serve as administrative support for the project.



14 copies of the six volumes of the submission to PRTL Cycle 1 on 26 February 1999, with (from left) James Walsh, Vincent Toal, Matt Hussey, Paul Horan, Suzanne Martin, Tia Keyes, Siobhán Daly, Hugh Byrne

Eight stages in the construction of the Focas building from December 2002 to July 2004



Site clearance



Foundation for the basement



Serious building site



Building taking shape



First floor



Third floor in Autumn sunshine in 2003



Completing from the roof downwards



Close to finishing off in Spring 2004

Speaking at the formal launch of the Focas building on 11 November 2004



Hugh Byrne



Matt Hussey



Brian Norton, President of DIT



Tom Boland, Chief Executive of the HEA



Brian McSweeney, Government Science Advisor

Groups at the formal launch of the Focas building on 11 November 2004



Catherine Tynan, AIB Corporate Banking; Brian Norton, President, DIT; Marie Quigley, AIB Corporate Banking; Barry McSweeney, Chief Science Adviser; Hugh Byrne, Focas Institute; Frank Lynch, Manager AIB Baggot Street.



(Back Row Standing) Martin Galvin, Maria Davoren, Eoghan Ó Faoláin, Luke O'Neill, Raghavendra Jallapuram, Colm O'Dowd, Niall Stobie.

(Middle Row Standing) Gráinne Duffy, Mark Davis, Alan Casey, Sinéad Keogh, Anthony Betts, Martha Hidalgo, Fiona Lyng, Theresa Hedderman, Des O'Mahony, Ray McCue, Anthony Farrell, Niamh Kilmartin, Marguerite Carter, Sharon Nugent, Alice Vines, Noeleen Cunningham, Peter Olwell.

(Seated) Mary McNamara, Matt Hussey, Hugh Byrne, Danny Gibbons, Noel Russell,
(Front) Sarah Gallagher, Garrett Farrell, Alanna Maguire, Louisa Hartnett, Paula Maguire, Orla Howe, James Murphy, Suresh Pillai



Demonstrating an optical lay-out, with (from left) Brian McSweeney, Raghavendra Jallapuram, Hugh Byrne



Lecture in the seminar room



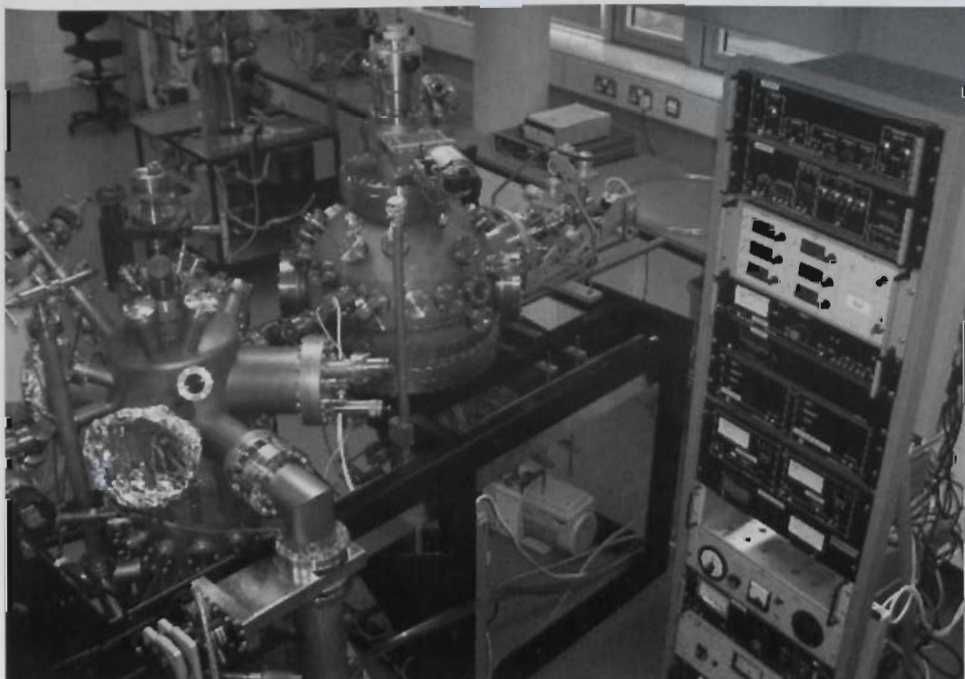
Meeting and seminar rooms and reception area

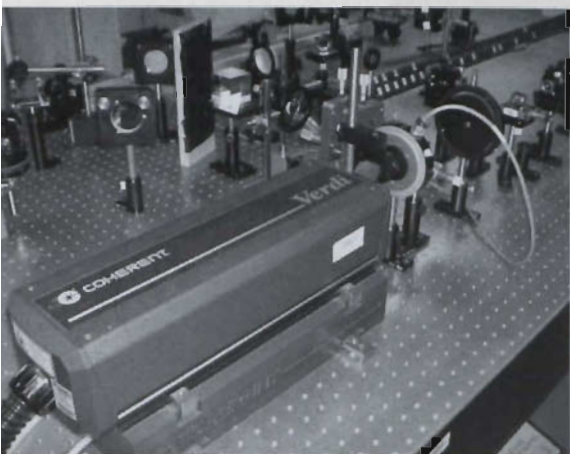


Laboratories

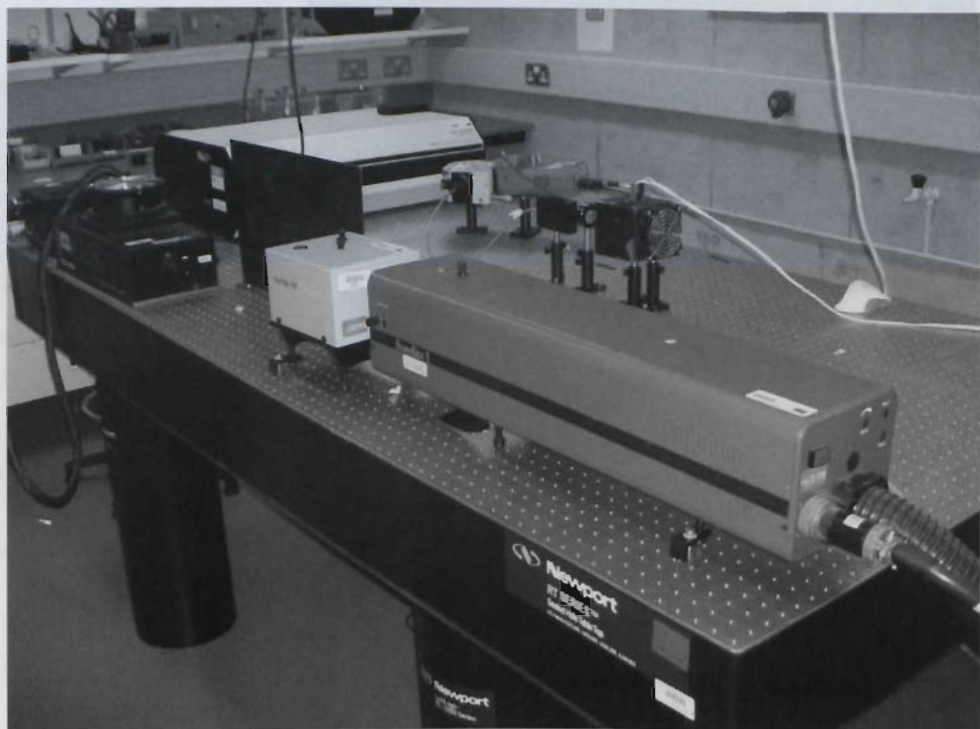


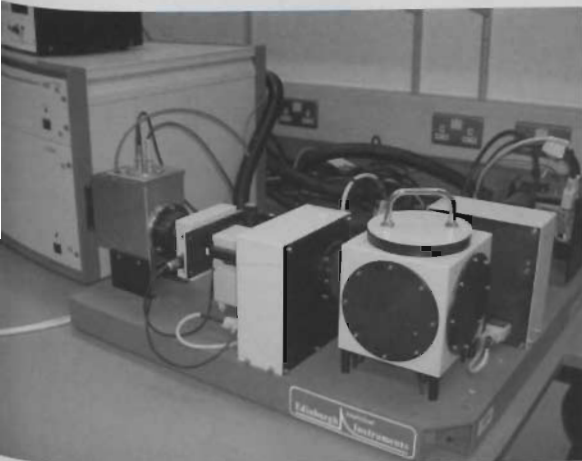
Instruments



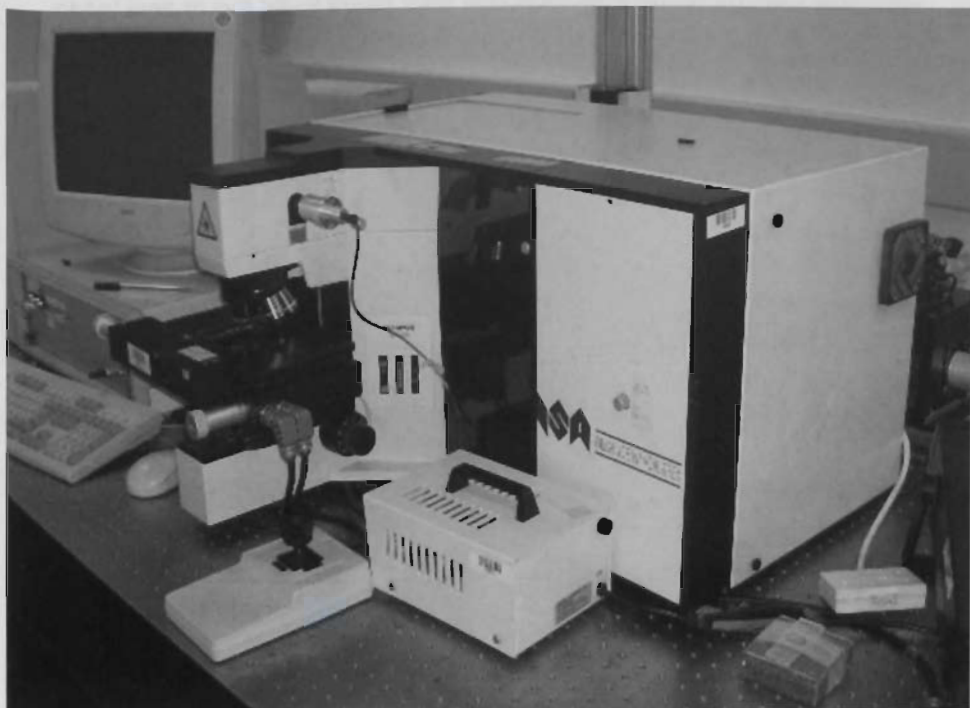


Some instruments and equipment





Further instruments and equipment





Two parts of the solar energy installation on the roof



To support the running of the facility and to permit maximum ease of access to the tools and equipment it was proposed to recruit five technical assistants to cover mechanical, IT, optical, electrical/electronic and material preparation duties.

To encourage international collaboration and to import specific areas of expertise it was proposed to make funds available to support a number of short visits by prominent researchers from overseas. They would also be expected to give advanced seminars in their fields of expertise.

5.3 Research groups, laboratories and projects

The proposal grouped teacher-researcher staff members under research topics to reflect strong commonalities and existing collaborations. Some of these staff and their activities were long established, with facilities having been built up over time, while some had joined DIT in recent years. Some of the research groupings were similarly well established, but in other cases the proposal aimed to bring together individual researchers under thematic banners to encourage synergistic strategic development of potential critical mass. A major aim of the proposal was to put all of these joint activities on a firmer footing, with adequate accommodation, equipment and support, and to actively facilitate and grow cooperation and collaboration amongst them and with external colleagues.

Each group would be particularly associated with an individual specialised laboratory, although their activities would strongly rely on the core facilities as well as interacting considerably with those of other groups. Within the context of the proposal, their immediate objectives were divided into projects growing from their earlier work. The resources that would be associated with each project had to be listed, and the degree to which they would use the core facilities, interact with other research groups and collaborate with external bodies also had to be described.

Each such project was designed to constitute a 3-year full-time post-graduate project. None of the projects was truly stand-alone and in many cases two or more activities within a group were intimately connected. The resources sought, as well as justification thereof, in terms of equipment, space and personnel, had to be presented for each group, rather than for each project.

5.3.1 Radiation and environmental science group (Maria Lyons, Fiona Lyng, Carmel Mothersill)

By 1999 DIT had a 25-year record in radiation research and the Radiation and Environmental Science Centre was the only academic centre for radiation research in the country and the only centre studying biological effects of radiation in humans in Ireland. The group had extensive experience in the identification of mechanisms by which radiation and other environmental mutagens damage biological cells, and an international reputation in this area, having made major contributions to the understanding of the mechanisms involved in radiation-induced damage. The group also had considerable expertise in the development of tissue culture models for human, fish and invertebrate systems. This combined expertise enabled the study of the mechanisms by which DNA-damaging agents, including radiation and heavy metals, kill, mutate or transform cells from different species. The particular emphasis of the research was to define pathways with a view to understanding the decision-making process that allows some cells to escape death and live with genetic damage. These would constitute the cell population at risk for producing a cancer or perpetuating a mutation. When pathways and decision points are understood it might be possible to identify substances that could prevent the persistence of damaged cell populations.

It had recently been recognised that faithful replication of DNA, which is necessary for cell growth and differentiation *in vitro* and *in vivo*, could be adversely affected by ionising radiation or other environmental mutagens, such as UV radiation, chemical pollutants or food additives. These challenges appeared to "reset" the cellular tolerance for replication integrity, resulting in genomic instability. This in turn might lead to the accumulation of mutations and increasing loss of replication fidelity. This laboratory first detected the phenomenon in 1986 as a non-clonal, high frequency event occurring in the progeny of irradiated cells that resulted in lethal mutations several generations after the original exposure. Subsequent work by several groups in the UK and USA confirmed this finding and extended the research to show that chromosomal instability could be induced in distant descendants of irradiated cells.

5.3.1.1 Projects

Two projects were proposed by this group:

- study of the mechanisms involved in the development and perpetuation of genomic instability using relevant cell lines and/or human tissue in culture. This could provide pointers for control and allow drugs interfering with the induction of instability to be identified. Information on the likely mechanisms involved in the induction of genomic instability could be used to target and then test biological agents that could have stabilizing effects.
- identification of novel bio-markers to show early effects in the multi-step development of cancer following exposure to environmental carcinogens and susceptibility to environmental agents. These effects include morphological alterations (e.g. piled-up irregular growth patterns), reduced serum requirement and growth in soft agar, and they can be used as *in vitro* markers of transformation.

Collaborations would be with Beaumont Hospital, the University of Dundee, the Gray Laboratory and MRC Harwell, the University of California at San Francisco, colleagues internally in Focas; University College Dublin (UCD); University College Cork (UCC); Athlone Institute of Technology (AIT); Daresbury Laboratory; Plymouth Environmental Research Centre; and Heriot-Watt University, Edinburgh.

5.3.2 Environmental chemistry and sensing group (John Cassidy, Pat Goodman, Jack Treacy, James Walsh)

The proposal from this group was to consolidate the body of expertise already accumulated in the Institute in the area of air quality monitoring and environmental sensing. Specifically it would extend the work on characterisation of pollutants in the atmosphere and the study of their harmful effects, and develop and characterise novel sensing methods.

Typical urban air pollution monitoring systems consist of a number of point source monitoring sites at which a variety of individual pollutants are measured. These sites are inevitably subject to local emission sources and

usually require a different technique for each pollutant. In recent years open-path spectroscopic techniques such as differential optical absorption spectroscopy (DOAS) and Fourier transform infrared spectroscopy (FTIR) have been adapted to ambient air monitoring. Such systems permit the concentration of several pollutants to be accurately measured over relatively long distances (1–10 km) within a single light beam.

In addition to pollution monitoring, it is important to be able to relate emission levels to recorded ambient concentrations. Air quality computer models are central to the process of understanding the chemistry and dynamics of atmospheric pollution and to using that knowledge to design effective strategies for pollution control. Although ambient dust levels have been measured in Dublin, little work has been done to elucidate the chemical composition of these materials. Depending on their source, respirable dusts can contain heavy metals, sulphates and a variety of polyaromatic hydrocarbons (PAH), all of which have documented adverse effects on human health.

Recent research had focused on particulate pollution of particles known as PM_{10} . The trend appeared to be developing to study the smaller fraction known as $PM_{2.5}$, and some researchers were of the view that the adverse health effects were linked to even smaller, ultrafine particles. Although it has been accepted that particulate pollution causes adverse health effects, there is still considerable research to be conducted into identifying the size range of particles that are the most significant. Another focus of the work of this group had been to monitor trends in urban air pollution levels. This had been ongoing over a period of years using an open-path spectroscopic technique in combination with conventional point-source analysers. The existing DOAS instrument, together with point-source analysers for sulphur dioxide, nitrogen oxides, ozone, benzene and toluene, had been in operation for five years at DIT Kevin Street, a southside urban location.

Another aspect of the work of this group had been trace metal analysis using graphite furnace atomic absorption and anodic stripping voltammetry. In particular the group had been looking at lead levels in potable water and was engaged in developing a technique for accurate lead determination in seawater.

Isoindoles with methoxy substituents were also being synthesised. These materials are monomers for the production of conducting polymers

either electrochemically or photochemically. By 1999 this group was also involved in the design, construction and testing of biomedical micro-spectrophotometer sensor systems. Such systems would have potential applications for monitoring the redox reactions of respiratory pigments in cell extracts and permeabilised cells.

5.3.2.1 Projects

Four projects were proposed by this group:

- inter-comparison between differential optical absorption spectroscopy (DOAS) and gas chromatography for the measurement of benzene and toluene in urban air
- development and characterisation of membranes that are sensitive to particular pollutants to produce novel detection methods. Typical pollutants to be studied would be CO₂, SO₂ and organics used in resins, paints and polymer fabrication. A variety of approaches would be taken, including the use of acid-base indicators within transparent layers for CO₂ determination and conducting layers whose conductivity varies with exposure to SO₂.
- measurement of both indoor and outdoor levels of PM_{2.5} and ultrafine airborne particulate pollution. This would involve analysis of the correlation between PM_{2.5} levels and adverse health effects, while controlling for meteorological and other possible compounding factors.
- provision of optical engineering expertise for the design, construction and development of novel instruments within the group. The specialised instruments such as the DOAS would form the primary measurement standards within the group but simpler alarm level and low specification instruments would be developed.

Collaborations would be with colleagues within Focas and with colleagues in UCD; NUI Maynooth; University of Limerick (UL); Institute of Technology, Tallaght (ITT); Trinity College Dublin (TCD); Bangor Hospital, Gwynedd; St James's Hospital, Dublin; Harvard School of Public Health, Boston; Beaumont Hospital, Dublin; and the National Metrology Laboratory in Enterprise Ireland.

5.3.3 Inorganic and supramolecular chemistry group (Mick Devereux, Tia Keyes, Declan McCormack, Mary McNamara, Noel Russell)

This group had been working on the applications of inorganic chemistry to molecular recognition, biomimetic chemistry and supramolecular chemistry. There were many motivations behind this research, for example the development of materials with novel magnetic, electronic and photophysical properties having potential applications as sensors, molecular switches in signal processing, light-energy conversion and DNA photocleavage.

By 1999 the group was working on the development of 2-D arrays of sensing sites self-assembled on electrode surfaces. Considerable work was ongoing in collaboration with Dublin City University (DCU) on the construction of novel cyclodextrin (CD) derivatives with a view to drug encapsulation and enantiomeric selection. A pyridine-substituted cyclodextrin assembled on a gold electrode surface had already demonstrated some interesting molecular recognition properties.

The development and study of novel donor-acceptor materials based on photoactive transition metal donor-acceptor sites was also being undertaken. Such complexes are capable of light- and electrochemically-induced transfer processes, with potential applications in energy and data storage. Biomimetic donor-acceptor systems were being developed inspired by the unit functions of photosynthesis.

The development of novel electrochromic materials based on conduction coordination compounds for use in electrochromic lenses and smart windows was an ongoing project in collaboration with Waterford Institute of Technology (WIT), with funding from Enterprise Ireland. Also in the area of biomimetic chemistry, the ability of metallo-complexes to mimic enzymes was being assessed and the group had been successful in the synthesis and characterisation of dicarboxylate complexes, shown to be particularly active catalysts.

Another aspect of the work of this group involved colloidal inorganic semiconductor materials and this research focused on the preparation and characterisation of well-defined nano- and micron-sized inorganic semiconductors such as PbS, TiO₂ and ZnO, with funding from Harris Semiconductors and Enterprise Ireland.

5.3.3.1 Projects

Five projects were proposed by this group:

- development of self-assembled monolayers of cyclodextrin derivatives (CDs) on metal substrates (gold and platinum) for selective detection of chiral organic species. Based on prior synthetic experience, substituted CDs that are capable of selective intercalation of biologically important chiral compounds would be created.
- development of photo- and electro-active nanostructural supramolecular species for molecular electronics, to advance on current research work in utilising synthesis, assembly and miniaturisation to the molecular level to create devices such as molecular wires, optoelectronic switches, transistors and memories.
- development of artificial photosynthetic centres. The chemical mimicking of the unit functions of photosynthesis had been a primary aim of a number of researchers over the previous two decades. There are two important motivations behind such research: the development of novel and efficient solar cells and the provision of insight into the mechanism of photosynthesis itself.
- synthesis of novel manganese and copper complexes with a view to mimicking specific metallo-enzymes. The group had developed a facile, one-step and high-yield synthetic route to soluble complexes. Using this procedure manganese dicarboxylate complexes would be synthesised and assessed as possible functional models for the non-haem catalases which had recently been isolated from *Lactobacillus plantum*.
- development of novel electrode-less metal coating procedures to facilitate the miniaturisation of electronic circuitry. The plan was to establish precise methodologies for the preparation of monodisperse colloids of well-defined sizes and shapes. An insight into the growth and behaviour of both nano- and micro-particulate materials would be crucial to the understanding of the fundamental behaviour of such materials.

Collaborations would be with colleagues within Focas and in UCD, DCU, the Forensic Science Laboratory, Queen's University, Belfast, University of Leeds, Monash University, University of Lund, NUI Maynooth, TCD and Harris Semiconductors Dundalk.

5.3.4 Physics of molecular materials group (Hugh J. Byrne, Maryanne Large)

Organic molecular materials have long been recognised as a potential alternatives to conventional solid state materials in applications as diverse as liquid crystal displays, electronic components, nonlinear and integrated optics, optical light-emitting diodes and lasers, electromagnetic shielding and anti-counterfeiting labelling. As well as considerations of cost and toxicity, the tailorability of both their mechanical and electronic/optical properties would be of considerable benefit. Organic chemistry is well developed and, for many families of compounds, an understanding of structure–property relationships is well advanced. In principle, therefore, materials could be designed and synthesised with particular desired properties, given the properties of the building blocks.

Studies of this class of materials, leading to a greater understanding of physical and chemical processes at a molecular level, could feed naturally into disciplines such as genetics, biochemistry and microbiology, eventually generating a broader understanding of biological systems.

This group had been working on the optimisation of organic polymers for laser applications by studying the fundamental processes of light emission. On-going work in collaboration with the ESPRIT 'LUPO' project aimed to prove that the primary competing mechanism is vibrational relaxation, and that this mechanism could be controlled through controlled variation of the local environment. This control could potentially lead to solid-state organic materials with light-emitting properties surpassing those of currently employed materials. This work paralleled on-going work on semiconductor materials within the solid-state physics group.

In collaboration with the National Chemical Laboratory in Pune, India, the group was also active in developing a water-based processing technique to be applied to the polymeric conductor polyaniline and polyphenylene-vinylene, a prototype highly emissive polymer employed in light emitting diodes (LEDs). The technique involved use of surfactants, followed by a micellar three-dimensional polymerisation. The group was involved in characterising the dynamics of the process, as well as the morphology, and the electrical and optical properties of the samples.

The group had continued the investigation of fullerene thin films and isolated carbon nanotubes in an on-going collaboration with the Max Planck Institute, Stuttgart and the National Institute of Materials and

Chemical Research (NIMC) in Japan. In fullerenes there exists a fine balance between a semiconducting molecular crystal-like behaviour in the ground state and a metallic-like behaviour under high-level excitation. The processes of controllably and reversibly switching between these states had been pioneered by the group in Stuttgart. This project aimed at a further investigation of these processes as well as the nature of the metastable states, in particular through *in situ* Raman spectroscopy. Nanotubes are a more recently developed member of the general family and separation and purification techniques are currently under investigation.

These structures closely parallel the inorganic nanostructures under investigation by both the solid-state physics and the inorganic and supramolecular chemistry groups and the physical phenomena tend to be similar to those of interest to the solid-state physics group.

An interesting aspect of research in molecular materials is the mimicking of biological processes. As such, the work of this group was strongly parallel to that of the environmental chemistry and sensing, the inorganic and supramolecular chemistry, and the radiation and environmental science groups.

The group was also interested in structural colour in nature, in which colouration occurs because of diffraction or interference effects rather than pigmentation. Many of the structures that produce this effect are laminar, essentially stacks of thin films of different refractive indices. This work would continue collaboration with the University of Sydney and the Australian Museum in this area, but would also overlap strongly with the optical micro-cavity work of the solid-state physics group. When the optical cavity is of the same dimensions as the wavelength it is referred to as a micro-cavity. A developing project at the time involved characterising the detailed optical properties of these microstructures using the suite of measurement facilities available. This involved polarisation studies and angular dependent and diffuse reflectance. Also essential was a study of their morphology by means of microscopy. It was anticipated that chiral polymers for making novel optical microstructures would be developed. These optically active layers could be incorporated in multi-layer structures, such as micro-cavities, which would introduce directionality into the structure. In other words, light could be transmitted in one direction but not the other, allowing the development of, for example, optical isolators.

Such a project would require accurate characterisation of the optical activity of the materials by polarimetry.

5.3.4.1 Projects

This group proposed five projects:

- development and characterisation of water-based light emitting and conducting polymers. The project would continue the collaboration with the NCL in Pune and would compare conductivities and luminescent yield to conventionally produced materials and correlate them with morphology, chain length and other structural parameters such as cis-trans ratio.
- investigation of the correlation of vibrational spectroscopy and luminescence quantum yields and stimulated emission. Previous studies of dyes in solution had illustrated that solvatochromic effects resulting from dipole interactions, rotary effects and conformational changes can affect the quantum yield. This study was aimed at illustrating that a further major influence on the radiative quantum yield was the inhibition of nonradiative processes in local environments whose vibrational structure does not correlate with that of the dye moiety.
- construction and characterisation of polymer LEDs. This project was aimed at developing the work of the above two projects towards prototype devices. Initially single layer sandwich structure devices of both polymers and oligomers in solid matrices would be employed. Current/voltage and current/luminance characteristics would be monitored for a range of film thicknesses and electrode materials.
- investigation of the nonlinear electronic and optical processes in fullerene thin films, which can be chemically doped to metallic and even superconducting states. It had been shown that optical pumping could produce similar metallic states in crystals and it was anticipated that the high intensity state would possess unique nonlinear optical properties. This project would aim to utilise electronic injection to generate high currents in thin films and so induce reversible metallic states.
- construction of model laminar structures to mimic natural colour systems and assessment of their optical and structural properties. The theme here would be the study of optical microstructures found in nature, including multilayer stacks and 2- and 3-D diffraction gratings.

Collaboration would be with colleagues within Focas and in NCL, Pune; TCD; Covion Organic Semiconductors, Frankfurt; the French Commissariat à l'Énergie Atomique (CEA); Sony Research Laboratories in Fellbach; Max Planck Institute Stuttgart; the Japanese NIMC; University of Sydney; and the Australian Museum.

5.3.5 Holographic photopolymers group (Clodagh Feely, Suzanne Martin, Sean Sheridan, Vincent Toal)

This group had a record of research in photopolymer holographic materials as well as techniques for surface metrology and defect detection using holographic interferometry, speckle interferometry and white light interferometry. Many of the systems used by the group had evolved from research activities in holography, and the development of photopolymer holographic recording materials had been a key aim of the group for some eight years. This research work was highly interdisciplinary, involving many aspects of physics and chemistry, and so ideally suited to thrive in the proposed laboratories, making use of all the facilities provided.

A novel self-processing holographic recording material had been developed by the group and optimised for high diffraction efficiency. In conjunction with the physics of molecular systems group, considerable work had been done on the chemical aspects of the recording process. A combination of physical and chemical processes occurs when a hologram is recorded in the photopolymer and further work using spectroscopic equipment to trace processes such as the diffusion of specific components was planned. The applications of this photopolymer in holographic imaging, diffractive optical elements and holographic interferometry for surface metrology had already been demonstrated and published but needed further investigation if the material was to be developed to its full potential. There had been international interest in these developments and future applications envisaged included display holography, optical data storage and holographic security systems.

5.3.5.1 Projects

Three projects were proposed by this group:

- studies to improve the resolution capabilities by investigating and controlling the physical recording processes. Development of the photopolymer

recording material was ongoing. Improvement of the resolution of the material would greatly expand its range of applications.

- automation of the holographic material testing procedures and data analysis. This would increase testing efficiency. The main test of these materials is for their suitability for recording holographic gratings and at present each holographic element is individually recorded and tested, limiting one to a maximum of about ten recordings per day.
- development of practical applications of the recording medium with particular emphasis on holographic data storage and surface metrology using holographic interferometry.

Collaborations would be with colleagues within Focas and in the University of Agriculture, Plovdiv; University of Mannheim; the Department of Engineering Technology in DIT; and the European Commission's Joint Research Centre (JRC) at Ispra in Italy.

5.3.6 *Solid state physics group* ***(Siobhán Daly, John Doran, Paul Horan, Des O'Mahony)***

The study of the solid state offers a considerable challenge to the fundamental scientist and the materials engineer as well as being technologically and economically important in Ireland today. Companies such as IBM, Seagate and Intel make extensive use of recent physical research into materials and the time from proof-of-principle to production in this discipline is now measured in months rather than the years typical of other fields. For instance, the discovery of giant magnetoresistance (GMR) in the mid-1990s led to a revolution in hard disc technology that was brought to the marketplace by IBM within two years of the initial publication of results.

Ultra-high vacuum (UHV) technology is employed to prepare and preserve ultra-clean crystalline silicon surfaces. Metals such as gold, copper, silver and indium deposited on these surfaces in thin layers of less than one deposited atom per surface atom can be induced to form highly regular and localised structures, in some cases forming idealised quantum wires. These nanostructures were of increasing practical interest but were also ideal model systems for the study of the fundamental physics of low dimensions. A reflectance anisotropy spectroscopy (RAS) system had been developed for optical studies of such systems. The structural analysis

technique of low energy electron diffraction (LEED) was employed as a diagnostic tool and additional Auger spectroscopy capability was planned for this facility. In addition, research was continuing on the magnetic properties of nanoparticles of transition metals such as Rh, Fe and Co. Optical characterisation was done in-house, but the acquisition of scanning probe microscopy facilities would greatly enhance the ability of the group to carry out further leading-edge research in this area.

A low temperature photo-thermal ionisation spectroscopy (PTIS) system was developed to characterise point defects. PTIS is a hybrid optical and electrical technique, complementary to existing conventional spectroscopic characterisation techniques, and has the advantage of probing directly the interaction between the excited state structure of defect-related levels in the forbidden band gap of a semiconductor and the band edges. Experience gained in the characterisation of defect structures and their interaction with the host semiconductor material was being extended to the evaluation of iron-related defects in triglycine sulphate (TGS), a ferroelectric material that had been shown to be optically sensitive in the ultraviolet spectral region. Such a material might be exploited in the production of high spatial frequency holographic gratings. Access to preparation facilities would enhance the ability of the group to routinely produce TGS:Fe samples and access to an extended range of spectroscopic analysis techniques would facilitate the characterisation of iron-related defects in TGS and simultaneously allow the determination of optimum sample preparation criteria.

In relation to photonic microstructures, work had been underway on the control of spontaneous emission in planar semiconductor microcavities and the implications this might have for LEDs. Control of the spatial and spectral properties of the emission would be quite easy to achieve but control of its temporal characteristics would be difficult. The coherent dynamics of cavity-polaritons in strongly coupled microcavities had also been studied, and this research work was aimed at uncovering the fundamental dynamics that determine the radiative timescales in this new and promising type of physical system. The optical properties of natural and designed non-periodic planar structures were also being studied.

The work on free-space optics and semiconductor modulators would concentrate on the study of solid-state III-V optical cavity modulator structures for such applications. In particular the work would probe the

fundamental limits of these structures as they approach micro-cavity dimensions. This would be strongly linked to the fundamental work on photonic microstructures. The development of a versatile emission and absorption spectroscopic facility with micron resolution would be central to this work and would be of use to other researchers in the overall project. An allied area of research would be the development of demonstration systems employing devices for applications in optical interconnection and optical computing. This work would include issues of system design and architecture, micro-optics and opto-mechanics, and concentrate on optical neural systems exploiting the high parallelism of optical systems.

5.3.6.1 Projects

Five projects were proposed by this group:

- investigation of micro-cavity effects in vertical cavity semiconductor modulators and amplifiers. The limitations in possible optical modes allow the fundamental optical properties of such a structure to be manipulated.
- studying the emission from optical microstructures that are designed to optimise the performance of light emitters in terms of speed or extraction efficiency. Modification of the temporal characteristics of the emission in planar structures represents a major challenge to material science on a fundamental level.
- development of defect characterisation in semiconductors and other materials. Defects occur in all crystalline materials, and may be either extended or localised in nature. The evaluation of point defects had been a fruitful research area for many decades. In particular the spectroscopic analysis of defect related energy level systems had provided material-specific data relevant to device manufacture.
- generation of transition metal quantum wire structures in UHV and their study using reflection anisotropy spectroscopy and low energy electron diffraction. The aim would be to optimise techniques for the growth of metallic quantum wires on semiconductor surfaces that are already successful and reproducible. Optical methods would then be the most appropriate non-invasive methods of assessing conductivity and quantum confinement, and the group would concentrate on using reflection anisotropy spectroscopy as its main optical analytical tool.

- conducting atomic force microscope/magnetic force microscope (AFM/MFM) and optical studies of transition metal magnetic multilayer systems and magnetic nanoclusters that are key components in new technologies for bulk data storage and retrieval.

Collaboration would be with colleagues within Focas and in TCD; the National Microelectronics Research Centre (NMRC) in the Tyndall Institute at UCC; University of Glasgow; Heriot-Watt University, Edinburgh; Supelec, Metz; l'Ecole Polytechnique Fédérale de Lausanne; DCU; Royal College of Surgeons in Ireland (RCSI); University of Liverpool; Technical University of Berlin; Lucent Bell Laboratories at the Brookhaven Synchrotron, New York; University of Utrecht; and Philips Research Laboratories, Eindhoven.

5.4 Facility and financial management

The proposal envisaged the overall facility as an integral part of existing DIT structures, particularly to ensure that maximum benefit would flow back into the core teaching activities. The staff and postgraduate students involved would remain members of their respective schools, and continue to be party to the established academic management structures. In order to ensure the smooth execution of such a major project it was proposed that a senior staff member would be recruited as a facility project manager for a 3-year contract, with an assistant administrator. The duties of the project manager would include liaising with staff during the detailed design phase, liaising with contractors during construction and fit-out, overseeing the commissioning of the laboratories, and facilitating the initiation and day-to-day running of the laboratories and other spaces.

Operations would be coordinated through a facility committee comprised of a representative of each laboratory and the facility manager. The committee would meet regularly and would be represented on the Faculty of Science research committee. The research laboratories would be coordinated by the associated academic staff and the relevant postdoctoral researchers. Technical support for the clean preparation room and the mechanical workshop, and electronic, optical and IT support was included in the proposal to ensure optimum use and regular access to all the facilities. It was planned that these technicians too would ultimately be integrated into the existing DIT technical staff arrangements.

Financially the facility would be administered as a cost centre through the DIT finance services. The postgraduate bursaries would be administered through the existing postgraduate studies office and be subject to the same academic management as other scholarships.

5.5 Match to PRTLl programme objectives

The proposal was strongly consistent with Institute policy on research. Increased research activity and postgraduate numbers were identified as key objectives for the Institute, but by 1999 research activities within the Faculty of Science were space-limited. The proposal sought to provide the basic accommodation, equipment and supports for a significant increase in postgraduate student numbers and associated academic endeavour in a focused manner.

The Institute had taken a strategic approach to promoting research in a number of key areas. In determining this targeted proposal the Institute acknowledged the relatively mature nature of research in science, particularly in optical characterisation and spectroscopy. It also acknowledged that a coherent proposal from the Faculty of Science, based on the research-active staff there, would have a good chance of success in the national competition. By 1999 some 50 per cent of postgraduate research projects undertaken within the Institute were supervised within the Faculty of Science, almost half of these by staff involved in this proposal. This reflected their continued success in winning funding for students and equipment from the Institute's internal funding mechanisms, as well as from external sources. Establishment of the shared interdepartmental spectroscopic facilities was further evidence of strategic development and the support of the Institute for these activities, and the desire to build upon those existing strengths.

The fact that the shared facilities would be readily accessible to all staff in the Institute would help to strengthen research activities in other areas, and thus further the Institute's aim of broadening the research base. The incorporation of both expert academic support from post-doctoral researchers and direct technical support with the shared facilities would facilitate staff from other areas and institutions to come and make optimum use of the facilities. The planned facilities should prove even more attractive to other users and act as a platform for inter-institutional

collaborations. Encouraging interdisciplinary links and collaborative efforts was fundamental to the philosophy of the proposal and in this also strongly reflected Institute policy.

The structure of the proposal implemented directly the strategic decision to establish groups that would have a good chance of developing self-sustaining critical mass in the conventional sense of research topics, but also more significantly as centres of excellence possessing a unique range of skills. The specific research groups represented a mixture of well-established activities, and the logical grouping of more recent efforts associated with staff members who had lately joined the Institute. The provision of these facilities at that juncture would represent an opportunity to further integrate these activities into the cohesive research programmes set out on this proposal.

5.5.1 Development of high quality research capabilities

Clearly the proposed development would greatly enhance the research capabilities of the staff involved, and the Institute as a whole, in providing basic space within which to work, state-of-the-art equipment to work with, and the personnel to make it all function together. The choice of facilities requested represented the results of long and detailed discussion between all staff, and would enable the execution and expansion of a range of research activities. In combining equipment usually found scattered between chemical, physical, biological and engineering laboratories, the planned facility would offer a unique combination of services. As well as directly enabling the activities of the staff involved, the facility would make the DIT attractive as a partner in collaborative research. Along with the established expertise, there would be a valuable instrumentation resource not readily available elsewhere. This would help enhance the profile of DIT nationally and internationally, and make it a more attractive choice for good postgraduate students, postdoctoral researchers and high quality staff.

The approach of having core shared facilities made it possible to justify resources of equipment and personnel that could not be readily acquired by any one research group, no matter how vibrant. By pooling resources the arrangement would be cost-effective and the work of all the groups involved could benefit greatly. The principle of targeted research

groupings was central, and represented an equally important component of this proposal. This recognised the importance of seeking to develop groups of critical, self-sustaining size. Fruitful interaction and cross-fertilization would be ensured by an underlying set of common research techniques and tools, and a working environment that facilitated frequent interaction.

At the time of writing the proposal, the twenty-two staff members involved supported about forty-four postgraduate students and five postdoctoral researchers. Almost all of these were supported under separate, individual funding schemes and thus represented a major endorsement of their collective work by the Institute and other outside funding bodies. Collectively they had authored over eighty refereed papers or presentations in 1998, and over 400 in the previous five years. This level of activity and productivity was all the more significant given the relatively limited levels of dedicated accommodation and resources available, and the teaching and administrative load borne by staff of the Institute. Furthermore, the scope of the proposal was not out of scale with the existing level of activities. The proposal combined a number of staff with established track records of national and international calibre with more recently recruited staff with strong records of research at doctoral and postdoctoral level, both in Ireland and abroad.

The extant levels of activity were only sustained with extensive links to other institutions. Listings of on-going collaborations were cited in the proposal and given in more detail in other accompanying documentation. They covered most third level institutions in Ireland and a range of eminent institutions abroad. Of the forty-four postgraduate students referred to above, eight were located at other institutions in Ireland, including Enterprise Ireland, NUI Maynooth and TCD. The limited experience of the existing shared spectroscopic facilities had highlighted the capabilities of this type of centralised facility in generating collaborations with other institutions and industries. This could only be greatly enhanced with the full range of measures proposed.

The choice of equipment, particularly the most expensive instruments, was informed by the concept of ensuring, where possible, complementarity with the resources of collaborators, particularly those in the greater Dublin area. In this way the interests of the DIT was served as well as those of the collaborators.

5.5.2 Contribution to teaching/learning

The proposal also fulfilled the Institute requirement to have strong links between the research activities and the core undergraduate teaching activities.

DIT offered an honours degree programme in applied sciences that encompassed two major science subjects at equal levels for four years. The subjects could be chosen from among mathematics, physics, physics technology, chemistry, computer science, software engineering and food science. The programme also had minor strands in management studies, ancillary mathematics and a European language in all years. In the final year students undertook a major project proposed and supervised by an academic member of staff. Many of the projects were conducted in association with existing research activities, or were developed to explore new research areas. The programme was by definition interdisciplinary. Indeed, in this structure could be seen the genesis for many of the elements of this proposal. There were also a number of other degree and diploma programmes that drew strongly on the techniques and research areas covered in this proposal, including the Degree in Chemical Sciences, the Technician Diploma in Applied Science (Physics, Chemistry and Biology options) and the Diploma in Chemistry. As with the applied sciences degree, all of these programmes involved a significant research project element.

The proposal impacted most directly on teaching in that almost all of the staff involved taught extensively on these programmes, thus ensuring students were exposed to the most up-to-date methods and knowledge. Curricula were designed and developed by programme committees comprised of relevant personnel from each discipline. Optical and spectroscopic characterisation techniques were important elements in all these programmes and so most of the staff members named in this proposal were involved with one or more programme committees, providing further direct links from research back into the content of undergraduate programmes.

These procedures were governed by the quality assurance procedures of the Institute as set out in the Institute's academic quality assurance handbook and included programme design, validation involving internal and external experts, day-to-day monitoring, annual reports with external examiner reports, and 5-year self-study and review, again involving internal

and external experts.¹ At each stage these procedures called for input from and relevance to the research activities of the staff members. They provided a direct route for the enrichment of the relevant programme from the research activities of staff members and the research and industrial links available to them.

As outlined above all the programmes involved significant project elements. These had always been closely linked to research activities where possible, although this had not always been possible due to limited research space and facilities. The availability of the proposed facilities would greatly enhance the ability to offer students high calibre projects in a stimulating environment. The proposal impacted directly on postgraduate teaching by providing funding and facilities to increase the number of students studying for a Ph.D. by research. This included the related provision of linked seminar rooms for regular research presentations, which were also attended by advanced undergraduate students. It would also be an integral part of the duties of the proposed visiting researchers to give advanced seminars in their field of expertise.

In providing state-of-the-art facilities for degree and diploma project students, along with postgraduate students, these would gain hands-on experience with a range of advanced techniques.

Such equipment and techniques would be essential to many industrial areas and exposure to them would greatly improve the standard of graduate skills and versatility. The possibility of working in a dedicated research facility would greatly enhance students' perception and appreciation of the scientific/industrial working environment. More importantly the interdisciplinary nature of the facility would reinforce the need for such a range of skills. The existence of this unique combination of facilities would also offer the potential to develop specialised programmes for continuing professional development.

5.6 Conclusions

The evidence presented in this proposal, and in further accompanying documentation, showed that the proposal was consistent with the strategic programme of the Institute to develop research, supported existing and new researchers, and was strongly tied to both postgraduate and

¹ *Course Quality Assurance Handbook*, 2nd ed., Dublin Institute of Technology, Dublin, 1997.

undergraduate educational programmes. It presented a cost-effective route towards establishing a state-of-the-art facility in which to develop specific aspects of research expertise in DIT, and the means to ensure the facilities would be as widely accessible as possible, including for materials-based activities in DIT Cathal Brugha Street and DIT Bolton Street. The choice of facilities proposed and the omission of others were the result of extensive discussion among the staff involved and others, based on the shared facilities being of common need, and of individual groups having clear necessity for regular access, including collaborators from the greater Dublin area and further afield. Acceptance of this proposal and winning of the funding in the national competition, and the provision of these facilities, would have a very major impact on research throughout DIT.

This proposal was also well matched to the objectives of the PRTL scheme. It represented a route towards the strategic development of the capacity and capabilities of DIT to engage in and support research activities, to provide resources for postgraduate education, and to impact favourably on teaching and learning at all levels.

Chapter 6

Survival During the Building Phase

The Institute was notified at the end of July 1999 that the Focas application had been approved for funding of IR£8.2 million (equivalent to €10.4 million) (some 4.5 per cent of the total national funding allocated) over the following two years under the HEA PRTL 1999–2001 scheme. This included IR£2.3 million (€2.9 million) in recurrent funding, IR£4.4 million (€5.6 million) in building capital funding and IR£1.5 million (€1.9 million) funding for equipment and furniture.

6.1 Priorities after the grant had been won

The tasks immediately after the grant had been won were to plan and construct the new research building as quickly as possible while simultaneously proceeding with the planned research activities and projects of the six groups during the construction phase.

The key first step was to appoint the facility project manager and an administrator to assist the manager.

6.1.1 *Appointment of facility project manager and administrator*

The 3-year contract of the facility project manager was envisaged as covering the early consolidation of the research groups and their collaboration during the phase of planning, building and equipping the facility, as well as the initial phase of fitting out, commissioning and fully operating the newly built facility. The work of the manager would be to manage and pilot the overall project through these phases, in consultation with the staff

researchers involved, and reporting to the director of the Faculty of Science. In the advertisement for the post, the person was required to have a Ph.D., preferably in an area of chemistry or physics, experience in research project management and a track record of acquiring funding for collaborative research. An ability to develop research collaboration between different disciplines in an academic environment was also considered essential. Experience of collaborating with industrial/research organisations in Ireland and internationally was considered an advantage, as was undergraduate teaching experience. An eagerness to undertake an exciting and pioneering challenge was viewed as essential.

In May 2000, Dr Hugh Byrne from the School of Physics, who had been the leader in creating, shaping and drafting the Focas proposal in the first place, was appointed the manager.

Also appointed soon afterwards was an administrative assistant to provide support to the manager as well as a reception service to the facility overall.

6.1.2 Implementation team

An implementation team for the project was formed, consisting of the director of the Faculty of Science, the director of finance, the buildings officer, the research finance officer and the project manager. This team met regularly, about monthly, to review the progress, and seek to resolve issues that arose.

6.1.3 Local management group

The local management group consisted of a representative of each of the six research groups and the project manager. Its role was to resolve issues that arose and monitor the progress of the research work.

6.2 Progressing the research programmes

In November 1999 the HEA requested an implementation plan for the overall project. In preparing this plan and interacting with the HEA in this process, it emerged that while the original plan submitted envisaged the research programme to be facilitated by and carried out in the new state-of-the-art facility, i.e. after it was built, the HEA required

the research programme to proceed in parallel with the building programme.

The teams involved in the programme agreed to progress the work planned, in a skeleton fashion, but to as full an extent as possible, during the construction of the building. This would involve developing the projects proposed, recruiting postdoctoral fellows and postgraduate students, and purchasing equipment.

However accommodation problems had to be overcome to allow development of the projects already underway. Thus, two houses owned by DIT, 33 and 34 New Bride Street, were eventually refurbished by late in 2000, using money from the grant. The provision of thirty desk spaces allowed the re-housing of research students then occupying laboratory space, and also the accommodation of postdoctoral fellows. The laboratory space thus freed allowed some of the equipment for the programme to be purchased and commissioned. Also current doctoral students working on projects that were to be part of the programme were transferred to the payroll of the programme.

Office accommodation was also allocated within the Kevin Street college for the manager and administrative assistant for the duration of the construction project.

6.2.1 Unforeseen issues and measures

Accommodating some thirty additional postgraduate students and the new equipment in laboratories so as to implement as much as possible of the planned research during the construction phase was very difficult in the context of the limited space available within DIT. In particular, the task of liaising with the research groups and finding acceptable solutions gave rise to un-anticipated delays and consumed considerable amounts of the manager's time. Obtaining permission from the HEA to divert some capital funding to refurbish interim accommodation also gave rise to delays.

This was the first major programme of the HEA to involve public-private partnership and there was a considerable learning curve involved for all parties: the HEA and the institutions, including DIT. Certainly DIT experienced delays in setting up the legal vehicle to procure and manage the matching non-exchequer funds appropriate under the taxation legislation and this, in turn, delayed the outfitting of the interim laboratories. In order

to process the public–private partnership according to Section 843 of the Taxes Consolidation Act the independent company DIT Research Ltd. was established. The HEA eventually did not release capital funding until mid-2001 and major capital expenditures could not be made until then.

Early in the project, due to budgetary restrictions, the HEA cut all of the grants awarded within the scheme by 10 per cent across the board. The currency conversion in 2001 from the Irish pound to the Euro led to a substantial increase in equipment costs because many of the items of equipment had to be purchased from the sterling zone. During the period 1999–2002 inflation in the building industry had contributed further to the costs of the project. Consequently reductions had to be made in the building features and in some of the equipment to be acquired and consequent changes had to be made in the plans, already well advanced. These tasks also entailed considerable delays.

The recruitment of the required numbers of postgraduate students was also more difficult than anticipated, given the sharply increased recruitment underway in all of the higher education institutions, and in the early years some undergraduate research assistants on technician level salaries had to be recruited to ensure the progress of the research work in the groups.

6.2.2 Research progress under difficult circumstances

The six groups proceeded to carry out their research projects as best they could in highly restricted accommodation and without much of the equipment envisaged for which funding had been obtained. The years during which the new building was being built might be characterised as a ‘batten-down-the-hatches’, ‘survive-at-all-costs’ period and as those years stretched on so too did the challenge to the morale and determination of the teacher-researchers involved. Initially it had been hoped that the building would have been built and occupied by the end of 2001. But the planning and construction processes had many false starts and delays and the building was not completed and handed over for use until July 2004, some five years after the announcement that the grant had been won and some two-and-a-half years after the December 2001 date envisaged for the end of the overall project.

Even during those difficult years the groups, while struggling with difficult and unfavourable circumstances, experienced some significant highlights and victories. For instance, as shown in Figure 9.1, a number

of the groups continued to win significant funding for their research projects and their general performance was assessed to be excellent in a number of international and national peer reviews.

6.2.3 Submission to PRTL Cycle 3, March 2001

There were also some setbacks. A submission was made for funding under the PRTL Cycle 3 scheme in early 2001, which involved a substantial development of the Focas model of Cycle 1 coupled with strong collaborations with the Royal College of Surgeons in Ireland and St Luke's Hospital. The proposal also incorporated food science from the Faculty of Tourism and Food as a new and emerging research area within DIT. Unfortunately this submission was not coordinated through the associated researchers and was also characterised by some of the weaknesses of the unsuccessful application for the pilot cycle in 1998, and was also unsuccessful.

6.2.4 International assessment, February 2002

A requirement of the PRTL scheme was that each endowed project would be reviewed and assessed by an international assessor on behalf of the HEA around the time of the scheduled end of the project. This international assessment took place on 7–8 February 2002. The assessor was Professor Eigil Praestgaard of the University of Roskilde in Denmark and he was accompanied by Dr Eucharía Meehan from the HEA. The assessors came equipped with a series of standard queries on which they sought information and comments.

On the first day the visitors were introduced to the background and given an overview of the Focas project. Senior representatives of each of the six research groups then gave presentations on the progress of their research. The visitors were also brought on a tour of the interim laboratories.

On the second day they were given presentations on the building design, the status of the building programme and the finances of the project.

6.2.4.1 Report on the assessment

The report by Professor Praestgaard, reproduced below, took the form of the set of standard questions followed by his description of the replies he had received and observed, together with his comments.

6.2.4.1.1 'Is the Centre established?'

'The Focas centre does not currently exist as a separate building as proposed in the original proposal. Space has been leased so as to allow accommodation, within the existing institute, of some of the core laboratories that are part of the original proposal. The programme has stressed the importance of setting up core laboratories, each of them containing equipment of related kind. It is a characteristic of this programme that the important part seems to be the establishment of these core laboratories to provide the necessary conditions for research groups, rather than the research groups being specifically orientated in certain thematic areas. The six research groups to a large extent will follow routes where the common core laboratories determine the topics and direction, rather than the reverse.'

'Group 1: Radiation and environmental science (group), formed on the basis of existing research activity, has a clear theme and is very prolific with regard to generation of publications and the output has clearly increased due to the resources provided by the PRTL I funding. Attempts to include new techniques learned from the other groups have also been undertaken. In contrast, other groups under Focas have more diverse programmes. The scientific activity has increased in this group as would be expected because of increased resources and a lower teaching load.'

'Group 2: Environmental chemistry and sensing (group) appears to have a number of very individual, distinct programmes with a limited resource applied to each, i.e. one postgraduate student. The DOAS project is very important and this has received considerable funding through European programmes. With regard to the other projects, an increase in collaboration activity with other institutions would be advantageous in order to strengthen this group. Much of the work has a strong similarity with work carried out normally in environmental agencies and this should be taken into account and exploited when considering the future of the work. Research in ophthalmology is not carried out elsewhere in Ireland and should be considered in this respect.'

'Group 3: Inorganic and supermolecular chemistry (group) appears to have a common theme around cyclodextrin exploitation and titanium

chemistry. A lot of the recent activity of the people involved is intricately linked with work in other institutions such as TCD and DCU. This is to be encouraged whilst the effort to heighten the specific profile of DIT and make its contribution in this area more visible in the coming years should be the priority. The food science and environmental health areas should be fostered.

'Group 4: Physics of molecular materials (group) has coherence in its approach concerning the thematic areas being researched. This is one of the groups that, given the ability to attract a good number of students and postdoctoral fellows, has good potential. This area is an extremely competitive area and thus it is difficult to attract and retain the calibre of student and researcher necessary to keep to the forefront of this science. The (oral) presentation was given by a recent graduate, whose work shows potential. It is important for an institute such as DIT to be in this area of materials research.

'Group 5: Holographic photopolymers (group) clearly had its working conditions improved by the funding of the PRTL. It remains unclear if new research work has been initiated in this field since the funding was provided. Some work on food science has been initiated.

'Group 6: Solid State Physics (group) has been allowed to initiate projects following the procurement and establishment of the equipment. These are thus at a very early stage and the impact and viability remain to be seen.

6.2.4.1.2 **'Does it function according to what was foreseen in the work programme?'**

'In the case of many of the core laboratories, the help given to new users, students and visitors is provided by postdoctoral fellows. Undoubtedly the effective running of the laboratories is due to these postdoctoral fellows. It raises however two fundamental questions:

- a. *does DIT envisage a continuous running of these laboratories in this core fashion?*
- b. *how do the management ensure that the appropriate recognition is given to these young well-trained postdoctoral fellows?*

6.2.4.1.3 'Does it support other research in the Institute and facilitate links with industry?'

'It is clear that there are a growing number of researchers at the Institute who are using the facilities. In addition a good number of researchers come from external institutions, up to 1.5 user days per week from universities and 0.25 user days per week for industrial consultancy. This is a commendable development and this involves not just use of the equipment but dependence on and recognition of the operator contribution.'

6.2.4.1.4 'Specific points regarding this grant'

'As already indicated above, the format of this programme is not based around the setting out of thematic areas for research but rather the establishment of a necessary instrumental platform for supporting and developing existing research potential. There is no doubt that this is an important and decisive step forward for 'facilitating' research of a competitive nature at DIT. To ask for this programme also to be thematic at this stage would be premature. The foundation is being built for future research. It is an immediate sign of success that so many student research projects have already begun and progressed.'

6.2.5 International conference, June 2002

The Focas team organised a successful conference on optical characterisation and spectroscopy on 26–29 June 2002, which was attended by more than 100 participants from all the major higher education institutions in Ireland and from the UK, France, Germany, Denmark, Italy, Austria, Australia and the United States. Papers authored by some sixty researchers were delivered on the following topics:

- Optical surface profiling
- Raman microscopy of carbon nanotubes
- The use of photopolymer as a recording medium in holographic interferometry and as a HOE in ESPI

- New applications of STM to functional organic materials
- Raman spectroscopy for cancer diagnosis
- Optical characterisation by confocal and scanning microscopy
- Molecular characterisation of human cervical tumours by Raman spectroscopy
- Reflection anisotropy spectroscopy
- Understanding the electronic properties of C_{60} : a spectroscopic study
- Spectroelectrochemistry of polypyrrole dodecylbenzenesulphonate
- Spectroelectrochemistry of donor-/acceptor-type conjugated polymers: 'double cables'
- Raman spectroscopy for the determination of phenols in aqueous media
- Environmental sensing
- Circular and linear dichroism: is it twisted or oriented and if so, how?
- Photophysical and novel charge transfer properties of polyoxomolybdate-ruthenium(II) trisbipyridyl adducts
- Transient Raman spectroscopy
- Photochemistry, photophysics and electrochemistry of supermolecules
- Urban ozone
- Non-linear dynamics in micro-cavity systems
- Excited states: from molecules to solids.

Twenty-seven posters, produced by some 106 researchers, were also presented.

6.2.6 Focas Self-Evaluation, October 2003

Although the building was not to be completed until March 2004, the technical work programme had begun in autumn 1999 and been completed in September 2003. At that juncture it was considered appropriate and worthwhile to review the work done and the effectiveness of the concept and strategy of the facility in achieving the goals of the PRTL scheme.

The fact that the new building was not yet in use had a significant impact on the implementation of the proposed programme. Nevertheless the interim structures and measures put in place should be sufficient to assess the impact of the strategy on the performance of the groups and the learning/teaching outcomes.

A one-day seminar series was scheduled for 30 October 2003 with Professor Matt Harmey (emeritus professor, UCD) and Dr Michael Brougham (Science and Innovation Department, Enterprise Ireland) attending as independent commentators. The role of the independent commentators was to provide objective comments and advice, in respect of each group, based on the presentations and discussions, on:

- the quality of the research
- the relevance and strategic significance
- the closeness to self-sustaining critical mass
- the feasibility of the future directions mapped out

and whether identifiable criteria should be addressed before any or all of these could be demonstrated.

They were also invited to comment on the overall Focas concept and strategy, whether well integrated groups with coherent thematic work programmes would be preferable to more loosely related groups with common development strategy, the value of core shared facilities compared to isolated laboratories, how the impact on learning/teaching at all levels might be enhanced, and any other aspect.

Each of the six groups was required to present:

1. the progress of the work programme since 1999
(postgraduate theses submitted, peer-reviewed publications, conference publications, and internal, national and international collaborations)
2. the proposed programme of research to 2006
(feasibility, plans to fund and implement, postgraduate students, post-doctoral fellows, expansion of group, new work programmes – not limited to original programme but close to original theme – ethos and coherence, and other members of staff to become involved)
3. the justification for the space allocation to 2006

6.2.6.1 Outcomes of self-evaluation

The independent commentators reported that they were very favourably impressed with the very high overall standard of the presentations. It was apparent to them that while talented individuals had been supported by the Institute, this needed to be highlighted.

Among the recommendations they made to the presenters from the groups were that:

- they should have made an initial statement of where the groups stood prior to the funding, then described where the work currently stood and finally where the work and the group was heading
- negative aspects of projects should not be neglected in that the solution to difficulties can be very educational and helpful for colleagues
- they should clearly distinguish between peer-reviewed publications and those not peer-reviewed, while maintaining the full lists of all publications
- the groups could with benefit interact and brainstorm together still more, as would be possible in the new research building
- each group should also maintain a list of all grant applications, even those not successful, to emphasise the positive effects of the expansion and development of the research.

They also made recommendations to the Institute in general, particularly in the light of the impediment to research presented by the weekly 16-hour contractual teaching obligation of staff members, that:

- incentives be developed for researchers
- the Institute strive to have research supervision fully recognised as teaching
- a sabbatical scheme would be helpful in this regard while also enhancing the reputation of the Institute.

6.2.7 PRTL I impact assessment, November 2003

The HEA carried out a detailed impact assessment of the project in DIT in November 2003, as part of a general review and assessment of the PRTL I scheme as a whole. At that stage further cycles, Cycle 2 and Cycle 3, of the scheme had been launched.

The PRTL I Impact Assessment Committee consisted of Professor Enric Banda (Director of the Catalan Research Foundation, Barcelona) (Chairperson), Professor Lauren B. Resnick (Professor of Psychology, University of Pittsburgh), Professor John Morrill (Professor of British and Irish History, University of Cambridge) and Professor Reijo Vihko (Professor

of Chemical Pathology and former President and Director General of the Academy of Finland).

6.2.7.1 Appointment of the expert team

The committee appointed an expert team consisting of Professor Nona Lyons (Education Department, Dartmouth College, New Hampshire), Professor Ian Halliday (CEO, Particle Physics and Astronomy Research Council, UK) and Professor Pär Omling (Director General, Swedish Research Council, and Physics Department, University of Lund) to visit and assess the programme in DIT. The task of the expert team was two-fold:

- to carry out a desk-based peer review of a selection of ten papers published by the research groups in the Focas project between 2001 and 2003
- and make a site visit to the Institute to meet and discuss the overall PRTL I project with members of the six groups.

6.2.7.2 Site visit

During the site visit on 5 November 2003 the expert team discussed with the research groups the following series of questions, indicative of the team's priorities in the impact assessment:

- does the added value justify the investment?
- what has been the greatest research impact of PRTL I?
- has participation in the PRTL I process resulted in any particular problems?
- how does the R&D programme interact with teaching and learning activities?
- how do you ensure that commercial, policy and other outputs of research are protected and communicated to potential users?
- how does the Institute's activity fit into the overall college research and technology development strategy, and vice versa?
- how are you planning for post-PRTL I growth?
- how does PRTL I complement other Irish science and technology supports?
- what impact has PRTL I had on the 'Europeanisation' and internationalisation of research in the Institute?

- how do you perceive the management of PRTL I overall?
- are all funds being allocated to the project?

All three experts considered the research work to be of 'excellent' standard on a five-point scale from 'poor' through 'weak', 'good' and 'excellent' to 'outstanding'. They each found the papers they reviewed to be of international quality, making a significant contribution to knowledge on the international scale, and likely to have socio-economic, policy or cultural implications.

6.2.7.3 Overall report of the assessment committee

The assessment committee reported on their overall review of the impact of the PRTL I scheme nationally in a wide-ranging but incisive document in 2004.¹ In general the report was highly positive and complimentary of the 'unique and far-sighted' and 'remarkable' scheme. It noted the 'more professional approach to research organisation, planning and management' in the institutions, including 'research quality, scale of operations and critical mass' being achieved, a breaking of the old mould and an 'emerging collaborative culture' between institutions, and 'improved teaching and learning environments for third level students' through closer rapprochement between research and teaching. The general trends in publications by the PRTL I-funded researchers were found to be generally very impressive in having 'high to very high' quality and higher than the national average in bibliometric impact, as well as increasing strongly in quantity of output, albeit from a low base. The report viewed the genuinely competitive PRTL I processes as satisfactory and of widely respected integrity.

The report touched on a key weakness of the PRTL I scheme when it repeated the view of all the examiners and reviewers that 'the important goals of PRTL I will be achieved only if funding on a significant scale is sustained over an extended period of at least another ten years'.

In this generally positive context, the report also voiced some concerns and, in particular, offered a series of recommendations to the government, the institutions and the HEA.

¹ *The Programme for Research in Third Level Institutions (PRTL I) Impact Assessment, Vol. 1*, Higher Education Authority, Dublin, 2004.

6.2.7.3.1 Recommendations to the government

The report recommended to the government:

- to provide consistent and sustained investment in the PRTL I scheme for at least ten years
- to develop a flexible and diverse funding system for the higher education institutions to underpin the highest quality teaching and learning and to motivate and facilitate multiple research opportunities and potentials
- to put in place arrangements to ensure improved coherence in research funding while retaining diversity in policies and programmes, supervised from the office of the Taoiseach, involving all major funding agencies, independently chaired, preferably by the Taoiseach, yet administratively thin and flexible and avoiding bureaucracy.

6.2.7.3.2 Recommendations to the institutions

The report recommended to the institutions:

- the introduction of business planning for all PRTL I centres
- to give greater attention to commercial and business potential of PRTL I investments and strengthening and resourcing of intellectual property rights arrangements
- specific and urgent definition by the highest officers of the institutions of the parameters of responsibility, authority and accountability for the relationships required between the new centres and the traditional institutional structures
- to provide more management training for centre managers and opportunities for managers from different centres to exchange information on their experiences and especially about effective management practices
- to regularly review strategic planning in the institutions to assist in concentrating the research into areas of institutional strength and/or emerging themes of significance
- the institutes of technology to continue to participate in the PRTL I scheme.

6.2.7.3.3 Recommendations to the HEA

The report recommended to the HEA:

- to put more focus on people and equipment rather than on buildings in the next phase of the scheme, while assisting institutions with infra-structural deficits
- to set demanding performance benchmarks and monitor their achievement by institutions already in receipt of PRTL funding, before they would be eligible for further PRTL support
- to continue the institutional and strategic focus of the scheme while seeking more explicit industrial policy agenda/priorities in the expression of the institutional research strategies
- to undertake a specific study of the innovation system from the perspective of education and research, in order to optimally improve the connections between PRTL and the economic and industrial policy agendas of government departments and agencies
- in regard to the PRTL processes:
 - to improve feedback and content of information provided to applicant institutions
 - to consider holding *vivas* or other face-to-face opportunities for applicants to present proposals to assessors
 - to develop a consistent set of indicators for monitoring the scheme, possibly along the lines of those used in this impact assessment
 - to review the opportunities for inter-institutional educational programmes
 - to strengthen the corporate image and general public relations aspects of the scheme
 - to undertake a further assessment of the scheme in three to five years, including bibliometric assessments and building on the data gathered for this assessment exercise.

6.3 Summary

While the proposal outlined the potential of improved space and resources, the work programme designed to utilise these resources had to be carried out in parallel with the building programme. This presented numerous

challenges to the Focas team but, despite the odds, significant progress was made and the work programme was completed successfully.

In this context, the experience and comments obtained in the course of the reviews by national and international experts were very encouraging for the teacher-researchers involved in Focas, particularly being recognised as maintaining such high international standards in the light of the circumstances of waiting almost three years longer than initially expected for access to the new laboratory facilities.

Chapter 7

The Planning and Building Project

When the grant was originally won in July 1999 it was a requirement that the construction of the new research institute be completed and the overall expenditure largely discharged by December 2001. Unfortunately this timescale proved to be very unrealistic for the HEA and for DIT. As indicated in the previous chapter the HEA did not begin to release capital funds until mid-2001. Eventually recurrent funding was extended to September 2003 and capital funding extended to 2004. Occupation of the new building did not finally take place until July 2004.

7.1 Building project

In relation to the construction of the building to house the facilities set out in the proposal, one of the first decisions that had to be made was the specific site for the development.

7.1.1 Choice of site

The Institute had very little free and available land and, by 1999, had made a major case for government support to develop a new, and ultimately a single, campus for the whole Institute at Grangegorman, a site then in the ownership of the Health Board (later the Health Service Executive). If that matter had been decided and the new campus allocated definitively to DIT, it might have been most desirable to locate the new Focas Institute building at Grangegorman.

In the circumstances this was not feasible and the small sites owned by the Institute had to be considered.

7.1.1.1 Proximity to Kevin Street college

During the planning phase many reasons were identified as to why the building should be within a short walking distance of the Faculty of Science campus at Kevin Street. The key factors included the nature of the work planned, the dual teacher-researcher role of each staff member involved, and the need to develop a research ethos and propagate it throughout the faculty and beyond. It was imperative that the teacher-researchers be able to readily travel between normal classes and teaching laboratories and the research laboratories in the new facility. It was also imperative, given the strong emphasis on impact on teaching and learning at all levels, that the research initiatives be visible and accessible to undergraduate students.

At that stage, it was the plan that the Faculty of Science would remain on the Kevin Street site, as part of a south city campus (combining with DIT Aungier Street and DIT Rathmines), until a later phase in the development of the new campus at Grangegorman.

7.1.1.2 Strategic development of the Faculty of Science

At that time the recently formed, but not yet implemented, Faculty of Science structure had four schools: Biological Science, Chemistry, Mathematics and Computer Science, and Physics. It was planned in the new faculties structure for DIT to establish and develop a fifth school, of Computing, from a section of the Mathematics and Computer Science School and other computer staff from elsewhere in the Institute. Development of research, and diploma and degree programmes in relevant areas, such as those emphasised in the technology foresight and other future skills deficiency studies of the government, were key ingredients in the strategic direction of development for each of these schools.¹

¹ *The White Paper on Science and Technology*, Forfás, Dublin, 1996; *Technology Foresight Reports, 1999*, Irish Council for Science, Technology and Innovation, Forfás, Dublin, 1999; *National Development Plan/Community Support Framework 2000–2006*, Department of the Taoiseach, Dublin, 2000; *Research and Development in Ireland, 2001, at a Glance*, Forfás, Dublin, 2001; *Third Skills Report (of the Expert Group on Future Skills Needs (EGFSN))*, Forfás, Dublin, 2001; *The Irish Labour Market: Prospects for 2002*, Forfás, Dublin, 2002; *Fourth Report of EGFSN*, Forfás, Dublin, 2003.

But areas of relative research and teaching strength, such as information and communications technology, food, materials, medical instrumentation, and chemicals and pharmaceuticals, would be particularly pursued and major programmes in these areas developed.

To allow these developments, which were closely in line with the priorities of the Department of Education and Science and of the government in general, further research accommodation as well as dedicated teaching laboratories and other resources would be required. Considerable refurbishment of the DIT Kevin Street college buildings would be called for.

7.1.1.3 Camden Row site

The Kevin Street college site was and remains largely landlocked. In a rare opportunity to spread outside the confines of the main site to allow some development, a site between Pleasants Street and Camden Row, behind the college, had been originally acquired by the CDVEC (City of Dublin Vocational Education Committee) in the late 1970s. In the early 1990s progress had been achieved and partial funding of IR£500,000 was pledged by Forbairt, the predecessor of Enterprise Ireland, for a research building on the site. But at that time the internal matching funds were not available and the initiative faltered.

This PRTL project of a 2,400 m² building would require about one third of that overall site, although it was envisaged that the development of further research facilities needed by the Faculty of Science would, over time, require the full site or its equivalent. Indeed the design brief envisaged an extension of the building westwards along Camden Row at a later time. Certain features of the building, as built, including the location of the main door, and the position of the stairs at the western end and the absence of windows on that gable end, were included to facilitate that future extension.

Discussions were initiated with the CDVEC and the Department of Education and Science to allocate the site to the Institute. Following a series of meetings, the CDVEC agreed in March 2000 to allow DIT to apply for planning permission relating to a portion of the overall site, so-called Site "A", for the new research building, without prejudice and without pre-empting the on-going discussions about the overall site. Negotiations about the legal transfer of the site to DIT were ongoing at that stage as were negotiations about the disposition of the remainder of

the overall site. By June 2001 agreement with the CDVEC on the transfer of the Site "A" section of the site to DIT had been made.

7.2 Employment of and interactions with the architects

The March 2000 agreement with the CDVEC allowed the employment of architectural consultants and the tender for their appointment was issued that same month. It was in August 2000 that the firm of Cullen Payne Architects was appointed as architectural consultants and they formed the design team for the construction project.

In the immediately following months an intensive series of meetings between the design team and the Focas management and the academic staff involved in the project took place to design and lay out the laboratory and other common spaces within the planned building. A legally required archaeological survey of the site was conducted in December 2000. The building design was completed and presented to DIT in January 2001 for approval in advance of submitting the application for planning permission. By that stage the special purpose company, DIT Research Ltd, formed to manage the non-exchequer matching funds and provide tax efficiency in the scheme had been incorporated. Following approval of the building design the planning application was lodged in March 2001.

A significant challenge for DIT emerged in early 2001 when the agreed building design, together with the furniture and equipment required, was again costed and the inflation in construction costs over that period, together with an increase in equipment costs associated with the currency conversion from the Irish pound to the Euro, while sterling remained outside of the Euro system, were taken into account. The overall cost was coming out some 30 per cent above the approved allocation under the PRTL scheme.

Coupled with the 10 per cent across-the-board reduction by the HEA in the grants awarded, as mentioned in Chapter 6, this resulted in a significant review of and reduction in the specifications for the building and the equipment to reduce the overall funding requirement. The mechanical workshop and associated mechanical technician were dropped. The radioisotope laboratory was abandoned. The plan for fibre optic interconnects between laboratories to 'pipe' laser light to and between a number of the laboratories was also removed. The Ti:sapphire laser to feed these interconnects was also dropped. The number of administration offices and

meeting rooms was reduced. The plan to locate the postgraduate studies and research office in the building was also dropped.

These changes entailed further changes in the plan for the building and further rounds of planning meetings with the architects. They were, however, significant strategic compromises essential for the successful completion of the project within the budget available. These were discussed with the HEA and it was broadly agreed that they would not compromise the essence of the overall venture.

7.2.1 Plan for the project in February 2001

In February 2001 the architects had produced a Gantt chart for the construction project that had the following features and landmarks:

- planning approval by mid-August 2001
- period for planning appeals to end by mid-January 2002
- tender documentation to be prepared from August 2001 to mid-January 2002
- fire safety certificate to be obtained between the start of December 2001 and the end of January 2002
- any extension required to the fire safety certificate to be obtained before the end of February 2002
- contract notice to be duly published during January 2002
- any queries and review to be completed during February 2002
- tenders for the construction project to be received during March 2002
- tenders to be assessed and reported on during the last week of March and the first week of April 2002
- contractor to be appointed and mobilised during the last three weeks of April 2002
- commencement notice to be completed before the end of the first week in May 2002
- contractors on site from 1 May 2002 and to finish in 15 months, by August 2003.

7.3 Construction

The main contractor appointed to carry out the work was P.J. Walls Ltd and, due to work schedules and other matters, work on the site

began on 9 December 2002, seven months later than envisaged in the plan drafted in February 2001. The new completion date was to be 5 March 2004.

7.4 Late complications

When the building was practically complete the decision by DIT, discussed in Chapter 8, to assign space in the building to two new research groups not originally involved in the project resulted in some re-vamping of the building and some further months of delay in completing it for occupation. In fact the building was handed over by the builders in July 2004 and there followed some two months of installing and commissioning of the equipment in the laboratories.

7.5 Comments

The building planning and construction was quite a tortuous and painstaking overall process characteristic of a first experience of such a project and was a considerable learning curve, for both the HEA and DIT. There were quite a number of unexpected and sometimes costly developments. It is highly desirable that the budgeting for such a relatively complex project be provided with substantial contingency funds. Furthermore, obtaining experienced consultancy advice, at the stage of finalising the proposal before final submission to the HEA, to at least gain insight into the possible delays and contingencies that might typically arise and allow funding and time for them, and even to avoid some of them, would be highly desirable.

Chapter 8

Installation and Operation in the New Building

The architects, contractors and builders achieved a building that well epitomised the integrated ethos of the original proposal – core laboratories and services, specialised laboratories, seminar and meeting areas, common write-up areas for postgraduate students and postdoctoral fellows, some provision for visiting professors and industrialists, and a general layout that would facilitate interactions and synergisms – with some scope for the research groups to develop and grow.

Indeed the building was selected for exhibition at the Irish Architecture Awards of the Royal Institute of the Architects of Ireland (RIAI) in 2005.

8.1 Allocation of space in the building

Each of the six research groups involved in the original PRTL application had participated in providing input to the design and, in the new building, each had duly equipped laboratories assigned to them for their use.

However, in the months leading up to the handover and occupation of the building, DIT decided to house two new research groups in the building as well as the original groups (some re-named and consolidated), as shown in Table 8.1. The reason given for this move was the chronic lack of available space to accommodate the new groups, a reality that is still a critical limitation to the development of research in DIT.

8.1.1 *Some controversy*

Unfortunately this decision gave rise to some controversy and disquiet among the original research groups within the Faculty of Science.

Table 8.1 The original six groups (1999) and the groups assigned to the Focas Institute (2004)

Original groups (1999)	Renamed and new groups (2004)
Radiation and environmental science	Radiation and environmental science
Environmental chemistry and sensing	Biomedical and environmental sensing and metrology
Inorganic and supramolecular chemistry	Materials synthesis and applications
Physics of molecular systems	Physics of molecular materials
Solid state physics	i. Nanophysics and surfaces
	ii. Solar energy
Holographic photopolymers	Industrial and engineering optics
	Communications network research institute
	Research in engineering surface technology

Although the additional activities, expertise and resources were welcome, the compromises proposed, giving priority to these new groups over the ancillary resources of Focas, seemed a breach of trust with the teacher-researchers who had won the grant for the building and perhaps a violation of the terms of the PRTL scheme, of the spirit and detail of the original proposal, and of the four years of progress reports submitted to the HEA. It was seen as a blow to these science teacher-researchers, the main research strength of the Institute. After many years of slow and painful development and after five years of waiting for this facility and surviving in hope in deprived spatial and temporal circumstances, instead of the Institute providing the facilities required and funded by the PRTL scheme and won by the teacher-researchers involved, it decided to reallocate some of those facilities.

The view was that this would be likely to be seen by other researchers across DIT as a still further significant impediment to the development of research in the Institute. Given that doing research is a largely voluntary activity in an already difficult environment characterised by lack of space, lack of time, lack of technical and administrative support and lack of reward, this was considered among active researchers as a negative move.

In relation to the research in engineering surface technology group, there was considerable overlap in terms of areas of interest, techniques and instrumentation requirements with some of the original groups and the core laboratories. Having its origins in Enterprise Ireland, this group promised to bring a commercial, close-to-industry element into the mix and some months of preliminary discussions had been held on the integration of this group into the Focas Institute. The group also brought with them a considerable amount of equipment and expertise, notably in electron microscopy, which could be added to the core facilities.

The work of the communications network research institute had little complementarity to the themes of the other groups but would have a close-to-industry richness that would strengthen that aspect of the Focas Institute.

Both groups would, together with the consolidated original groups, help to bring further funding in to improve the sustainability of the enterprise.

Installing the new groups in the building required some months of further delay in occupying the building to allow changes to the building to reduce common areas, to enclose more space and reduce the space allocated to the original groups. One seminar room and the common room were lost and some of the core facilities had to be reallocated. The changes to the building resulted in significant reduction in the originally envisaged openness and interactivity that was designed into the building to promote a synergistic ethos as well as a potential for further expansion of the originally proposed activities.

8.2 Appointment of Manager

It was decided to name the building the Focas Institute and all the research groups within it would be components of this Focas Institute. It was anticipated that, as the pioneer in such an organisational element

within DIT it would serve as the pilot and developmental model for further such research institutes within DIT.

Dr Hugh Byrne was confirmed as the Manager of the Focas Institute on a secondment contract basis.

The core staff, administrative assistant and four technicians also had their contracts extended at that stage.

8.3 Developing a working modus operandi

As originally envisaged and intended, the Focas Institute addresses the common needs of the research groups associated with it, and those of the schools from which the academic teacher-researchers come, providing dedicated research space, administrative and technical support and 24-hour access. Its aims are to:

- consolidate and develop existing expertise
- nurture developing research activities within DIT
- support a range of postgraduate and undergraduate research activities
- promote interdisciplinary collaboration within DIT and with other national and international bodies
- underpin postgraduate and undergraduate curriculum development
- provide a support service for industry nationally.

From the start of the PRTL Cycle 1 project, the manager advocated a modus operandi or comprehensive constitution for the facility, which would underpin the integration of the Focas Institute into the normal DIT administrative and management structures, including making provision in the annual DIT budget for its sustainability under the terms of the original PRTL grant from the HEA. Thus the Focas Institute running costs, including non-pay costs, materials/consumables, services and maintenance, would be provided for through the DIT budget and written into the annual Institute Operational Plan.

Within this modus operandi the overall operation and development of the facility would be guided by the Focas Advisory Board of up to ten members drawn from external academic, industrial and state bodies, including two international members, and representing the range of activities of the Focas Institute. The Board would report to the Directorate of DIT and guide the work of the Focas Management Board.

The month-to-month operation of the facility would be overseen by the Focas Management Board, consisting of the manager (chairperson), directors of associated faculties, heads of associated schools, representatives of each research group, and representatives of the technical staff, the postgraduate students and the postdoctoral fellows.

The manager would provide day-to-day management of the facility, reporting to the Focas Management Board and the Focas Advisory Board.

8.3.1 Assessing progress and deciding on developments

It was proposed that all activities associated with the facility would be required to work to a rolling 3-year work plan, reviewed at least annually, and aiming to achieve the highest standards in the work. The Management Board would assess and approve these work plans and on-going changes to them. Generally, this assessment would be guided by the PRTL I evaluation criteria, i.e. quality of strategy, quality of research and quality of impact of research on learning/teaching at all levels.

8.3.2 Financial management

All the groups associated with the facility were committed to generating income to maintain group activities and contribute to core costs. This funding would have to come from the competitive schemes of the various granting agencies. All income generated by activities associated with the facility would be subject to an overhead charge to cover indirect costs, along the lines of the model recommended by the HEA/Forfás Steering group in July 2003.¹

Income would also be generated commercially through exploiting the facilities in the core laboratories and renting the seminar and meeting rooms.

8.3.3 Health, safety and ethics

Health and safety matters would be monitored through the Focas Health and Safety Committee, which would act in accordance with the Safety, Health and Welfare at Work Regulations 2001. This committee would report to, and be represented on, the Focas Management Board and liaise

¹ *Report of the Group on Research Overheads*, HEA/Forfás, Dublin, July 2003.

with the DIT Kevin Street campus Health and Safety Committee. It would also be the responsibility of this committee to ensure that chemical risk assessment and management, and ethical approval procedures of DIT, would be duly carried out for all activities of the facility.

8.3.4 *Modus operandi still to be approved formally*

While this *modus operandi* has not been formally developed and agreed by DIT, its general spirit and approach has guided the functioning of the Focas Institute since its inception in 2004.

8.4 Developments in the Focas Institute since 2004

The following chapter provides a quantitative overview of the broad academic success of the Focas Institute and its individual research groups over the past three years. But a number of other very promising and notable developments have also occurred in that period.

8.4.1 *SFI UREKA FEATURE site, 2005–2007*

For twelve weeks each summer from 2005 to 2007, the Focas Institute hosted the Science Foundation Ireland UREKA FEATURE (Focas on Education in Advanced Techniques and Research Expertise) site. This initiative aimed to utilise the framework and infrastructure of the Focas Institute to train young undergraduate scientists in the application of advanced experimental techniques for the analysis of materials, while exposing the participants in a “fun and engaging way” to the research environment. In addition to the specific research projects, each summer the participants engaged in a programme of core and group seminars, and a support training programme. Each of these summer programmes culminated in a 2-day symposium at which each of the students orally presented their work.

For example the research projects in summer 2007 comprised the following:

- Instrumental calibration and assessment of scattering in Raman spectroscopy
- Evaluation of the effectiveness of various solvents and surfactants in the de-roping of carbon nanotubes
- Eco-toxicological assessment of single-walled carbon nanotubes

- Investigation of the potential leaching mechanisms of nanoparticles from food packaging materials
- Synthesis and characterisation of conjugated polymers
- Capillary electrophoresis for pharmaceutical purification
- Development of an anatomically realistic renal flow phantom
- Drug design of anti-cancer therapeutics
- Eco-toxicological assessment of three heavy metals of environmental relevance (Cd, Cu, Pb) using a battery of marine bioassays
- Investigation of radiation-induced bystander signalling
- Evaluation of prostate tumour and non-tumour tissues
- Cell response to high frequency radio wave exposure and the influence of hypoxia in the advancement of cancer therapy
- Irish sunlight damage of human skin cell mitochondrial DNA
- A biological evaluation of trioxanenaphthalimide
- Drug conjugates in cancer therapy
- Raman spectroscopy for cancer diagnosis in human cervical cells
- The use of holographic photopolymers in the fabrication of light sources and optical communications filters
- Influence of the exposure to elevated temperatures on the properties of volume and surface relief holograms recorded in a self-processing photopolymer

The programme of formal sessions covered the topics of orientation, health and safety, fire training, chemical risk assessment, first aid training, the history of Focas, spectroscopy tutorial, presentation skills, science and society, microscopy tutorial, careers seminar, research activities, time management, intellectual property, report writing, postgraduate opportunities, privacy, secrecy and satellites, and research 'speed dating'.

Over 100 applications were received annually for places on this scheme and sixteen students were chosen each year from DIT and other Irish institutions (TCD, NUIM, GMIT, AIT), as well as from abroad (France, Italy, Poland).

In December 2007 the DIT UREKA site received funding for a further three years.

8.4.2 Industry-oriented workshop, December 2005

The Focas Institute has organised a number of interactive seminars, conferences and workshops exemplified by the workshop 'Nano-Talks:

Interfacing Industry, Academia and Society' on 9 December 2005, at which nine speakers from the Institute and Forfás presented aspects of their work to representatives from industry, Forfás and Enterprise Ireland. There was an attendance of about sixty people. The titles of the talks were as follows:

- Nano-Ireland project
- Irish Nanotechnology Association
- EU IMPART nanotechnology consortium
- Nanotechnology and background to the NanoTox project in DIT
- Nanomaterials
- Nano-coatings and corrosion control
- Nanotoxicology
- Ultrafine particles
- Nanoeducation

A wide-ranging panel discussion on the topic 'Public Perception and Industry's Dilemma' brought an end to the workshop.

8.4.3 DIT's team research scheme (TERS)

In 2002 DIT launched its team research scheme (TERS) to promote sustainable research teams and provide support for new research groupings in the Institute meeting the criterion of interdisciplinary research. Three such teams have been established within the Focas Institute.

8.4.3.1 Development of new inter-disciplinary cross-group cancer research team (INDICATE)

The recently established INDICATE team, housed in the Focas Institute, specialises in mechanisms of cancer induction and the development of novel diagnostic tools and therapeutic agents. INDICATE draws together researchers from the schools of Physics, Chemical and Pharmaceutical Sciences, and Biological Sciences, and the Radiation and Environmental Science Centre. The team is currently focussing on four main research areas:

1. The first area focuses on the potential of vibrational spectroscopy for the diagnosis of human tumours. To date, the research undertaken has shown that Raman spectroscopy can be used to accurately

- differentiate normal from tumour tissue. Multivariate analysis of the data sets has shown a prediction accuracy of 100 per cent. The researchers are currently bringing this research towards a possible commercial product with the aid of an Enterprise Ireland proof-of-concept grant.
2. A related second area investigates the use of spectroscopy as a novel probe of cellular damage. A recently awarded Enterprise Ireland International Collaboration grant will allow a postgraduate researcher to further develop this research at the University of Reims. Both research areas 1 and 2 are part of the EU Special Support Action, Diagnostic Applications of Synchrotron Infrared Microscopy (DASIM).
 3. In the third area, mechanisms of solar UV radiation damage in human skin cells are being investigated. An EU Marie Curie training fellowship will enable a postgraduate researcher to continue this research at the LIGHT laboratories, Leeds University.
 4. The fourth research area aims to chemically analyse extracellular medium from irradiated cells to identify the currently unknown "bystander" factor. This factor (or factors), produced by irradiated cells, can also affect un-irradiated cells and as such could potentially be used as a novel therapeutic agent. This research is associated with an EU Integrated Project involving twelve other EU laboratories.

8.4.3.2 Development of a nano-tech@DIT team for nanotechnology research

The nano-tech@DIT group was established through TERS in 2005 and comprises several research groups working on nanotechnology-based projects.

Nanotechnology is an umbrella term used to describe a number of processes occurring on a scale of 1–100 nm. In essence it is an enabling technology. The rapid expansion of nanotechnology-based research in the last decade has led to a vibrant and highly competitive research area. The focus for much of the research has been on the application of nanotechnology in a wide range of industries, spanning the highly technical electronics sector to more traditional manufacturing sectors like the food industry. However, as nanotechnology moves out of the research laboratory and into the public domain, potential regulatory issues will emerge ranging from worker protection to environmental exposure and risks.

Previous technologies such as biotechnology failed to consider these aspects early in their development and as a result experienced a considerable public backlash.

The nano-tech@DIT group is thus taking a proactive approach to nanotechnology by the implementation of a strong nanotechnology educational programme as well the incorporation of nanotoxicology and risk assessment into the daily nanoscience practices at the Institute.

Nanotoxicology is an emerging discipline evolving from studies of ultrafine particles and is one of the fastest growing areas of nanotechnology. DIT has already developed considerable expertise in handling and characterising nanoparticles and is now rapidly expanding its toxicology expertise to address the needs of the nanotechnology community as a whole.

The Institute is also developing a strong nanotechnology educational programme with the launch of Ireland's first undergraduate B.Sc. in Science with Nanoscience in September 2006. This programme offers a unique interdisciplinary approach to science. The need for nano-education however extends beyond the development of a sufficient skills base for industry and so the group will also attempt to increase public awareness of nanotechnology in Ireland through a series of workshops and surveys and through its website, <http://www.nanotech.dit.ie>.

8.4.3.3 Development of strategic therapeutics research team (StART)

As stated in the Government's Strategy for Science, Technology and Innovation 2006–2013,² growing research capability is a core component of the EU drive to become the most competitive, knowledge-driven economy in the world, and Ireland has fully endorsed this goal. Target industries include the pharmaceutical sector. Currently fourteen of the top fifteen global pharmaceutical companies are based in Ireland, employing 24,000 people and with exports valued at greater than €40 billion annually. DIT underpins this sector through undergraduate and postgraduate programmes, including research, in the Faculties of Science, and Tourism and Food.

² *Strategy for Science, Technology and Innovation 2006–2013*, Department of Enterprise, Trade and Employment, Dublin, 2006.

In 2006 funding was obtained from DIT's capacity building scheme (CaBS, formerly TERS) to establish and develop the cross-faculty and multi-disciplinary strategic therapeutics research team (STaRT).

This is planned to be the first strategic pharmaceutical research team in DIT comprising researchers from the School of Chemical and Pharmaceutical Sciences (Faculty of Science), the Focas Institute, the inorganic pharmaceutical and biomimetic research group (Faculty of Tourism and Food) and the Radiation and Environmental Science Centre (RESC). To date the proposed members have had significant success in attracting grants and producing output. In the period 2005/2006 alone, the team members attracted over €600,000 in funding and contributed to over forty peer-reviewed papers and conference presentations. The senior researchers have supervised fourteen postgraduate research students to completion. Furthermore all the team members have carried out their work in collaboration with leading research centres in Ireland and abroad.

The research has involved the following three cognate themes:

- inorganic chemotherapeutics
- organic chemotherapeutics
- drug purification and delivery

The consolidated STaRT team is concentrating on the synthesis, characterisation, purification and chemotherapeutic applications of novel organic and inorganic drugs.

8.4.4 Development of a solar energy initiative

As an evolution of the activities of the original solid-state physics group and incorporating the expertise of the new president, Professor Brian Norton, a seedling solar energy initiative was begun in 2003. Expanding to four postgraduate students and one postdoctoral fellow by 2006, the group utilised the ideally oriented south-facing flat roof of the Focas Institute to establish a solar installation that could monitor and log solar radiation twenty-four hours a day, could act as a test bed for solar cells and concentrator devices, and could provide facilities for evaluating solar weathering. This installation was completed in summer 2007. The group now incorporates activities in engineering in both DIT Kevin Street and DIT Bolton Street under the umbrella title of the Dublin Energy Lab, and

has been instrumental in rejuvenating the Solar Energy Society of Ireland, a group that promotes issues related to renewable energy sources in Ireland.

8.4.5 Microscopical Society of Ireland Twenty-Ninth Annual Symposium

In September 2005, researchers at Focas organised and hosted the Twenty-Ninth Annual Symposium of the Microscopical Society of Ireland. There were about 100 attendees and as well as oral and poster presentations, the programme included lectures by the following invited speakers:

- Dr Pamela Hamer, Head of Research and Development, Forensic Alliance Ltd., UK
- Professor Jean-Yves Buffiere, GEMPPM INSA, Lyon, France
- Dr David C. Cottell, Electron Microscopy Laboratory, UCD
- Dr Takeshi Fukuma, CRANN, TCD
- Dr Gerwin Puppels, Erasmus University Rotterdam, Holland

Workshops on the Zeiss LSM 510 META confocal microscope housed within the state-of-the-art facilities at the Focas Institute were over-subscribed.

8.5 Summary

Over these initial three years there has been a palpable growth and maturation of the research ethos within the Focas Institute. Its activities are becoming increasingly embedded in national and international collaborative networks and it is playing a constructive, collaborative and growing part in 'Ireland Research Inc.' In particular it is building an improving reputation for DIT as a research institution. Furthermore within DIT it has enhanced the positive feedback between research and undergraduate learning and teaching, thereby contributing to quality assurance at undergraduate and postgraduate levels. Further details of its academic contribution over the past three years are provided in the following chapter.

Chapter 9

Indicators of Academic Achievement, 2004 to 2007

As outlined in the previous chapter, the Focas Institute and the research groups within it have made considerable advances since the initiation of the Focas project and particularly since the occupation of the new research building in 2004. In the period since then a small number of sustained and sustainable research teams carrying out world-class research in their areas have developed and begun to thrive.

9.1 Quantitative indicators of academic achievement

A key measure of progress towards sustainability has been the increasing annual research grant income to the groups from external sources, shown in Figure 9.1.

Other positive indicators are the growing numbers of postgraduate students working in the Focas Institute, shown in Figure 9.2, and the steadily growing numbers of M.Phil. and, especially, Ph.D. graduates produced annually by the groups within the Focas Institute, shown in Table 9.1.

The annual production of peer-reviewed publications and of other scholarly publications, such as conference presentations, consultancy reports, patents and licences are shown in Figure 9.3 and Tables 9.2 and 9.3.

The positive effects of research have long been evident in undergraduate education provided in the Faculty of Science – in final-year project research opportunities for undergraduate students and in advanced course materials reflecting new areas of staff research expertise. This has continued and grown in the new research building as indicated by the

Figure 9.1 Overall external grant funding each year

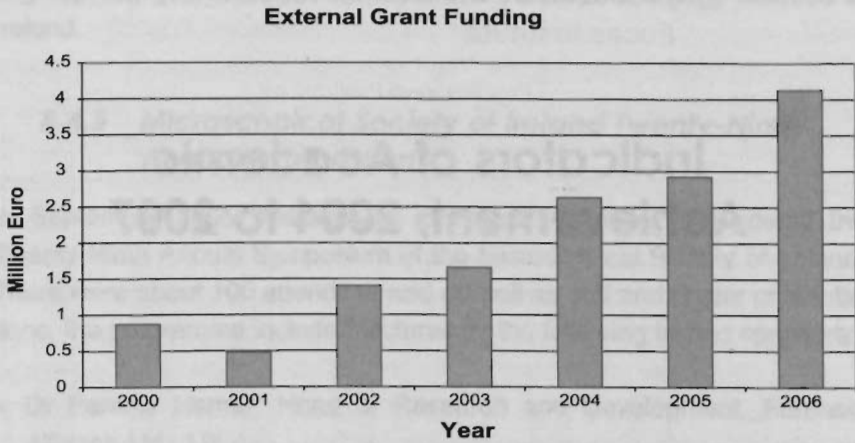


Figure 9.2 Numbers of postgraduate students working in the Focas Institute, by year

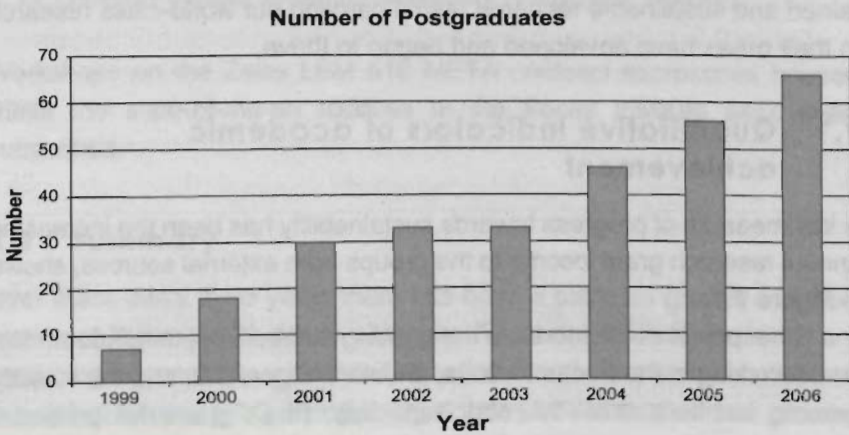


Table 9.1 Annual production of M.Phil. and Ph.D. graduates by the teams in Focas

2001	2002	2003	2004	2005	2006
3 × Ph.D.	3 × Ph.D.	5 × Ph.D.	4 × Ph.D.	7 × Ph.D.	9 × Ph.D.
7 × M.Phil.	2 × M.Phil.	2 × M.Phil.	8 × M.Phil.	5 × M.Phil.	4 × M.Phil.

Figure 9.3 Annual numbers of peer-reviewed publications produced by the teacher-researchers in the Focas Institute

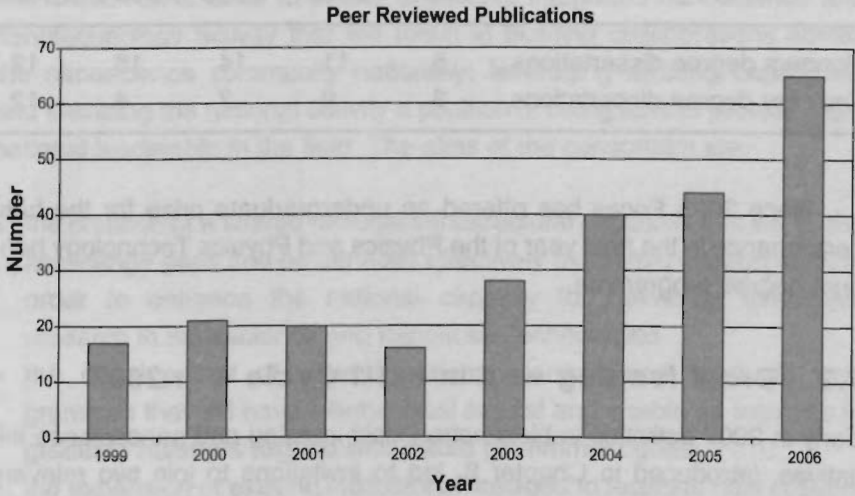


Table 9.2 Annual numbers of conference publications

2001	2002	2003	2004	2005	2006
37	21	25	30	46	35

Table 9.3 Annual numbers of consultancy reports, patents, licences and other scholarly publications

Scholarly publications	2003	2004	2005	2006
Reports	12	47	27	59
Patents			1	7
Licences			1	1

numbers of final year undergraduate projects and dissertations prepared within the Focas Institute, given in Table 9.4. This is a further measure of the vitality of these research groups and their value to learning/teaching within DIT.

Table 9.4 Annual numbers of undergraduate student projects and dissertations

	2001	2002	2003	2004	2005
Honours degree dissertations	5	11	14	16	12
Ordinary degree dissertations	3	9	7	4	12

Since 2005 Focas has offered an undergraduate prize for the best performance in the final year of the Physics and Physics Technology honours degree programme.

9.2 Grant funding won in PRTL Cycle 4 in 2007

Early in 2007 activities in biospectroscopic imaging and nanoscience initiatives, introduced in Chapter 8, led to invitations to join two relevant national consortia to submit applications to the PRTL Cycle 4 scheme. On 3 August 2007 their success in winning substantial grants in this scheme, outlined below, was announced by the Minister of Education and Science, Mary Hanafin, TD.

9.2.1 The nanoscience project

The nanoscience and nanoscale technologies for Ireland (NANOTEIRE) national consortium was awarded a total funding of €31.6 million. It consists of

- Trinity College Dublin – CRANN
- Cork Institute of Technology – CIT
- Dublin City University – RINCE and NCPST
- Dublin Institute of Technology – FOCAS
- National University of Ireland Galway – LIGHTHOUSE
- University College Cork – TYNDALL National Institute
- University College Dublin – UCD
- University of Limerick – MSSI

The NANOTEIRE group within DIT, essentially the nano-tech@DIT team, is an interdisciplinary combination of the physics of molecular

materials/nanophysics, radiation and environmental science, and industrial and engineering optics groups together with a new physics education research group.

NANOTEIRE aims to create a national integrated nanoscience and nanotechnology activity that will result in building collaborations across the nanoscience community nationally, leveraging existing capabilities and elevating the national activity a position of being able to provide international leadership in the field. The aims of the consortium are:

- the creation of a shared national infrastructural capability that will fill the knowledge gaps and be serviced effectively by trained support staff, in order to enhance the national capacity for delivering innovative research in nanoscience and nanoscale technologies
- the development of shared national nanoscience graduate programmes that will have international appeal and enable an increase in graduate numbers aligned with stated government goals
- the expansion of existing institutional linkages to facilitate new collaborations locally, regionally and nationally across institutions and across disciplines.

The Focas Institute contribution will include:

- nanomaterial characterisation
- toxicological assessment and
- education and public awareness research.

The work programme emphasises the development of higher throughput materials characterisation techniques to support capital intensive microscopy techniques, the physico-chemical characterisation/toxicology interface, and the feed-through from research to education and public awareness. This contribution will thus support the materials aspects of nanoelectronics and nanophotonics while impacting significantly on the bionanoscience area and informing and contributing to graduate enhancement and outreach activities. Focas offers a unique blend of nanomaterials and toxicological expertise to the consortium. Focas Institute expertise in carbon-based nanoparticles is internationally recognised and its emphasis on developing high throughput physico-chemical characterisation techniques for all materials will be in collaboration with

Intel. Its expertise in cyto- and eco-nanotoxicology is nationally unique and will complement the expertise within the bionanoscience area.

The DIT funding award of €2,092,000 (capital) and €2,168,000 (recurrent) – €4,260,000 in total – allows for additional and replacement equipment, additional personnel and, with the NBIP grant below, contributes to a physical development of the Focas Institute to accommodate up to fifty additional workstations.

The project consolidates and integrates the activities within the Focas Institute in nanoscience, adding capacity and capability in the form of accommodation, capital equipment and personnel. DIT adds expertise in the key areas of research and education to the consortium, and participation in the consortium broadens the scope for DIT in both areas. Through the consortium, definitive protocols can be established for:

- characterisation of a range of nanomaterials of potential importance to emerging nanotechnologies according to size, morphological state and chemistry
- determination of potential human and environmental impacts of the range of nanomaterials using a comprehensive battery of tests
- optimised transfer of knowledge generated by the project through the third level, fourth level, and second level school systems as well as enhanced public awareness of the developments in nanoscience and technology.

These outputs can inform national and international standards and policy, and act as a service for industry nationally and internationally. The associated activities will generate a cohort of highly trained graduates and other specialised technical personnel to ensure sustainability in the area. In the longer term, an understanding of the interaction of such particles with biological systems will add considerably to the growing areas of nanomedicine and nanopharmacology.

9.2.2 The biospectroscopic imaging project

The national biophotonics and imaging platform (NBIP) was awarded a total national funding of €25.4 million. This consortium has the following membership:

- Royal College of Surgeons in Ireland – RCSI
- Dublin City University – DCU

- Dublin Institute of Technology – FOCAS
- National University of Ireland Galway – NUIG
- University College Cork – UCC
- National University of Ireland Maynooth – NUIM
- University of Limerick – UL

The NBIP sub-group within the Focas Institute in DIT is a combination of the original physics of molecular materials/nanophysics, and the radiation and environmental science groups.

The mission of the NBIP is to provide an integrated national access and training infrastructure in research, education, technology development and industry collaboration for the State's investment in biophotonics and imaging. It will provide a national framework to support and encourage the development of centres of expertise. The provision of adequate core technologies in advanced imaging will greatly enhance the national research infrastructure. This will ensure that the recent investment in research equipment and buildings translates into an increased efficiency of usage, which should in turn provide a solid foundation for development of key research areas. The major objectives of the NBIP consortium are:

- to provide a structured research and training framework for Ireland's investment in advanced imaging applied to the life sciences (PRTL, SFI, HRB, Wellcome Trust)
- to establish graduate training programmes in cell signalling and imaging
- to bridge the physical and life sciences interface and, through partnership with industry, enhance technology developments in biophotonics and imaging.

The Focas Institute will provide nationally unique spectroscopic imaging facilities and expertise to the molecular and cellular imaging core of the project. The associated expertise is based on the collaboration since 2000 of the radiation and environmental science and physics of molecular materials/systems groups, leading to the biospectroscopy team. The biospectroscopy team is the only group active in the use of vibrational spectroscopy for cellular and tissue analysis within Ireland. Spectroscopic imaging will be employed to characterise:

- cell signalling
- disease diagnostics and progress
- cellular response to external agents

In all areas the work programme is linked to other platform partners. The work programme will demonstrate the additional dimension provided by the characterisation and mapping of molecular markers. The techniques will be employed to complement other platform imaging techniques. DIT will provide training and modules in microscopy and spectroscopy to the graduate enhancement programme.

The funding award of €1,946,000 (capital) and €1,642,000 (recurrent) – €3,588,000 in total – allows for additional and replacement equipment, and additional personnel and, with the NANOTEIRE grant above, contributes to the physical development of the Focas Institute to accommodate up to fifty additional workstations.

DIT's involvement in the NBIP will consolidate the DIT group as national leaders in the field of spectroscopic imaging and will strengthen DIT's reputation within the international community by adding capacity and capability in the form of state-of-the-art equipment, dedicated personnel and accommodation. It will furthermore contribute to the consortium the additional imaging dimension of spectroscopy and facilitate the development within the consortium of complementary imaging and hybrid techniques. This will create numerous opportunities for innovation and commercialisation and, through partnership with industry, will enhance technology developments in biophotonics and molecular imaging.

The joint research projects will lead to an increased understanding of cell signalling through radiation-induced bystander effects, of cellular interactions with nanoparticles and the development of novel instrumentation for disease diagnosis and screening. The training aspects will generate Ph.D. graduates and research engineers with key skills in imaging techniques translatable across the consortium, and therefore add to the sustainability of this research area and of the Focas Institute.

These awards under PRTL Cycle 4 represent the single most significant development of the Focas Institute since the original PRTL Cycle 1 award in 1999. They will enable a consolidation and expansion of the capability and capacity of the core facilities to support priority areas. They will establish these facilities and activities on the national and international stages and will contribute the niche expertise of the groups within the Focas Institute to the national concerted actions in these priority areas.

9.3 Comments and conclusions

These quantitative indicators show steady consolidation and improvement over the past three years indicating a growth in the maturity, productivity and sustainability of the Focas Institute and the groups within it.

Another development has been the growth of new themes, new projects and new functional teams as outlined in the previous chapter. The winning of two major grants under the PRTL Cycle 4, as a partner in two major national research consortia, copperfastens the sustainability of the Focas Institute as developed over its first three years in its dedicated building.

There have also been other positive indicators of vitality such as the annual series of Focas seminars, the annual postgraduate research assessment presentations in May each year, and the faculty research seminars that are held regularly in the seminar room.

The Focas Institute has been by far the most successful initiative ever within DIT relating to developing research and a research ethos and culture. It continues to forge ahead and serves as a beacon for the way forward in this vital aspect of the mission of DIT.

Chapter 10

Prospects and Potential

Research is a vital element of the work of DIT and its mission of service to Irish society and to the wider world. But the general circumstances of academic staff, teacher-researchers, within DIT – contracts of employment, resources, accommodation, facilities, supporting structures – can be unfavourable for the task of developing research. The national and international academic and industrial environment for research is extremely competitive. Protecting, preserving, assisting and boosting the morale and determination of the Institute staff involved in and committed to research constitute a key task of the management of DIT.

A major reason why research is so vital to DIT is its influence on building on and enhancing the Institute's long-established industry orientation and its orientation to providing appropriate applied educational services to young people and to those at work throughout their careers, from Dublin and all over Ireland and abroad.

The story of the origins and on-going development of the Focas Institute within DIT carries both positive and negative lessons regarding the development of research within DIT. When, within DIT, we have formed a realistic and objective assessment of our research strengths we have managed to achieve notable victories in external competitions for funding. When we have allowed hope and aspiration to cloud our assessment, and allowed desire to run ahead of our capability, we have received heavy defeats.

The great value in the Focas Institute model of core, shared facilities embedded in specialised satellite work areas has been amply validated. This model allows for easy sharing of experiences and facilitates synergy to develop organically. It also strengthens the mutual enrichment of the

experience of the teacher-researchers and the postgraduate students through multiple peer interactions. It is a cost- and space-effective way to maximise the facilitation of research activities with limited resources.

Another vital feature of the Focas Institute model, which is a very significant advance for research within DIT, is the provision of dedicated administrative and technical support. This helps to free the teacher-researchers to concentrate on the research, its planning and implementation, and on publication and networking relating to the research.

An open management style, where the teacher-researchers are trusted and given considerable autonomy to develop their lines of research rather than narrow direction, also helps to ensure the success of this model of a research institute. This could be further enhanced by central services of DIT elaborating new ways to help, facilitate and maintain the morale of the teacher-researchers, particularly in underpinning the basic longer-term sustainability of the Institute and assisting in developing public awareness of its reputation. For instance, at central level, DIT was ill-prepared, as were many of the institutions, to proactively respond to the public-private partnership character of the capital element of the PRTL scheme, even though this aspect had been heralded in the consultation process before the call for proposals for PRTL Cycle 1. This cost considerable time, money and staff morale.

10.1 Strengths of the PRTL scheme

The PRTL scheme and our experience with it have taught potent lessons for DIT and many of these lessons are described in this book.

Certainly the scheme has been remarkably transparent and objective. It has set out clear guidelines and faithfully followed them. It has set a national strategic perspective for research in higher education institutions, with an emphasis on collaboration both nationally across all the institutions and internationally, and has stimulated the institutions to also think and plan in this way. Indeed it has set out useful guidelines on how to serve the institutional and national strategic objectives.

Furthermore the assessment criteria resonated strongly with the thrust of DIT's approach and philosophy to industry-oriented, applied, science-based and technology-based education. They also resonated powerfully with and confirmed DIT's academic quality assurance policies and

procedures for all postgraduate and undergraduate programmes, both taught and research.

The PRTLTI scheme has helped to expand considerably and consolidate the research infrastructure in the country and has set a challenge for all the higher education institutions to develop funding mechanisms to achieve continuity and sustainability. It is likely that this challenge, and the response of the institutions to it, will be a major aspect of the development of Ireland as a centre of world-class research in the coming decade.

10.2 Internal processes released in DIT

As outlined in this book, the PRTLTI Cycle 1 scheme released an inspiring and energetic process of creativity and willingness to cooperate among many teacher-researchers within the schools.

Success in winning the original grant under the scheme has helped to resolve for the moment one of the basic contradictions of research within DIT, a vital activity but needing the teacher-researchers themselves to voluntarily raise most of the funding for accommodation, equipment, research assistants and postgraduate students to pursue research. The reverse of this contradiction is that the accommodation and equipment for the other 'normal' learning/teaching activities, such as lecturing, administration and library services, are provided by DIT.

It is significant that, as in PRTLTI Cycles 1 and 4, the proposals developed mostly by the teacher-researchers themselves were most successful. These teacher-researchers possessed the deepest understanding of where the true abilities, strengths and feasibilities rested. They were able to base the proposals on the greatest research strengths, on an agreed unifying theme to achieve cross-disciplinary synergy and coherence, and on collegiality.

DIT needs to develop and improve its capabilities and processes to assist, facilitate and reward these highly creative, constructive approaches.

The PRTLTI scheme has spurred the further qualitative development of research strategy in DIT, although the emphasis on aspirations and desired developments remains heavy. There is still need for an honest, substantial and objective self-study of research strengths and weaknesses in, and impediments to, research across DIT. The strengths must not be weakened by conscious or inadvertent policies or actions. Appropriate actions, in

emphasis and pace, must be taken to correct weaknesses and deficiencies and remove impediments.

The scheme has also projected DIT's researchers and research programmes more thoroughly and more positively than ever before into the national and international arenas and helped to enhance the academic profile of the Institute. This is evidenced by the invitation of the Focas Institute into national collaborative programmes under PRTL Cycle 4 and of many of the research activities of the groups into EU collaborative programmes, including the Framework Programmes. The challenge will be to find approaches to further develop the research activities and contribute to 'Ireland Research Inc.', a coherent and active national research strategy and, as a key part of 'Ireland Education Inc.', contribute a coherent and active national higher education strategy. This will entail, for DIT, contributing to the planning and policy setting as well as to the implementation, administration, coordination and further applications of research outcomes in industry and society in general.

The PRTL Cycle 1 scheme initiated DIT into public-private partnership schemes and the relevant tax legislation. It will be important for the future to systematise and internalise this experience.

10.3 Issues to be addressed

Probably the greatest issue facing the Focas Institute within DIT is that of medium-term sustainability based on a comprehensive business plan to provide basic services in the building, governance under a clear and facilitating *modus operandi*, clear and agreed procedures for allocation of accommodation in the building, and all of these to be compatible with the terms of the PRTL scheme as signed off by the President in the formal acceptance of the original PRTL grant from the HEA in 1999.

Other important issues are the main recommendations made to the government, the HEA and the institutions by the impact assessment report on the overall PRTL scheme in 2004. These are set out in Chapter 6 and must be required reading for all teacher-researchers and all central service personnel involved in supporting research in DIT.

Similar detailed study and absorption of the rules and procedures for all the other important research funding agencies, SFI, EI, EU and others, will be vital at school, faculty and central research support levels to ensure fluency and proficiency, as well as early preparation of suitable and strong

proposals for all the relevant calls. This requires a facilitating, informed and collegial institutional team to campaign for and collectively drive the research enterprise, knitting it to the other learning, teaching and industry activities of DIT.

10.4 A major achievement for staff members involved

The Focas Institute has been a major indigenous academic achievement of a group of staff of DIT. It is one of the highest points in the academic history of DIT and its earlier precursor colleges, and continues to lead the development of research in DIT. It has helped enormously to reshape DIT and move research much closer than ever before to the mainstream of DIT's activities.

The overall approach adopted in attaining this achievement, creative and inspirational, and founded organically on the long-established ethos of DIT and its historical strengths, can be a key ingredient of DIT's model for how to organise research optimally in the future, and raise the funds required for research developments from all available funding sources.

This book outlines the roots and development of a new scientific research institute, called the Focas (Facility for Optical Characterisation and Spectroscopy) Institute, within the Dublin Institute of Technology (DIT). Formed by the creativity and initiative of talented members of staff of the Faculty of Science, who grasped the opportunity offered by the PRTL scheme of the HEA in 1999, it also arose from the history and ethos of DIT and its 120-year drive to provide an applied, industry-oriented educational service of the highest quality to students from Dublin, from across Ireland and from abroad.

The academic aspects of this historical development are summarised, and principally those aspects that the teacher-researcher members of staff were able to participate in and for which they pooled their academic expertise, energy and creativity to make a dramatic contribution to the development of the Faculty of Science and DIT as a whole.

It is dedicated to the achievement of these teacher-researchers, but it is also intended as an outline of the lessons learned in initiating and developing the Focas Institute, to assist others both inside and outside DIT to understand, evaluate and optimally marshal and consolidate their strengths to reach for and achieve such significant goals.

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