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Removing Barriers to Conducting Research in Ireland's Institutes of Technology

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Institutes of Technology (IoT) in Ireland didn't engage in significant levels of research until comparatively recently. With Ireland's move towards a knowledge society and to position Irish Industry to take full advantage of economic recovery when it arrives, it is imperative that the research resources in the IoT sector are utilised more effectively. Most national programmatic research schemes support new research initiatives including greater 4th level activity and IoTs have or are developing research initiatives to respond to these schemes. Over the past 5 years significant increases have occurred in the numbers of graduates (at both masters and doctorate levels) from the IoT sector. Such graduates have garnered considerable research experience making their skills very attractive for employment in industry, the professions and wider society.

Attempts to address the gap in research between the Institutes of Technology and the more traditional Universities, have only been partially successful, although a significant increase in both the quality and the quantity of research conducted in the Institutes has occurred. However, significant issues remain that impede progress towards becoming more effective research-informed or research-led establishments. IoT's were originally set up to provide high level technical education and training with a strong regional focus. Only since 1992 have the IoTs had the opportunity to become 3rd level, research informed institutes and are now graduating students at all levels up to PhD in a wide range of disciplines.

This paper presents the results of a recent study that assessed the impediments to research being carried out in the IoT sector. It was conducted by members of the country's largest IoT, Dublin Institute of Technology (DIT). A thorough analysis of key strategic research publications outlining issues affecting research in both national and international regions (and especially in other European institutions) has highlighted many of the most important problems. The key issues identified included implementation of restrictive employment contracts (teaching and time constraints), inflexible human resource practices (involving employment of inexperienced research staff), lack of physical infrastructure, poor management infrastructure, inadequate funding models, resource issues concerning annual leave and often an institutional ambivalence towards a research culture. These are discussed

in the context of the needs of DIT and similar Higher Education Institutes throughout the country. In addition key researchers were surveyed to ascertain their views. Once identified, the intention of this process was to address the barriers at executive level in an attempt to either remove them completely, or to minimise their potential impact for the benefit of the country's burgeoning research sector.

1. Introduction

Formed from an amalgamation of colleges, some dating back to 1887, Dublin Institute of Technology (DIT) is one of the country's oldest educational institutions. The DIT Act of 1992 brought together six colleges of higher education, formerly under the City of Dublin Vocational Educational Committee. It has over 20,000 students and is one of the largest Higher Educational Institutes (HEIs) in the country, providing courses ranging from Apprenticeship level to ordinary and honours level degree courses. More recently postgraduate programmes with a pronounced research content have been developed. These include Masters and Ph D degrees as well as Postdoctoral training schemes.

The European Union's Framework Research Programme VII (FP VII) has changed the landscape for the majority of European HEI's. Even in terms of domestic funding, a research team will often consider how an application to a funding body, say to build a 'core strength', can position the researchers to engage in broader inter-institutional and international programmes. The pursuit of a personal interest or specialisation may have to be subjugated to the necessity of providing niche research for a larger group. Purchase of equipment and recruitment may be determined by the requirements of an industrial partner. The provision of a specialist piece of laboratory equipment, that may never find an application in undergraduate programmes, or the appointment of specialist research staff, probably on fixed-term or special purpose contracts, raises critical issues about the aims and ethos of higher education. In some systems there is already a move to a demarcation between 'research led', 'research informed' and 'teaching only' universities. This realignment can be either planned or unplanned, but inevitably, two questions arise:

1. Can undergraduate teaching programmes retain their standard and relevance if they are not research informed by academics? Doing so will ensure that their teaching of undergraduates is contemporaneous through engagement in research or other equivalent forms of scholarship.
2. Does research carried out by specialist teams in R&D centres, often with a commercial focus, have tangible benefits for taught programmes?

Institutes of Technology, such as DIT, with a relatively recent track history of research have found it difficult to participate in many research programmes, especially larger-funded projects, such as those undertaken in FP VII. A less well-developed research infrastructure has hindered some of the IoT's, especially by comparison with many University departments with a well-established research ethos. Mechanisms have to be developed to overcome this and many other problems unique to the IoT Sector. One of the most productive solutions developed over the past few years has proven to be the setting up of

dedicated Research Support Units or Offices with a strong mandate to promote, manage and assist the conduct of research in the IoT's.

2. Barriers to the Development of Academic Research in an Irish Higher Education Institution

Dublin Institute of Technology, like all other Higher Education Institutions (HEI's), seeks solutions to balancing teaching and research that are grounded in its own unique setting. It is the largest university-level HEI in Ireland and is actively pursuing university status. The European University Association (EUA) determined in its recent assessment that DIT meets the requirements for definition as a university {1}. The institute is currently dispersed around more than thirty sites spread mainly around the centre of Dublin. However the imminent move to a single campus (in Grangegorman near central Dublin), the largest single investment ever in education in the state, will help to remove many of these geographical difficulties. It presents a unique opportunity to blend state-of-the-art facilities with a highly developed knowledge base and experience. In this context, close to forty percent of DIT undergraduate courses are unique in Ireland. Strengthening research in its six faculties and in the R&D centres and groups (listed in Table 1) focuses on realising two goals outlined in its Research and Scholarship Strategy {2} for 2007 – 2011 (This new strategy modifies targets that were set and achieved in the last four years {3}, however, the most significant goals remain essentially unaltered):

1. To advance research and scholarship within DIT, including technology and knowledge transfer, whilst developing the expertise of its staff and students and positively impacting upon and improving the Institution's educational programmes.
2. To support Ireland's requirement for a knowledge-based society by engaging in research and scholarship, including knowledge transfer, thereby making a direct contribution to the needs of Irish industry and the economy while enhancing DIT's position as a leading higher educational institution.

focas institute/dit	The Focas Institute	A multi, interdisciplinary research institute in the physical sciences.
CREST	Centre for Research in Engineering Surface Technology (CREST)	CREST is the leading surface coatings and corrosion control laboratory in Ireland
dublin energy lab	Dublin Energy Lab (DEL)	DEL is a leading energy related research and development laboratory
ieo Industrial & Engineering Optics	Industrial and Engineering Optics (IEO)	IEO specialises in holographic and interferometric techniques.
CNRI	Computer Networks Research Institute (CNRI)	CNRI specialises in pure and applied research in all aspects of communications networks.
resc	Radiation and Environmental Science Centre (RESC)	RESC specialises in radiation biology and environmental toxicology

	Digital Media Centre (DMC)	DMC specialises in geospatial information systems, speech, audio and cognition and social, e-community software and artificial intelligence.
	Centre for Elastomer Research (CER)	CER specialises in the characterisation of hyperelastic and viscoelastic properties of elastomers.
	Centre for Social and Educational Research (CSER)	CSER is a dynamic and innovative research centre which seeks to improve the quality of life of children, family and society.
	Centre for Transcultural Research and Media Practice (CTMP)	CTMP specialises in the public understandings of migration and globalization, post-conflict/border zones and transcultural identity formations in Ireland and beyond.
	Tourism Research Centre (TRC)	Marketing, tourism, training and research expertise for the tourism industry
	Food Product Development Centre (FPDC)	FPDC provides a comprehensive range of confidential, professional and innovative services to support the Irish food industry.
	The Futures Academy	The Futures Academy develops a more innovative and effective approach to long term planning through the 'futures thinking'
	The Marine Research Centre (MRC)	MRC specialises in the Rapid detection and quantification of pathogenic organisms and environmental issues in relation to fish health
	National Institute of Transport and Logistics (NITL)	NITL is a fundamental resource for logistics and sustainable transport efficiency in Ireland
	Photonics Research Centre (PRC)	Photonics research with a particular emphasis on optical sensing
	Research Institute for Culture and Heritage (RICH)	RICH Fosters the development of high quality research in culture and heritage
	Institute of Minority Entrepreneurship (IME)	IME Researching the needs of minority entrepreneurship groups
	Antenna and High Frequency Research Group (AHFR)	AHFR specialises in the analysis, design and measurement of radio frequency and microwave devices
	Consumption & Leisure Studies SIG (CLS)	CLS studies consumption, consumer society, media studies, and sport and leisure-related studies
	Audio Research Group (ARG)	ARG researches speech and audio processing

DAG Discourse Analysis Group	Discourse Analysis Group (DAG)	DAG researches discourse from talk to text to music
EPRG	Electrical Power Research Group (EPRG)	EPRG is working in power quality conditioning
PERG	Physics Education Research Group (PERG)	PERG Researches pedagogical innovations in physics education
TeaPOT	(TeaPOT)	TeaPot Researches technology that interacts with humans or with the human body
DIT RETAIL RESEARCH UNIT	DIT Retail Research Unit (DRRU)	Conducts research of relevance to the retail industry

Table 1. DIT Research Institutes, Centres, Units and Groups

Many of DIT's leading research centres are located in the Focas Research Institute {4}, which was created with funding from the Programme for Research in Third Level Institutes (PRTLI) and is an example of a successful public-private partnership approach. Focas was designated formally as a Research Institute following external independent review in 2007 and as such provides a model for the creation of other Research Institutes in DIT.

3. Barriers to Research Group

In order to identify many of the unique issues impacting upon research in DIT, a Barriers to Research Group was formed from Research Managers and some research-active staff across the Institute. Its remit was to identify the currently existing Barriers to Research. Findings were then presented to the Institute's Directors for further action. The methodolgy undertaken was a critical review of existing reports, analysis and categorisation of issues raised. A wide variety of documents and reports from a range of sources were examined, including those from national, international, private sector and educational institutions. These were all given due consideration by the group before being summarised as key points resulting in a series of recommendations, leading to an implementation plan to address the issues. These were recently presented to the Institute's Directors.

However, one significant omission was the lack of importance attached to issues concerning equality of research opportunities, especially with regard to issues of gender. DIT researchers did not attach any special significance to this and both genders maintained that this was not important in the Institute. The Barriers Group recommended however that this be kept under review.

Barriers to conducting research resulting from this process are identified in Table 2.

Entries	Rank	Contents/Issues
30	**1**	Teaching contract and teaching load
18	**2**	Accommodation and access
16	**3**	Research quality measures and methods
12	**4**	Access to help and support
8	**5=**	Administration and procedures
8	**5=**	Postgraduate supervision capacity and training
8	**5=**	Access to and relevance of information
6	**8**	Perception and marketing of DIT research
5	**9**	Research partnerships and alliances
3	**10=**	Technical help and support
3	**10=**	Structure and organisation of centres
2	**11**	Lack of internal financial incentives (seed funding, sabbaticals, etc.).
-	**-**	Equality of research opportunities/gender

Table 2. Barriers to Conducting Research in IoTs in Ireland

A number of key issues were identified in this approach. They included implementation of restrictive employment contracts (with teaching and time constraints), restrictive human resource practices (involving preferential employment of staff in the past who may be inexperienced in conducting research), lack of physical infrastructure, poor management infrastructure, inadequate funding models, resource issues concerning annual leave and an institutional ambivalence towards a research culture. These are discussed in the following sections:

1. One of the key issues is that surrounding the teaching commitment demanded of IoT lecturers. With a typical teaching load significantly greater than that normally undertaken by lecturers in traditional Universities, time devoted to research activity is often very restricted. This is one of the most cited problems. In conjunction with restrictive employment contracts, it makes it much more difficult for IoT lecturers to perform research than for their University counterparts {5}. Some research funding schemes do however recognise this and it is sometimes possible to buy-out time, providing replacements to deliver parts of modules and courses.

It is not sufficient to consider time spent in research and teaching time as equivalent. By making an absolute equivalence between "research time" and "teaching time" there is a danger that most research active staff will end up being relieved of any teaching. This would be a most unfortunate consequence. While it is very difficult to measure, the impact of research on teaching is crucial to keeping teaching materials and content contemporaneous. Letting research evolve into a parallel activity to teaching rather than being fully integrated would dramatically undermine an institute's ability to prepare undergraduate students for careers in the real economy.

There is another important issue as often "recearch activity" is not counted in career progression in the IoT sector. This sector is still predominantly teaching focussed. The procedures inherited make the recognition of research effort in career progression very difficult. The Barriers to Research Group has recommended that DIT re-evaluate progression criteria in order to ameliorate this issue.

2. As in many third level institutions significant growth in student numbers in recent years has placed enormous pressure on facilities. Accommodation for laboratories, lecture halls, libraries and especially postgraduate student offices is limited. In additiion institutions, designed for teaching purposes often restrict after-hours access, meaning some facilities are unavailable for research. This is a special problem in Summer when undergraduate holidays occur.

3. It is difficult to measure and maintain research quality and this can impinge upon postgraduate student recruitment making the IoT less attractive to a potential researcher and/or research partner from another institution. Often a wide variation in research quality can occur within an institution.
In the absence of any national research quality assessment, the quality of research activity and outputs are difficult to measure either among peer institutes in Ireland, or more generally, against potential partner institutes in other countries. Researchers themselves advocate a transparent programme of research assessment.

4. Gaining access to help and support divides into two related issues. The first is access to adequate administrative help and support before, during and after a project's completion. This is an issue for Institute Management but in an increasingly fraught economic situation, it is becoming more difficult to identify and allocate appropriate resources to this function. However it does highlight the necessity for full-cost accounting for research and does highlight the issue around institutional overheads from where this type of support should be paid. In larger institutions such as DIT, it can be difficult to identify the people responsible for certain functions. DIT is currently developing an integrated Research Information System to provide "one-stop" access to DIT staff to relevant information and help.
The second support issue faced by many recearch active staff is insufficient technical staff. There is a strong case for the employment of dedicated research technicians who can assist the efficient running of facilities.

5. Administrative issues and procedures can cause Researchers considerable concern. There is a need to reduce bureaucracy and eliminate problems caused by historical practices which are largely paper-based approaches. Many of these procedures are currently under review and will be streamlined in the near future. Internal electronic communications and information are essential for overcoming the problem. Again it can sometimes be difficult to identify the person responsible for a certain function and the internal web is used to resolve such problems in DIT.
Recent moves in Ireland towards the development of a national research information platform will oblige research institutes to maintain standardised research information and to make this electronically available to research funding bodies, policy makers and other

concerned parties. This will force the Institute to update its information requirements and to move the collection of research information on-line.

6. Postgraduate supervison and training is extemely important for the performance of research. Effective supervision ensures that the student completion rate is high. However supervision is a skill that has to be learned and very effective training programmes have been instituted in DIT to alleviate these problems. In addition it is intended that more training be given to postgraduate researchers in a wide range of skills, thereby equipping them better for future employment in industry. The Graduate Research Education Programmes (GREPs) are intended to address this after a Training Needs Analysis has identified the precise training requirements.

7. DIT is a large institution and information can often be difficult to obtain. Electronic information is available on the intranet but again it can be difficult to identify. Regular updates of activities, including those concerning research are made available on the web ("Update") as well as a magazine entitled "Innovation". The latest edition of a research magazine, "Research News" specifically showcasing the best of DIT's research is soon to go to print. It has already proven to be an effective aid in identifying and promoting researchers and their activities throughout the Institute.

8. The remaining issues concern a range of topics, some of which are currently being addressed. For example Research Centres are moving to faculty control thereby streamlining the decision-making processes. The success of this move from direct Research Support control will only become apparent in the future.

4. Future Research Direction in the Institute

After a rigorous cross-institute review of research strengths DIT established a policy of supporting and promoting research in the following six key areas:
1. Social, Business and Economic Development
2. Environmental Sustainability
3. New Materials and Technologies
4. Food and Health Sciences
5. Creative Arts and Media.
6. Information and Communication Technologies

Two immediate changes ensued from this policy. Firstly, internal competitive research funding switched from a programme of creating sustainable research teams where the quality of research was the principal criterion (twenty one teams had each been funded for two years under the Team Research Scheme, TERS) to the support of teams aligned to the five research strengths (Research Capacity Building Scheme, CaBS). Secondly, external funding bids were sharpened by alignment to a clearly defined strategy. Of necessity, teams were drawn together from both within and across disciplines. This heightened the need for the strategic inclusion of national and international partners. DIT research with external collaborators is underway in all the disciplines aligned to the Institute's recognised research strengths. Examples include joint research programmes with the Deutsches Institut Für Kautschuktechnologie (DIK, the German Rubber Research Institute), University of Art and

Design Helsinki, Universitat Pompeu Fabra Barcelona, VTT Finland, University of Limerick, Athlone Institute of Technology, Trinity College Dublin, and Dublin City University amongst many others.

Hence, DIT research has moved from individual or localised team projects to strategic research clusters. This process is aided significantly by Ireland's practical support for proposals under the European Union's FP VII, by providing an FP VII National Director and National Delegates and Co-ordinators in all the research themes. A series of high profile events have highlighted national support for the programme and generous grants of €25000 are readily available to all prospective research proposal co-ordinators, as well as €2500 travel grants for FP VII participants. This enables researchers to spend time preparing proposals and to meet potential collaborators overcoming two of the major concerns preventing many research-active academics from participation.

To consolidate measures to ensure an increase in research activity and greater engagement in interdisciplinary research projects, DIT set challenging targets for research over the five year period 2005-2010 {3} Meeting these targets required doubling outputs in the key metrics (Ph D registrations and completions, research earnings, refereed journal publications, citations and evidence of research applications) in this five year period. Crucially a 2 to 1 ratio of MPhil to PhD registrations and completions was reversed to provide the research doctoral graduates that Irish industry and the professions need.

Reorganisation of management structures is essential to bring about change, so 'Research Support' is evolving into the provision of a dedicated Office of Research and Doctoral Studies that includes Research Finance, a Technology Transfer Office and R&D managers with specific responsibility for the major funding schemes and research aligned to the Institutes research strengths. Concurrently, DIT has embarked on a policy of creating sixty academic posts that are predominantly research positions and sixty others that are 50% research positions. Also, the Institute's centres and groups, most of which are listed in Table 1, have all been placed in and across faculties to ensure that research and development does not become an activity wholly separated from teaching and learning and has more than just a commercial value for the Institute.

With this policy change, the central role of the Faculty Head of Research becomes evident. These individuals are uniquely placed to ensure that research takes place throughout and across faculties, that strategic links are built beyond the Institute and that academic researchers are applying for funds from appropriate schemes at the right times. Similarly, a proactive technology transfer office is essential for this arrangement to exploit the potential of the research resulting in patents, licenses and Spin-out companies. The health of R&D in the Institute cannot be safeguarded without rigorous external periodic reviews of faculties and centres.

At the same time, in a difficult economic climate it is recognised that greater emphasis on joint research with Industry and greater success in European funding schemes are of major importance. To this end, DIT has established task forces to strengthen Industry led research and European engagement and these two groups are dominated by industry experts external to the Institute.

5. Building Sustainable Academic Research

In March 2000 in Lisbon the European Council endorsed the objective of creating a European Research Area (ERA) {6}. This was a response to the growing globalisation of Research and Technology and the emergence of eastern economies with increasing Research and Technology capabilities. The intention is to make Europe a leading Knowledge Society, thus creating favourable conditions for long term prosperity {7}. The Irish National Development Plan (2007-2013) follows these ideals and great emphasis is placed on the urgent need to conduct more research {8}. Consequently there has been a steady increase in expenditure over the past ten years on Science Technology and Innovation (SSTI), the rate accelerating within the period 2000-2006 as identified in the Plan. Two significant initiatives occurred during this period; the creation of Science Foundation Ireland (SFI) and the Programme for Research in Third Level Institutions (PRLTI), both of which have had a profound influence on the country's research capacity and its profile.

The "European Research Area: New Perspectives Green Paper" {9} describes several key outcomes leading to the creation of effective research policies. It sets out the need for an adequate flow of competent researchers with high mobility across institutions, disciplines and various sectors. It promotes the idea of the formation of World-Class research infrastructures both networked and accessible to research teams from across Europe and the World. Excellent research institutions engaged in public-private schemes, formation of research and innovation clusters in interdisciplinary areas are sought and effective knowledge sharing is required notably between academia and industry. Well-coordinated research programmes and priorities are essential as part of the European research agenda and a special emphasis is placed on interaction with neighbouring countries and a commitment to addressing global challenges with Europe's partners.

Two key outputs are defined in the Strategy for Science Technology and Innovation 2006-2013 {10}: the creation of highly educated people and new knowledge. Ireland with 125 PhDs per million graduating population in 2001 is well behind Switzerland (364), Finland (363), Denmark (169) and the UK (239). There is an urgent need for this gap to be closed in order that Ireland can compete in the global knowledge economy**.** Thus an increase of PhD numbers (doubling) and the desire to build a sustainable system of World Class research teams are key actions. This requires recognition of the need for progression of team members to other roles. Equitable career paths for researchers has become a central issue in safeguarding academic research and the opportunity must be available to progress from Postdoctoral Researcher to Senior Research Fellow / Principal Investigator. It is inarguable that academic research and development in a knowledge economy must:

(i) be sufficiently differentiated such that work is not replicated unnessarily elsewhere
(ii) draw on a range of disciplines and skills to solve complex problems of importance to society

(iii) be frequently evaluated to ensure that quality and relevance are maintained

(iv) equip graduate researchers for the diverse requirements of industry and the professions {11}

(v) inform undergraduate education and ensure that degree courses keep pace with the science, technology and methodology at the leading edge of industrial and commercial activity

(vi) recognise and exploit intellectual property for maximum benefit

(vii) allow participation from teachers of undergraduate courses, thereby enabling transfer of knowledge and continuous updating of skills to occur.

In response to the challenging economic environment, the Irish Government recently signalled the need for the country to carry out significantly more research, which is currently well below the OECD average {12}. It is clear that overcoming barriers to conducting research in the IoT sector will enhance the ability of Ireland to improve its economic prospects through participation in the "smart economy" of the future.

6. Conclusions

If all undergraduate degrees are to be regarded as equal, a teaching only university is unsustainable. The rate of change in all spheres of industry and commerce is so great that without new ideas permeating undergraduate teaching, teaching programmes soon loose their relevance. Some other forms of scholarship, for instance in architecture or fine arts, can maintain this relevance. However, for the majority of academics, doing research is the most sensible and viable way of strengthening and advancing both undergraduate and postgraduate taught programmes.

Conversely, where research becomes distant from mainstream faculty activity and researchers pursue goals that are inconsistent with a university's mission and ethos, in all but a few elite organisations, the research is unjustifiable. To ensure that research informs teaching and learning and to avoid the proliferation of specialist research teams divorced from the academic process, R&D centres and groups must be grounded in and across faculties. The faculty head of research (or equivalent), in partnership with the faculty research board, must engage academics in research. Often this will require identifying where:
a) individual research strengths, that may often be perceived as quite narrow, can complement cross-faculty or inter-institutional research clusters.

b) the appropriate funding sources can be accessed to support the full range of R&D skills in the faculty.
It is now appropriate that barriers to the performance of research in DIT are identified and where possible eliminated or mitigated if the Institute is to achieve the full potential from its Research Strategy. Recent success in the Programmes for Research in Third Level Institutes (PRTLI) has demonstrated a Government committment to encouraging high quality research in the IoT sector in Ireland. This has resulted in the creation of a number of dedicated Research Centres, including the Focas Research Institute in DIT. In this case a public-private partnership was used to build a new facility and funds were made available to staff it. Competition in various Research Programmes has resulted in the successful

completion of many M Phil and Ph Ds and the building has expanded to accommodate larger cohorts of postgraduate research students. Home to several of the centres listed in Table 1, Focas has successfully overcome many of the physical and resource problems associated with use of other DIT research facilities and presents a model for optimising research in a modern higher education context.

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