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Growing Research in a Traditionally Teaching-Oriented College

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Growing Research in a Traditionally Teaching-oriented College

Introduction

There is increasing pressure on universities to contribute to 'the knowledge society' by increasing the level of research activity and output within the university. This is particularly true in the sciences, engineering and technology. This increased pressure applies equally to traditionally teaching-oriented colleges (TTOC), although not at the same scale as research-intensive universities. For the TTOC, given the primacy of teaching, this paper discusses the nexus between teaching and research and the question 'why do research?' is addressed within the overarching goal of embedding a research culture within the college. Initiatives to develop and grow sustainable research activity in traditionally teaching-oriented colleges are introduced and discussed. It seeks to answer the question as to how such initiatives can prove successful in both North American and European colleges.

Economic Context, Rationale and Justification for Research Activity

It is recognised and acknowledged that success in science, technology and innovation are key components to the economic and social progress of regions and countries. In an increasingly global world, high levels of investment in research and innovation are essential, both for economic competitiveness, and to yield innovations in areas which make tangible improvements to our quality of life, such as in healthcare and environmental technologies.

Within Europe, growing research capability is a core component of the European Union's (EU) stated drive to become the most competitive and dynamic, knowledge-driven economic area. The EU "Lisbon" agenda is aimed at making Europe more competitive and innovative on the world stage. The European Council agreed that Europe as a whole should aim to reach a target of spending 3% of GDP on R&D by 2010, with two thirds of that spend to come from industry. While some EU countries such as Finland and Sweden are above that target, Ireland (at 1.2%) remains substantially below it (see Figure 1 below).

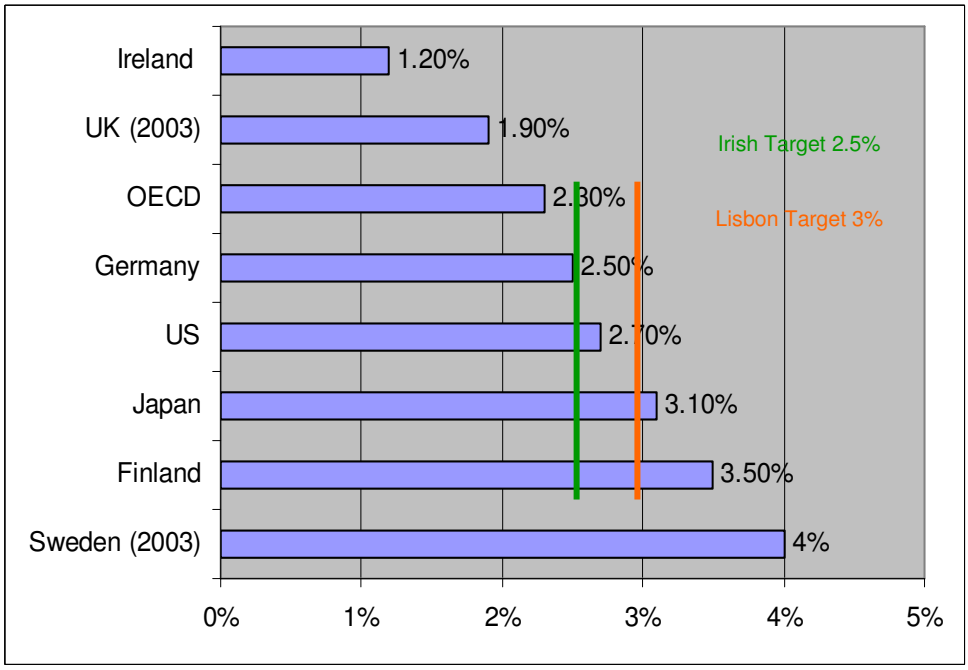

Figure 1: Gross Domestic Expenditure on R&D, % GDP, 2004 [13]

The low level of spend at national level (1.2% of GDP) within Ireland is characterised by a relatively low number of researchers within the country. This is illustrated in Figure 2 below. The EU average, standing at 5.3 researchers per 1000 employed in the workforce, is also low.

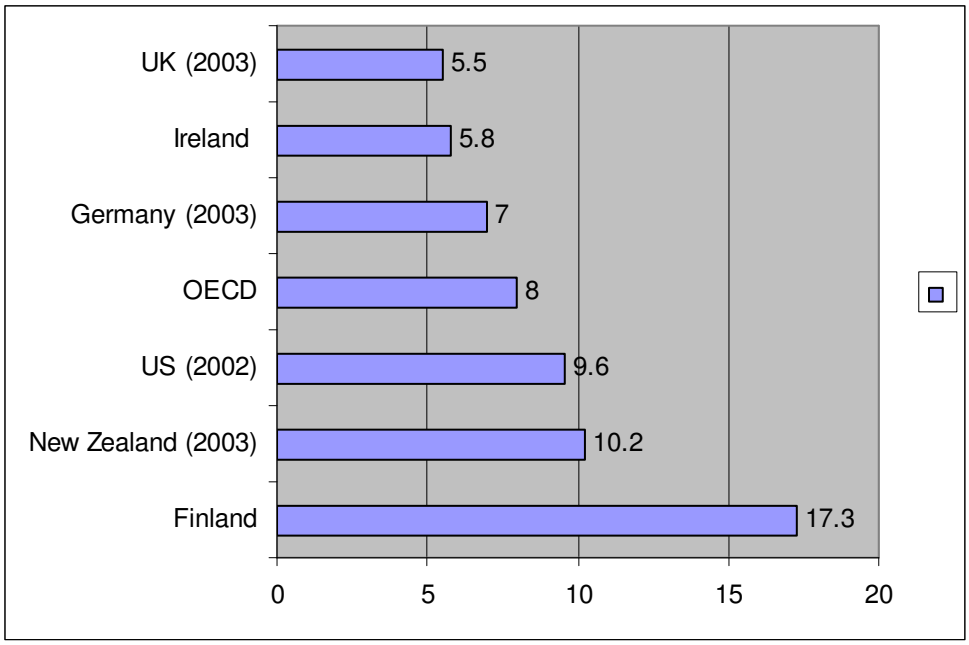

Figure 2: Total Researchers per 1000 Total Employment, 2004 [13]

At a national level, Ireland has embraced this European challenge both at policy level and within the higher education community. Irish government policy focuses on knowledge-intensive employment underpinned by international excellence in education and research. It seeks to shift its economic activity from lower value-added

activities to higher value-added activities. Consequently, Irish Higher Education is being asked to help create a 'knowledge island,' [1] wherein the largest number of people will be educated to their highest achievable third (and higher) level.

It must be recognised from the above data that Ireland and the US are at different stages of capability and output with respect to research activities. Ireland clearly has some catching up to do. Therefore at a national or policy level, approaches to fostering sustainable research may and likely will be different between Ireland and the US. However the imperative to engage in research and scholarship persists and thus the initiatives to grow and develop research in TTOC's will be the same in the US and in Ireland.

Ireland has established a knowledge-based vision that "Ireland by 2013 will be internationally renowned for the excellence of its research, and will be at the forefront in generating and using new knowledge for economic and social progress, within an innovation driven culture." For example, national targets for categories of researchers are provided in Table 1.

Table 1: Cumulative Increases in Irish Higher Education Researchers by 2013 [12]

Total Net New Appointments	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Principal Investigators	40	80	120	160	205	250	295	350
Researchers (PhD +)	120	240	360	480	615	750	885	1,050
PhD Students	235	438	719	976	1,191	1,375	1,569	1,775

National reports and educational reviews have underscored this vision and the need for supporting actions. "Ireland's economic development will depend to a large degree on knowledge and innovation, both of which are essential in making the transition to higher value activities that support economic growth and wealth creation".[2] The on-going transition to an innovation-based, technology-generating society requires all Ireland's higher education system to become proactive unfettered drivers of creativity and innovation to ensure international competitiveness. [3]

As a consequence of such a consistent message, the agenda of Irish higher education has progressed from a desire to simply increase the general education level of the population and the output of scientific research to that of meeting the needs of a knowledge-driven society within a global economy. There is now concern to harness higher education, research and scholarship to broader social, economic and cultural objectives. [4] The Irish National Development Plan, 2000, [5] states that "research is a core element of the mission of higher education. The extent to which education institutions are engaged in research and development activities has a key role in determining the status and the quality of these institutions and the contribution, which they make to economic and social development." Table 2 below indicates that Ireland lags other countries in the common metric of research publications.

Table 2: Science Publications per Million Population (2002)	
Switzerland	1,757
Denmark	1,332
Finland	1,309
Netherlands	1,093
UK	1,021
Norway	972
US	926
Ireland	647

It is difficult to argue that the TTOC should and indeed can refuse to engage in research and scholarship in the face of such consistent pressure on an economic and national basis.

Definition of Research for a TTOC

This section proposes a definition of research that recognises the broader definition of engineering and technology scholarship. Metrics are identified based on the proposed definition.

It is appropriate to consider an inclusive definition of research that is intended to recognise the range of scholarly activities that can occur in traditionally teaching-oriented colleges. The definition proposed here (adopted by the Dublin Institute of Technology [11]) uses an adaptation of the OECD definition of research and experimental development as its definition of research and scholarship:

> Any creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge transfer, or to develop new materials useful for teaching and learning, or to add to the stock of creative works and includes applied, oriented and basic research, consultancy and experimental development.

This definition is used because it is broad and inclusive. It covers the categories of *research* (including basic or applied); *professional and creative practice* (including architecture, design, consultancy, etc.) and *knowledge and technology transfer* (including development projects and other forms of innovation).

There are other relevant definitions of research and scholarly activity, for example that detailed in Boyer's articulate and visionary review [14] of scholarship in a post-war, modern environment.

As a general rule, definitions of scholarship and research are characterised by originality, have investigation as a primary objective, have the potential to produce results that add to humanity's stock of knowledge (theoretical or practical) and are

deemed so by public scrutiny via peer appraisal. Yet they are also sufficiently broad and flexible to be useful in a TTOC environment.

Research Metrics

Research metrics should be defined for a transition period as research activity grows within the TTOC, and then final metrics can be implemented. Transition period metrics may be looser than steady-state metrics, for example counting peer-reviewed conference papers or internally generated research funding. The objective with transitional metrics is to stimulate scholarly activity among faculty with no track record of research engagement and output, and thus begin a culture of enquiry. It is important that steady state or final research metrics be known and understood and implemented as soon as is feasible.

There are six metrics that can be used as either transitional or final state metrics. These are provided in Table 3 below.

Table 3: Six Interim or Final Research Metrics

Description of Metric	Interim (I) or Final (F) Metrics
The number of new taught modules, courses and programmes that emanate from research and scholarship.	Interim
Organisation of and participation in significant conferences, exhibitions, etc.	Interim
Evidence of the use of outputs of research and scholarship by others, including citations, knowledge transfer, commercial exploitation of research and scholarship, etc.	Final
The number of PhD students recruited, their output and achievements and their completion rates within given time scales	Final
Peer-reviewed publications, arts and artefacts	Final
The level and balance of income from internal and external sources	Final

Rationale for Research in a TTOC

National economic arguments aside, the so-called "elephant in the corner" that can't be ignored is the fundamental question of why the TTOC should in fact engage in research? [9] Generally there is a basic belief that a positive relationship exists between research and student learning. There are also some related beliefs, such as that research underpins high-quality under-graduate education; that researchers are better teachers and finally that research is the best way to maintain knowledge currency. It should be noted however, that studies have not always backed up the positive link and that "the common belief that teaching and research are inextricably intertwined is an enduring myth." [7]

Notwithstanding this, it is not unusual to find universities linking research to the quality of their teaching. For example, typical Research-Teaching sections of

university mission statements can include language such as: “Support for scholarship, research and consultancy which serves the teaching of students…” (London Metropolitan University); “Our courses are designed so that students are introduced to the latest research findings in their subject, its methodologies and tests for truth…” (Coventry University); “Provide higher education of excellent quality informed by research and scholarship…” (University of Kent).

One of the defining characteristics of a university is the co-location of teaching and research. These twin pillars are seen as vital in order to be allowed to award research degrees and to underpin their quality. It is also assumed that a significant proportion of academic staff is engaged in research. Teaching in higher education that is not provided in a research environment is likely to be, if not second class, then certainly not of as high quality as teaching provided in a research environment. [8]

Research activity can benefit undergraduate students in two key ways. There should be improved learning across their discipline and there should be a growth of research awareness and research skills in the student. However, these benefits may not follow automatically from simply using research active staff and deliberate intervention may be helpful. This may include the need to re-design a program’s structure so that it supports research activities, and assessment methods that are well-defined learning opportunities. Learning opportunities can include preparation of a simple research paper, research essay on selected topic, research seminar delivered to peers and others, group interview of a researcher, problem-based learning focusing on a selected research problem.

Successfully integrating research activities into undergraduate learning will result in students’ improved research awareness and skills. Consequently undergraduate students should leave college with a zest for inquiry.

Establishing a high-quality undergraduate learning environment for students can also sow significant research benefits, in that exposure to research can imbed a desire to undertake research on the part of capable undergraduate students and it offers the possibility of identifying and nurturing suitable future postgraduate students.

Research Growth Initiatives

This section compares and contrasts a number of growth initiatives, recognising the generally different academic environments of both North America and Europe. The starting point for these initiatives is that the tenure and promotion process cannot be the only mechanism to promote a research culture. These initiatives include identifying strategic research areas, approaches to nurture a strategic research area, how to gain critical and sustainable mass and how to improve the quality of research supervision. Initiatives can be categorised as either strategic level initiatives or academic management-led initiatives. Strategic initiatives should advance an overall research agenda while management-led initiatives should benefit individual faculty engaging in research.

Strategic Initiatives:

1. Begin with a vision of success: what will success look like? Is the vision that of a *research-led* TTOC or a *research-informed* TTOC?
2. Develop a Strategy for Research and get buy-in and agreement by academic management and faculty.
3. Conduct an independent review of research activity and research output. The review should provide an accurate account of research output (baseline assessment), commentary on organisational strengths and weaknesses and a set of recommendations that can be used going forward. Such a review should be conducted every three or perhaps five years.
4. Identify strategic research areas. These should come naturally from the independent research review. Ideally they should represent the alignment of national policy and university policy with existing research strength within the college. These areas should allow scarce internal funding to be concentrated in relatively narrow research areas.
5. Establish transition period metrics. In the early stages of establishing a culture of research, it can be helpful to measure, as contributions to research, scholarly activities such as conference papers, internally-generated income, etc. (See Table 3 above).
6. Understand the rule of thirds. At the risk of over-simplification, the faculty can be split into three groups: Group 1 - those who are already research-active; Group 2 - those who are capable of research but are not producing any output and Group 3 - those who are not capable of conducting research. The most effective strategy is to focus support, resources and effort on moving faculty from Group 2 into Group 1.
7. Recruit an associate dean of research or head of research. Having one person responsible for implementing research strategy and growing a research culture is essential. In the early years of the strategy, the role of the dean will likely be supportive and collaborative. The dean will build bridges among faculty, identify funding opportunities and generally act as a catalyst. The dean must also measure research output based on agreed metrics. As the volume of research activities grows, the role of the dean of research should evolve to ensuring alignment of research activities with strategic research areas.
8. Establish a Research Support Unit to help with identifying funding schemes, proposal writing, research project accounting and general monitoring and support activities.
9. Allocate resources to implement the research strategy:
    a. Implement research capacity building schemes that are focussed on the strategic research areas. These schemes can include seed funding and larger research team awards. Seed funding should be available only once to a faculty member.
    b. Ensure that adequate space, lab and other necessary research facilities are made available. It is important that impediments to research activity are identified and removed so as to ensure that faculty see that the research agenda is a college priority.

Academic Management Initiatives:

10. Recruit excellent postdoctoral researchers. This is perhaps the single most important initiative that can be implemented. Postdocs can immediately

influence the quality and quantity of research outputs through more publications, and more PhD students.

11. Focus on research capable staff when academic recruitment opportunities present. This can be easier to say than to implement in colleges that have strongly vocational undergraduate teaching programs to deliver.
12. Be careful of timetable and academic load for young faculty. Ensure that schemes are available for faculty to buy-out their time or to balance PhD supervision against traditional teaching activities.
13. Develop an effective research supervisor/advisor training programme.
14. Hold regular workshops for graduate students. The goal here is to get research students connected with other research students and therefore to begin to develop a support network. This will help reduce any isolation that some research students might feel.

Indicative Results of Research Growth Initiatives

Initial quantitative data for research areas within the fields of electrical and electronic engineering are positive and highlight the importance of recruiting excellent postdoctoral researchers to support senior academics and to promote research within the School. Table 4 below shows the number of postdoctoral researchers, the comparable number of postgraduate students and the number of publications for six different areas of electrical, electronics and communications engineering.

Table 4: Quantitative Data for Electrical, Electronics and Communications

Research Group	No. of Postdocs	No. of Postgrads	No. of Publications
Wireless	3	3	8
Photonics	2	4	16
Antennas	2	6	28
Microelectronic Systems	0	0	9
Liquid Crystals	0	6	6
RF Propagation	0	0	5
Digital Audio	2	7	24
Electrical Power	1	3	10
Health Engineering	1	4	10
Control	0	3	15
Fuel Cell	0	3	6

The data indicate that it is the presence of postdoctoral researchers that will most likely facilitate peer-reviewed publications.

Organisational Culture

The culture of the traditionally teaching-oriented college must be understood in order to implement sustainable change and embed a research culture. At an institutional level it

is imperative to articulate a vision for the TTOC that is inclusive of the need for all academic staff to engage in scholarship.

Organisational culture has been variously described as incorporating power, role, task or person culture and as collegial, managerial, negotiating and developmental. It is sometimes described as *the way we do things round here.* [10] In a TTOC it would not be unexpected to observe the view that vocationalism is favoured over the Newman ideal of a university, that skills are favoured over content and teaching over research. In the TTOC, academics may seek to protect the divide between teaching-oriented and research-focussed that ensures a more down to earth standard of teaching. Pride in the excellence in undergraduate teaching may cause resistance to attempts to promote a culture of research if it is perceived that it is at the expense of teaching quality.

Developing an effective culture of scholarship depends on motivated individuals who are eager to undertake research and to interact with others. The TTOC must build a supportive research culture and environment as the intellectual and physical seed-bed for sustainable and productive research and scholarship. Fundamental characteristics of a good research culture and environment include a strong synergy between teaching and research and scholarship, the promotion of collegiality, collaboration and interdisciplinary activity and appropriate reward, recruitment and other human resource policies.

Future Work: Development of a Framework Suitable for Sustainable Research

Future work will propose a framework suitable for developing and growing sustainable research in traditional teaching-oriented environments.

The key objective is to build critical mass in research teams. Research activity may begin with individual researchers, but to the extent that such individuals can begin to collaborate and cluster, the faster will be the growth of research outputs and grant proposal successes. The general evolutionary approach to building research critical mass is outlined in Figure 3.

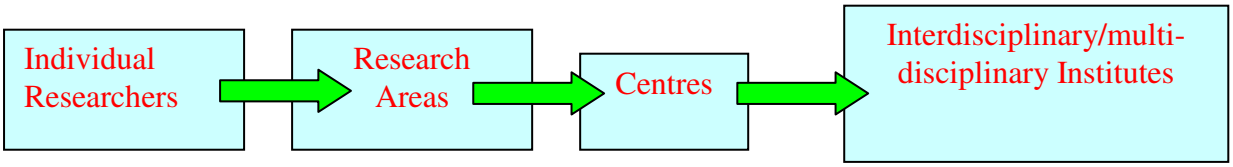

Figure 3 Diagrammatic View of Research Focus

Future work will explore whether critical mass can best be achieved by anchoring a senior academic researcher together with one or more post-doctoral students. The complete research team will include postgraduate research students and research assistants and technicians.

The structure and balance of a sustainable research team could be along the lines suggested in Table 5.

Table 5: Sustainable Research Team	
Senior Academic Researcher	1
Postdoctoral researchers	1 to 3
Postgraduate research students	5
Support (e.g., research manager, technician)	1

Conclusion

Universities in a knowledge society have two responsibilities:

To produce new knowledge by conducting research and promoting scholarship, knowledge development and knowledge transfer;

To produce new knowledge workers by underpinning teaching through emphasis on and development of a strong nexus between teaching and research and scholarship.

Central to these responsibilities is the need to support and develop the expertise of academic staff and the training of research students to develop a culture of research and scholarship.

This paper described a number of initiatives to develop and grow sustainable research activity in traditionally teaching-oriented colleges. To date qualitative and quantitative results are very encouraging and a framework for sustainable research is being developed.

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