

RESEARCH



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Peter Brown
Director, Irish
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OVERVIEW OF RESEARCH IN 2018

I am delighted to introduce the research chapter for Education Matters' Yearbook of Education this year. 2018 has been a year of continuing change and evolution in Irish research and innovation, and this chapter will tease out some of the issues that are a particular focus for the research community and policymakers.

FROM FRONTIER RESEARCH TO INNOVATION

A milestone in the research funding landscape occurred this year with the allocation of the first tranche of awards under the Irish Research Council Laureate programme for frontier basic research. A key strategic action under Innovation 2020, and funded by the Department of Education and Skills, the programme was established in recognition of the scarcity of opportunities to secure individual awards for frontier research across all disciplines.

Thirty-six 'Starting' and 'Consolidator' awards were made across Life Sciences, Physical Sciences and Engineering, and Social Sciences and Humanities, representing an investment of just under €18m. The adjudication of the expert panels that a further thirty-one proposals were entirely worthy of funding indicates the wealth of research talent in the Irish system, and emphasises the need for the Laureate awards to be embedded in the research funding landscape for the long term.

The Council is currently evaluating proposals for the 'Advanced' grant strand of the Laureate awards, and the result of this competition will be announced in early 2019. At a meeting of research agencies in Dublin in November 2018 with Jean-Eric Paquet, director-general for research and innovation in the European Commission, it was very encouraging to hear him describe the Laureate awards as a 'remarkable programme' and one that he hopes is replicated throughout Europe.

It is something of a cliché, but critical nonetheless, that the innovations of tomorrow depend on the basic research of today. This is a theme taken up by Council member Dr Felicity Kelleher of Waterford Institute of Technology in this section of the Yearbook. Without a vibrant ecosystem for frontier basic research, including individual awards across all career stages and disciplines, we will shrink the base on which innovation, and Ireland's ambition to be an innovation leader, depends.

Investing in frontier basic research also builds strong foundations for world-class international collaborations and funding success in prestigious awards such as the European Research Council's.

Perhaps most importantly of all, a vibrant environment for frontier basic research cultivates the knowledge, expertise, and skills that will be critical to addressing the daunting global challenges of climate action, sustainability, food production, and ageing, among others.

ENGAGING WITH THE CHALLENGES OF TODAY AND TOMORROW

The research and innovation system clearly has a massive role to play in meeting national and societal challenges. The Council is building strong links between the research community and policymakers on the forefront of decision-making in these areas. Ireland 2040, the country's blueprint for development for the next twenty years, sets out ten national strategic outcomes (NSOs) on which achievement of the overarching goals of Ireland 2040 will depend. Globally, achieving the UN's Sustainable Development Goals (SDGs) grows in urgency, while Europe is developing a framework of challenge themes and missions that will underpin Horizon Europe (FP9).

From a Council perspective, the need for excellent researchers to work with policymakers and practitioners to address challenges is more important than ever, and we must think in these terms in how we approach the development of early-career researchers also. The Council was delighted this year to launch COALESCE, Collaborative Alliances for Societal Challenges, bringing together previous schemes into a new framework that has Ireland 2040 NSOs and the UN SDGs at its core.

We are particularly delighted to have formed an exciting partnership with Irish Aid, who will fund research projects addressing their remit over the coming years, through COALESCE. Engaged research, in which academic and non-academic stakeholders learn from each other and work effectively together, is key to impact. Kate Morris and Sarah Bowman of Campus Engage contribute to this theme later in the chapter.

The Council has published a statement on STEAM research and how it will support this area over the coming years.

INTERDISCIPLINARITY

Successfully meeting national and global challenges will require an increasing emphasis on interdisciplinarity. The Irish Research Council, funding as it does across all disciplines, is uniquely well placed to encourage this form of collaboration. We have taken steps this year to enhance opportunities for diverse disciplines to come together and co-create new ideas and project proposals.

The Council's popular New Foundations programme has a STEAM science communication strand. The Council has published a statement on STEAM research and how it will support this area over the coming years. Finally, the Council has issued a Call (Creative Connections) inviting consortia of institutions to make proposals for interdisciplinary workshops. Successful proposals will drive new momentum in interdisciplinary co-creation, regionally and nationally, and will build on the first Creative Connections call in 2016.

OF PARTICULAR NOTE IN 2018

There were many developments of note during a busy year for research and innovation. Mary Mitchell O' Connor TD, the Minister of State for

Higher Education, was at the forefront of two in particular. First was the announcement of Ireland's first technological university (TU), after TU legislation was passed. TU Dublin will be launched next year, and with the consolidation of institutes, more TUs will follow. Developing research and innovation intensity will be at the heart of the TU sector; Dr Jennifer Brennan, director of research and innovation in the Technological Higher Education Association, addresses this challenge in her article.

A second key event this year was the publication of the report of the Taskforce on Gender Equality in Higher Education. Research funders have a strong role to play in supporting gender equality, and the taskforce report and recommendations were jointly welcomed by the Council, Science Foundation Ireland (SFI), and the Health Research Board (HRB). How research funders promote gender equality is discussed in this chapter by Dr Caitriona Creely of the HRB.

Another significant development this year was the triggering of 'Plan S' by a group of national and European research funders, in furtherance of open access to research. Signatories include SFI and UK Research and Innovation. The plan has sharpened focus on how Europe ensures that publicly funded research is openly accessible, supporting the optimal circulation of research results and knowledge. The Council strongly supports the objectives of Plan S and is currently reviewing its implications for all disciplines. The Council is also actively contributing to the work of the National Open Research Forum (NORF).

Research funders have a strong role to play in supporting gender equality.

R&I CHALLENGES LOOKING FORWARD

The remaining articles in this chapter address themes of enormous strategic importance for Irish research and innovation moving forward: the impact agenda, research infrastructures, and doctoral education. Excellent contributions have been made on these topics in the research chapter of the Yearbook this year.

Evaluating research impact is the topic of discussion of Dr Eavan O'Brien, assistant director (impact and partnerships) in the Irish Research Council. She contextualises research impact, explores impact classifications, and considers some challenges ahead. Undoubtedly, research impact is a matter of increasing importance both in Ireland and internationally. From a Council perspective, reflecting the broad range of impacts arising from our funded research is a priority. This includes recognising that tangible, game-changing impacts often arise along a continuum that starts with basic research.

Dr Sinead Riordan and Dr Jennifer Kenneally of the Royal Irish Academy discuss research infrastructure in Ireland and bring the fruits of the Academy's recent work in this area to bear. Future development and replenishment of research infrastructures will need to balance different considerations. These include supporting all disciplines to future-proof the broad research base, ensuring both early impact and sustainability for the long term, and achieving a balance between particular strategic infrastructures and more general underpinning infrastructure.

Finally, Dr Máire Leane of UCC discusses how the challenges for doctoral training can be explored and managed through the National Framework for Doctoral Education. As the national funder of individual postgraduate scholarships for excellent research across all disciplines, the Council is heavily invested in the development of early career researchers for both academic and non-academic careers. In her analysis, Maire notes that the establishment of the National Advisory Forum for the National Framework, jointly chaired by the HEA and QQI, provides a mechanism to guide the further development of doctoral education and training in an inclusive manner.

In conclusion, it has been a year of continuing development in Irish research and innovation, and the topics in this chapter draw out several of the salient issues. I am delighted to introduce this chapter and wish to sincerely thank each of the authors for their excellent contributions. The Irish Research Council is very pleased to be associated with the Education Matters Yearbook again this year and looks forward to many more editions in the future.

World's Most Highly Cited Researchers

Clarivate Analytics has ranked five academics at NUI Galway in the top 1% of the world's most highly cited researchers: Prof Henry Curran, Prof Colin O'Dowd, Prof Donal O'Regan, Prof William Wijns, and Dr Derek Morris.

The *Clarivate Analytics* list of Highly Cited Researchers for 2018 identifies scientists and social scientists who have demonstrated significant influence through publication of multiple highly cited papers during the last decade. Researchers are selected for their exceptional performance in one or more of 21 fields (those used in Essential Science Indicators (ESI)) or across several fields.

The 2018 Highly Cited Researchers list can be viewed at www.clarivate.com



L-r: Professor Donal O'Regan, Professor Colin O'Dowd, Professor Henry Curran and Dr Derek Morris from NUI Galway. front: Professor William Wijns

Photo: Aengus McMahon



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EVALUATING RESEARCH IMPACT

Context, classification, challenges

Evaluation of research impact is increasingly important, both in Ireland and internationally. This was clearly stated by Carlos Moedas, European Commissioner for Research, Science and Innovation, in a speech in October 2016:

I hope that in the next Framework Programme we can have a more sophisticated approach to this issue of impact. [...] We have an obligation and an incentive to be much better at understanding and communicating the impact of what we do. Not only to ministers of finance, but to the general public!

In the UK, the increasing importance of impact can be clearly demonstrated: the Research Excellence Framework (REF) 2014 assigned the societal impact component a 20 per cent weighting; this increased to 25 per cent for REF 2021. There are myriad reasons to evaluate research impact. Paraphrasing Penfield et al. (2014, p. 22), the impact agenda matters because:

- It enables research-performing organisations and research funders to monitor and to manage the effects of their work.
- It acts as an important public accountability mechanism, which is vital where publicly funded research is concerned.
- It forms an important evidence-based case to government for sustained or enhanced research support and for optimal funding instruments.
- It enhances general understanding regarding the varied means and pathways through which the effects and benefits of research are realised and maximised.

This brief article will set impact in the current research context and consider it in light of the shift towards mission-oriented research. It will then discuss classification and evaluation systems, noting some challenges that face the impact agenda.

CONTEXTUALISING IMPACT

One of the effects of adopting the 2030 Agenda for Sustainable Development on 25 September 2015, at the UN Summit on Sustainable Development, has been to underscore the global impact of research. As noted by the UNESCO Science Report, 'there can be no sustainable development without science' (2015, p.9); thus, research will play a key role in achieving the Sustainable Development Goals of Agenda 2030. Further highlighting the link between research and the achievement of global goals, Horizon Europe will include a number of missions that specifically target global challenges. Logically, as Arnold and Giarracca (2012) note, mission-oriented research tends to be evaluated in terms of its impacts.

The proliferation of mission-oriented research shows the interrelationship between basic and applied research. Researcher-initiated, curiosity-driven research is often described with terms such as ‘fundamental’, ‘frontier’, or ‘basic’. While it is not directly or immediately oriented towards practical applications, these may result indirectly from the discovery of new knowledge and fresh approaches. This constitutes a long-term economic investment, with basic research as the prerequisite for any scientific breakthrough (UNESCO, 2015, pp.9–10).

This bolsters the argument that basic and applied research are two sides of the same coin: interconnected and interdependent. Of course, this is not a new argument. As the International Council for Science position statement noted in 2004:

Major innovation is rarely possible without prior generation of new knowledge founded on basic research. Adequate public investment in basic science education and research is a critical factor underpinning socioeconomic development. [...] Support for basic science is not something that can be postponed or diminished when times are hard in the misplaced hope that applied research alone will provide a better return. Basic and applied science are a continuum. They are interdependent.

Rather than an unhelpful dichotomy between basic and applied research, this presents us with timely, stimulating opportunities for complementarity and synergies.

It has been debated whether basic or applied research offers more impact. Evidence suggests that both have impact, but on different timescales (Arnold and Giarracca, 2012). It can take longer for the impacts of basic research to become visible, and this can pose challenges for demonstrating impact to policy-makers, who naturally prefer to see results more swiftly.

Of course, the idea of a linear relationship from basic research to impact has long been discredited (Martin and Tang, 2006). The road from an idea to societal benefits often involves participants going back and forth with ideas, temporary results, experiments, half-products, and formal and informal collaboration (LERU, 2017). Nonetheless, basic research is a vital step on the winding pathway to achieving global missions, sustainable development, and long-term impact.

Basic research is a vital step on the winding pathway to achieving global missions, sustainable developments, and long-term impact.

CLASSIFYING IMPACT

At this juncture, it is worth considering: What is meant by impact? Definitions abound. This one is proposed by the Science and Innovation group of the Small Advanced Economies Initiative (2015, p.5):

The direct and indirect ‘influence’ of research or its ‘effect on’ an individual, a community, or society as a whole, including benefits to our economic, social, human and natural capital.

The UK REF has defined impact as ‘an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia’. Research Councils UK categorise it as academic or economic and societal, defining each as follows:

Academic impact: The demonstrable contribution that excellent research makes to academic advances, across and within disciplines, including significant advances in understanding, methods, theory and application.

Economic and societal impact: The demonstrable contribution that excellent research makes to society and the economy.

This definition of economic and societal impact specifically encompasses the diverse ways that research-related knowledge and skills benefit people, organisations, and nations by fostering global economic performance (specifically the UK’s economic competitiveness), increasing the effectiveness of public services and policy, and enhancing quality of life, health, and creative output.

When defining impact we must consider the national policy context. In Ireland, the vision of Innovation 2020 centres on ‘excellent research in strategically important areas that has relevance and impact for the economy and society’ (DBEI, 2015, p.7) – again emphasising economic and societal benefits. The refresh of *Research Priority Areas 2018 to 2023* clearly states two over-arching goals of public investment in research, needed for successful prioritisation but not necessarily drawing from the prioritised programme areas: Research for Policy, and Research for Knowledge (DBEI, 2018, p.5). So it is recognised that support for these is essential to meet the vision of Innovation 2020. In discussion of research impact, the academic impact of excellent research and the policy-related impact of a research-informed evidence base must not be overlooked.

Impact is the direct or indirect influence of research on an individual, a community, or society as a whole, including benefits to our economic, social, human and natural capital.

A number of more micro-level impact classification systems are in use. Taking the European Science Foundation (ESF), Science Foundation Ireland (SFI), and the Independent Research Fund Denmark as a sample group, the table

below shows the range of impacts that these research organisations have chosen to highlight. The Independent Research Fund Denmark adopts a novel approach in its 2018–2020 strategy, conveying research impact in the form of the stakeholder groups whom its research benefits. Logically, the chosen system will be affected by the mission and mandate of the research-performing organisation or funding agency. For an agency such as the Irish Research Council (IRC), which funds excellent researchers across all disciplines, or for a research-intensive Irish university, a broad spectrum of impacts should be considered.

European Science Foundation <i>Types of impact (x9)</i>	Science Foundation Ireland <i>Types of impact (x8)</i>	Independent Research Fund Denmark <i>Impact on (x5)</i>
Scientific		
Economic	Economic & Commercial	Business
Social	Societal	
Political	Impacts on public policy	Public sector
		Legislation & regulation
Health	Health & wellbeing	
Environmental	Environmental	
Training	Impacts on human capacity	Educational system
Cultural		Cultural development
Technological		
	International engagement	
	Impact on professional services	

Importantly, all three organisations in this sample highlight the educational, skills-related, or training impacts of research. Impacts in this category include the benefit to society through its graduates, who have benefited from cutting-edge, research-informed teaching. In Ireland, this is clearly in keeping with the planned outcomes of the *National Framework for Doctoral Education*.

CHALLENGES OF IMPACT ASSESSMENT

As noted by the ESF (2012), there is increasing pressure to demonstrate impact, particularly in relation to basic research. This poses a challenge to research-performing organisations and research funders. Clearly, impact matters and is broadly defined. So how do we measure it?

When interpreting and communicating research activity, it is important to consider the associated terminology of outputs, outcomes, impacts, and their interrelationships (Jones and Cleere, 2014). Outputs are the products of research, for example peer-reviewed publications and patents. Outputs can become outcomes, which are ‘the results or consequences of the research activities and outputs on academia, society or the economy: examples are trained postgraduate staff, licence income from patents, follow-on grant income’ (ibid., p.24). Time is a significant factor in understanding impact, as it is the long-term contribution of research to the economy, society, and other areas highlighted by the foregoing classifications. As the ESF observes (2012, p.6), the dividing line between outputs, outcomes, and impacts is not always clear-cut.

As a step along the path to impact, output and outcome measures are regularly assessed by research-performing organisations or funding agencies, with bibliometric tools offering particularly popular measures. Output and outcome metrics are included in the 2017 annual reports of Ireland’s funding agencies (SFI, IRC, and the Health Research Board), with

There is increasing pressure to demonstrate impact, particularly in relation to basic research.

the chosen indicators being determined by the remit and mission of each agency.

Knowledge Transfer Ireland's Annual Knowledge Transfer Survey collects valuable quantitative data on the commercialisation of research. A joined-up approach is taken in the UK, where a number of research funders, including all seven Research Councils, use Researchfish. This online platform is used by researchers to log the outputs, outcomes, and impacts of their research, enabling funders to track the effects of their investment.

Research metrics continue to grow in importance globally. But it is risky to rely on quantitative measures; there is a tendency to count what can be easily measured, rather than measuring what is of real value. Concerns about coverage are often raised, as bibliometric data inadequately captures outputs from humanities and social sciences. Metrics need to consider the full range of disciplines and of researcher career paths.

The responsible use of metrics has been raised through several recent channels: the San Francisco Declaration on Research Assessment (DORA) in 2012, the Leiden Manifesto for Research Metrics (2015), and *The Metric Tide* (2015). These concerns are being taken seriously: all seven of the UK's Research Councils signed DORA in February 2018. So assessment of impact should not focus solely on readily quantifiable metrics. This is in keeping with the first principle of the Leiden Manifesto: quantitative evaluation should support qualitative, expert assessment (Hicks and Wouters, 2015).

There is a tendency to count what can be easily measured, rather than measuring what is of real value.

Martin and Tang (2006) outline various econometric studies to measure the economic impact of publicly funded research and development. Such studies generally involve statistical analysis of large datasets. As the authors make clear, there are significant empirical difficulties in measuring scientific knowledge and its contribution to technical change and to economic or social welfare. In particular, there are problems in representing the precise extent to which the results from research contribute to an innovation.

In Ireland, recent studies that have focused on the economic impact of research investment include 'Economic and Enterprise Impacts from Public Investment in R&D in Ireland' (DBEI, 2016) and 'Ten Years On: Confirming Impacts from Research Investment' (PA Consulting, 2011). Both take care to emphasise their detailed quantitative focus on a particular set of impacts. While economic effects are clearly a valid area of investigation, concerns have been raised about limiting consideration of impact to economic benefit (LERU, 2017).

Case studies can be used to show research impact, and are currently employed to varying degrees by Irish research funders. The UK has made particular advances in this area. As part of the 2014 REF exercise, UK higher education institutions submitted almost 7,000 impact case studies using a standard template. All are publicly available online: a valuable source of information on the impact of UK research. A project to develop a similar tool in Ireland would be of significant benefit, articulating the benefits of

academic study and strengthening the case for continued, or increased, public spending on research.

Of course, no method is perfect. It is difficult to generalise beyond the case studies provided, and they cannot offer an exhaustive sense of the multiple links between research and its application (Martin and Tang, 2006, p.6). Somewhat akin to case studies is the occasionally suggested idea that researchers write short 'bio-sketches' to summarise their most important research contributions and activities (Curry, 2018).

A further impact-assessment method is expert review. Since 2016, the European Research Council has adopted an approach along these lines, seeking to build a portfolio of evidence in favour of expenditure on basic research. The ERC's third annual assessment report was published in 2018, involving peer-review of a representative sample of ERC-funded completed projects by independent experts following established guidelines. Reviewers address questions on the academic, societal, economic, and policy-making impact of the projects, and are invited to give an overall grade for projects, with 'scientific breakthrough' as the highest point in the scale.

Clearly, this is a resource-intensive exercise, perhaps prohibitively so for most research funders. The most recent qualitative evaluation indicates that seventy-six panel members and sixty-five remote reviewers participated. The exercise resulted in a consolidated report for 223 projects, consisting of an overall assessment and responses to multiple-choice questions. It was found that almost half of the projects have already had impact on the economy, society, and policy-making, with around three-quarters foreseen to have such impact in the medium or long term (ERC, 2018).

It was found that almost half of the [223] projects [evaluated] have already had impact on the economy, society, and policy-making.

CONCLUSIONS

It is clear that research impact matters more and more, both in Ireland and internationally. Impact is equally relevant to basic and applied research, particularly in global missions. A broad-ranging definition or classification system of research impact appears optimal, with an implicit or explicit focus on the beneficiaries of research. Various impact-assessment methods are available to research-performing organisations and research funders. While those we have looked at are not an exhaustive list, and fresh approaches may be developed, case studies combined with carefully selected metrics may offer optimal assessment results.

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First Irish Recipient of International Early Career Award

Hannah Durand, a doctoral researcher in the School of Psychology at NUI Galway, has received an Early Career Award from the International Society of Behavioural Medicine (ISBM). Ten outstanding early career researchers in the field of behavioural medicine were honoured at the award ceremony which took place in November 2018 in Santiago, Chile.

Dr John Bogue, Head of Psychology at NUI Galway, said: "The School of Psychology at NUI Galway has recently been ranked in the top 1% of psychology departments in the world. This award confirms that our standards of education and research are at the very top in international standings. We are very proud of Hannah's remarkable achievement."

Hannah's research was funded by the Health Research Board Patient-Oriented Research Award and supported by the Primary Care Clinical Trials Network Ireland.

RESEARCH INFRASTRUCTURES AND RESEARCH EXCELLENCE

Building on strong foundations, preparing for the future

Ireland's excellence in research and innovation brings major public, social, economic, and cultural benefits. This excellence assumes a high-performing research system supported by the best researchers across a broad research base and by appropriate research infrastructures (RI). It is RI that this article considers, providing a snapshot of current provision and future needs based on a Royal Irish Academy (RIA) survey and stakeholder workshop with researchers from the sciences, humanities, and social sciences, research funders, and policy stakeholders.

Recognising the considerable investment in specific research areas in line with research prioritisation, the RIA sought not so much to consider the needs of specific disciplines but to identify areas of concern and opportunities to enhance RI across the wider research base. Striking commonalities emerged across disciplines in the need for platform-enabling technologies, sustainable mechanisms to ensure maximum value from public investment in RI, and the national strategic framework for RI development and investment.

WHAT ARE RESEARCH INFRASTRUCTURES?

Research infrastructures are facilities, resources, and services used by the research community to conduct research and promote innovation. They come in many forms and sizes, from large facilities and specialist equipment to e-infrastructure networks, libraries, and collections (Royal Society, 2018, p.6). RIs are highly dynamic and continually evolving to support new lines of enquiry or to build on advances in technology and techniques.

CURRENT CONTEXT

Significant public investment in RIs is a relatively new phenomenon for Ireland's higher education (HE) and research system. Prior to 1998, the HE system struggled to obtain enough domestic funding to support investment in HE buildings, research centres, equipment, programmes, and training. The roll-out of the Programme for Research in Third-Level Institutions (PRTLTI) transformed the research infrastructures and innovation ambitions of Ireland's HEIs and government.

The government's Strategy for Science, Technology and Innovation 2006–2013, the 2007 road map for national research infrastructures, Innovation 2020, and the National Strategy for Higher Education to 2030 built on this momentum. They brought enhanced focus on internationalisation and linked domestic funding with emerging EU



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RI policy and initiatives such as the European Strategy Forum for Research Infrastructures (ESFRI)¹ and ERANETS.

Ireland's policy-makers worked hard to protect the level of state investment in public R&D during the post-2008 global economic recession. Research prioritisation linked continued state investment in R&D and RIs with the prioritised national objectives of securing Ireland's competitiveness and developing high-value jobs. After completion of Cycle 5 of the PRTL, responsibility for the next wave transferred from the Department of Education and Skills (DES) to the Department of Business, Enterprise and Innovation (DBEI).

The further development of RIs is a key commitment in Innovation 2020: Action 3.16 charges the DBEI with leading the development of a successor to PRTL to support RI development across the research base. While this is in development, state RI investment continues to be concentrated in strategic research priority areas and actioned through DBEI agencies, particularly Science Foundation Ireland (SFI) and Enterprise Ireland. To a lesser extent, the Irish Research Council (IRC), Health Research Board, Enterprise Ireland, Teagasc, Marine Institute, and other government departments also offer sector-specific schemes to support RI.

Key sources of public funding for research infrastructures in Ireland

- National budget through HEA core grant to higher education institutions (HEIs) for foundation investment in research infrastructures
- European Fund for Strategic Investments
- Research funding agencies with grants to support RI related to their remit
- State agencies with grants to support RI specific to their remit.
- Horizon 2020, which supports research projects associated with RI.

Source: Inroad Ireland: Research Infrastructure Factsheet.

The transition to open science, and the need for national alignment with EU policy to compete for Horizon Europe opportunities, are influential drivers in the future development of Ireland's research infrastructure. The refreshed ESFRI Roadmap 2018 specifically identifies the transition to open science and religious studies as areas of high potential for new RI.

RESEARCH STAKEHOLDERS' VIEWS

In early 2018, the RIA survey 'Examining the Adequacy and Requirements of Research Infrastructures in Ireland' explored researchers' satisfaction with current RIs as well as future opportunities and needs in terms of provision, access, and maintenance. It invited respondents to suggest investment

1 The ESFRI Roadmap is the mechanism used for a cohesive approach to developing major RIs in Europe, identifying new RIs of pan-European interest that match the long-term needs of European research communities, covering all scientific areas.

priorities to guide future allocations of public research infrastructural funding.

The survey results, and the discussions of the June 2018 RIA stakeholder workshop, establish a clearer picture of research-infrastructure-related successes and challenges.

- 90% of respondents in the sciences, and 85% of arts, humanities, and social sciences (AHSS) respondents to the Royal Irish Academy's RI needs survey believed there are gaps in the availability of research infrastructures for their discipline.
- 35% of respondents in sciences and 39% in AHSS said they are not generally able to access the research infrastructural resources they require.
- 77% in sciences and 72% in AHSS believe that current RIs in Ireland are not adequately funded and maintained.

WHAT'S WORKING WELL

Several programmes that fund and support research infrastructure development and capacity-building in the HE sector attracted considerable praise. There was notable support for Enterprise Ireland's Technology Gateway Programme by researchers in the Institute of Technology (IoT) sector. In the absence of PRTL, it was identified as a key support for IoT research, particularly with their regional small and medium enterprise (SME) base. IoTs' increasing participation in research consortia, such as SFI centres, was welcomed as one way to offset the scale challenges experienced by IoTs in competing for substantial RI investment in the short to medium term.

The RIA survey 'Examining the Adequacy and Requirements of Research Infrastructures in Ireland' explored researchers' satisfaction with current RIs.

Previous funding allocated by the IRC was highly valued by disciplines whose research falls outside of research prioritisation, as were sector-specific RI schemes and strategies such as those developed by the Marine Institute and Health Research Board. These schemes were considered to offer a credible and highly targeted way to respond to the RI needs of specific research communities and to support the wider research base.

The positive legacy of PRTL was repeatedly cited. Participants noted the benefits for a range of RI, from training of research personnel to physical and virtual infrastructures.

A move towards a national subscription model for academic publishing, as proposed by the National Forum on Open Data, could deliver significant system-wide benefits.

CHALLENGES

Clear differences emerge in the RI needs of universities and IoTs. Concern was expressed about the level of funding available to support streams of research activity that are aligned with regional industry strengths or

the needs of national SMEs. Recurring concerns included the relatively low budget of much-valued schemes such as the Technology Gateway Programme, the ineligibility of research equipment costs, and the large number of IoTs (fourteen in total) competing for the scheme. Scale and research capacity were repeatedly identified by IoT respondents as hindering their ability to compete for larger RI budgets through, for example, SFI programmes.

The rewards arising from the substantial baseline investment in RIs through PRTL were praised, but many cautioned that the research and innovation spin-offs were nearing the end of their time span, with significant investment needed to support the future pipeline of research, innovation, and commercialisation, particularly for the IoT sector and AHSS disciplines. The question arose as to how the next iteration of this research can best be supported.

High-performance computing capacity, data storage and processing, and the need for platform-enabling technologies emerge as near-universal priorities for future RI investment. There is concern that Ireland has not fully grasped what is needed for progression in terms of capacity, budgets, and renewal timelines to future-proof investment in such resources.²

Clear differences emerge in the Research Infrastructure needs of universities and institutes of technology.

The challenges faced by non-commercial research data centres in the Irish HE system, in adapting to the needs of long-term open data, emerged as a strong theme. Issues highlighted include the need for high-speed data encryption and storage, robust data governance, and security systems. The workshop identified the importance of suitable expertise to inform HEI involvement in increasingly complex legal and governance structures for large-scale international RIs, and to ensure compliance with the open data agenda. The complexities of the open data agenda also invited much comment.

In the chatter around large-scale, international, multi-partner research infrastructures, it is easy to lose sight of smaller but equally valuable types of investment. Respondents clearly wished to see more availability of smaller RI funding schemes. From the relatively small equipment grant that buys a gauge to measure changes in ocean temperature, to the digitisation of an archive, respondents noted that these investments enable excellent, impactful research and should be supported. Researchers across disciplines repeatedly called for more small-scale funding to support the renewal or maintenance of existing, often costly, equipment. The spirit of the nursery rhyme ‘for want of a nail, the shoe was lost’ was frequently invoked to illustrate the detrimental effect of failing to plan for such costs at the starting point of investment.

Workshop participants identified several Irish research projects that are on track to benefit from participation in a specified European Research Infrastructure Consortium (ERIC). Each project has already secured the funding and resources required, and needs similar approval at national level

² One respondent noted that Imperial College London has greater high-performance computing (HPC) capacity than that available to Ireland’s HE system.

for participation. This approval presently lacks a standardised process, leaving several national projects stuck at the gates, unable to participate in international collaborations despite having the necessary national expertise and resources. A cross-departmental protocol to assess Irish applications for an ERIC would be extremely useful for researchers and government departments.

MOVING FORWARD

Ten years on from the first national roadmap for RIs, the preparatory discussion for Horizon Europe, implementation of Innovation 2020, funding allocations in Budget 2018, and the National Development Plan 2018–2027 offer a substantial rationale to consider what is working well and what could enhance Ireland's RIs and support excellence in research and innovation.

HEIs, as the primary research performers, must continue to work closely with the research community and state funders to better understand the RI needs, funding, and collaborative opportunities available at domestic and European level.

Restructuring the next cycle of PRTL to include support for new proposals and existing investments across the research base on an open, competitive basis was widely agreed as crucial to future rounds of infrastructure development. Balance and scale were recurring themes: for example, how best to balance the scale and type of investment needed across discipline types and research-performer sizes.

This was neatly illustrated by an observation from an IoT participant at the RIA workshop: The €20 million top-up budget estimated by one university as necessary to bring its RIs in line with international standards was close to the level of investment made to date by the Technology Gateway programme to support regional industry IoT R&D and innovation collaborations.

Developing a whole-of-system RI strategy that speaks to the wider research base offers a way to knit together the current variety of schemes, and thereby better equip the research community to plan for long-term excellence and sustainability. Given the speed of technological advances and requirements, such a strategy should be revisited regularly to ensure its continued relevance – and to give the wider research base, policy-makers, and funders a continued opportunity to engage on the shared ambition of research excellence.

Such a strategy could speak to issues such as approval mechanisms for joining ERICs. The current HEA commitment to update the Large Infrastructure Equipment Research database to catalogue equipment and databases and other eligible resources would similarly inform discussion and decision-making on a national level, and facilitate better access to and use of this equipment by researchers.

Supporting a high-performing research system that incorporates all disciplines is a complex endeavour. Support must be provided for staff, maintenance, collections, library facilities, and those new pieces of advanced technology that lead to the types of headline breakthroughs to

In designing an effective research system, we must be practical as well as aspirational.

which all researchers aspire. In designing an effective research system, we must be practical as well as aspirational, and we must take a coherent national approach to large-scale data management – which needs tackling before it affects Ireland's success rates in Horizon Europe.

For Ireland, as for many of its EU counterparts, involving the wide body of R&D stakeholders in a continuing dialogue on future waves of RI investment will help to achieve that delicate balance between supporting emerging areas of potential excellence, existing strengths, funding for development and long-term sustainability, investment at national level, and funding for international collaborations.

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John Halligan TD, Minister of State for Training, Skills, Innovation, Research and Development; and **Sharon Bolanta**, Irish Research Council Postgraduate scholar, launching the Irish Research Council's International Engagement Strategy.

ENGAGED RESEARCH

From the margins to the mainstream

Irish universities are committed to academic excellence that benefits Ireland, the EU, and the international community. At the heart of our institutional guiding documents is the acknowledgement that engagement with society is interwoven into the fabric of college life. Our strategic plans point to academic excellence, transformative student experiences, impactful research, and engagement with society. The question is: How does an institution move from aspirational engagement to demonstrated societal impact?

Civic and civil society engagement is integral to the higher education policy landscape. Ireland's 'National Strategy for Higher Education to 2030' refers to civic and community engagement as one of the three core roles of higher education. The Higher Education Authority's (HEA) 'System Performance Framework, 2018–2020' includes civic and community engagement in two of its six key objectives:

- Objective 2: Creating rich opportunities for national and international engagement which enhances the learning environment and delivers a strong bridge to enterprise and the wider community.
- Objective 3: Excellent research, development and innovation that has relevance, growing engagement with external partners and impact for the economy and society and strengthens our standing to become an Innovation Leader in Europe.

The detailed metrics which form the basis of higher education institutional *system performance compacts* with the HEA now refer specifically to engaged research activity.

At both national and international levels, the emergence of research programmes focused on public/patient involvement, innovation missions, and industrial competitiveness is shaping a more inclusive research landscape. Under Horizon Europe, the Commission aims to launch missions with bold, ambitious goals and strong, European, added value to tackle issues that affect our daily lives. Examples include the fight against cancer, cleaner transport, gender equality, peace-building, and plastic-free waterways. These missions will be co-designed with citizens, research-relevant stakeholders, the European Parliament, and member states.

More than ever, funding applications require researchers to make explicit the connections between their research and its capacity to generate or improve products, processes, and services, to address societal challenges, and to demonstrate impact on issues of public



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concern. It is in this changing and challenging context that collaboration between researchers and public research stakeholders – including civic and civil society organisations, state and semi-state agencies, industry partners, professionals, and members of the public – has begun to move from the margins to the mainstream of research design and execution. This change is also reflected in increasing application and demand for new pedagogies and research methods, promoting interactions between students at all levels and the organisations they may one day work in.

Based in the Irish Universities Association, Campus Engage is a national initiative that supports the implementation of civic and community engagement and informs policies across the Irish higher education system. Through its steering committee and associated working groups, Campus Engage is dedicated to providing resources and training on civic and community engagement across teaching, learning, and research.

Funded by the Irish Research Council, the Campus Engage National Working Group for Engaged Research consulted across Ireland and the EU for one year, including a series of workshops with more than 320 participants. Based on this widespread consultation, Campus Engage established a nationally agreed definition of *engaged research*, along with a methods register and principles of good practice.

Engaged research describes a wide range of rigorous research approaches and methodologies that share a common interest in collaborative engagement with the community and aim to improve, understand or investigate an issue of public interest or concern, including societal challenges. Engaged research is advanced *with* community partners rather than *for* them.

A great deal of engaged research literature refers to community engagement. *Community* refers to a range of public research stakeholders, including public or professional service and product users, policy makers, civil and civic society organisations, members of the public and other relevant stakeholders.

An evidence review of international literature informed the development of the *Engaged Research Framework* and the *Engaged Research Impact Framework*. These frameworks provides how-to guidance for researchers on engaging with partners across the research life cycle, encouraging high-quality and impactful research, efficient collaboration, knowledge exchange, and reflective questions aimed at clarifying roles and responsibilities.

This Campus Engage initiative builds capacity for engaged research by providing real opportunities for those most affected by the research topic to become involved in setting research priorities, informing research questions, building and using research instruments, collecting and analysing data, and communicating findings through networks. There is a shift of focus from activities of education, popularisation, and dissemination, to dialogue, co-created and co-produced research, knowledge exchange, and deepening public involvement through peer researcher opportunities.

ENGAGED RESEARCH FRAMEWORK



Figure 1: The Engaged Research Framework presents opportunities for engagement across the research lifecycle

While every research project is unique, the **Engaged Research Framework** encourages researchers to consider opportunities for engagement and involvement that exist at each stage of the research life cycle.

At its foundation, engaged research is simply relationship-building over time, and this is where Irish universities can struggle: our engagement is often interpreted as self-serving rather than mutually beneficial.

Engaged research requires strong project management and communications skills, but it also requires unique skill sets, especially in leadership, facilitation, and occasionally conflict-resolution. It requires courage, resourcefulness, and thoughtfulness and results in highly skilled graduates. Investment in engaged research ultimately helps researchers at all levels to find and then develop a community that honours both the professional and lived experiences – and it is at this frontier that exciting and impactful research can happen.

While there are outstanding national exemplars of engaged research, we also continue to advance tokenistic box-ticking approaches, which fail to meet the core principles of sincere engagement. If we are to be genuine in our approaches to engaged research, we must ask the following questions:

- Have we engaged those most affected by the research to clarify whether research is needed? If not, how is this approach reflective of best practices in scientific enquiry?
- Does the proposed research tap the expertise and tacit knowledge of both researchers and research stakeholders? If not, how is this the best use of public monies?
- Does the research design ensure that teammates are clear about the extent of their collaboration, their roles and responsibilities, what they can expect to gain from the research, and what they will be expected to contribute? If not, how is this ethical?
- Is the allocation of funds appropriate for the roles and responsibilities assigned to each teammate? If not, how is the research environment we're creating fair and sustainable?
- Are supports and training required to encourage and support meaningful involvement?
- Are planned research outputs usable by partners and collaborators, and are they recognised or acknowledged?

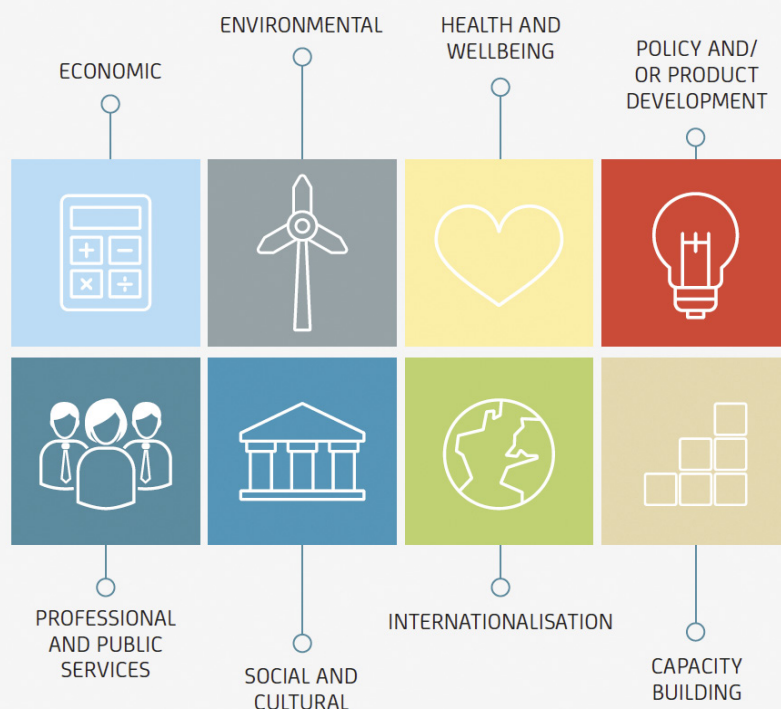


Figure 2: The Campus Engage Engaged Research Impact Framework

At a sectoral level, and in a country the size of Ireland, there is a real risk of both peer-researcher and participant fatigue unless we advance more thoughtful approaches that honour the commitment of time that engaged research requires. In many ways, a conversation about engaged research is a conversation about power. A focus on engaged research requires that we ask and try to answer some fairly significant questions: Who is involved in the decisions about which knowledge is created? How is knowledge created? How it is used? And how it is shared?

At the institutional level, we need systems in place to advance relationship-building in the absence of third-party funding, and we need to do a better job of translating knowledge for positive effect and longer-term impacts. This requires an engagement strategy for every research office. In too many cases, we have no understanding of the history of engagement. Those in civic and civil society organisations can be inundated with requests that do not align with their remit. This shows a lack of care on our part, but it also shows that in institutions, we're unclear about who is doing what, because we are not memorialising efforts or recognising our collaborators in publications, case studies, profiles, awards, plans, reporting structures, and other activities. This is not only irresponsible but incongruous with the goals of higher education.

At its foundation, engaged research is simply relationship-building over time, and this is where Irish universities can struggle: our engagement is often interpreted as self-serving rather than mutually beneficial.

To right these wrongs, Campus Engage has established high-level recommendations for higher education institutions, policy-making bodies, and research funding organisations to promote excellence in engaged research and to make Ireland the benchmark, go-to country for collaborative enquiry. Informed by researchers and community partners in Ireland and abroad, the following opportunities aim to advance a vibrant and responsive research sector with the capacity to deliver impact and innovation for the benefit of all.

RECOMMENDATIONS FOR HIGHER EDUCATION INSTITUTIONS

- Provide training, in partnership with public or professional service and product users, policy-makers, civil and civic society organisations, and members of the public, on good practice for engaged research.
- Assign dedicated staff to support institution-community partnerships on all aspects of engaged research.
- Put in place simplified payment/reimbursement systems and processes that facilitate partnering and accommodate non-university staff.
- Develop local communication and information systems which link all departments, disciplines, and colleges to capture past and ongoing engaged research projects to promote mutual learning and to avoid duplication.
- Provide networking opportunities for public or professional service and product users, policy-makers, civil and civic society organisations, members of the public, and higher education staff interested in working together.
- Provide institutional reward and recognition for engaged research, and reflect this in academic workloads and promotions procedures.
- Embed a commitment to engaged research in research and innovation, teaching and learning, strategic plans, undergraduate curricula, and postgraduate and doctoral training.
- Accommodate flexible scheduling and timetabling of workloads to facilitate engaged research activities.

RECOMMENDATIONS FOR HIGHER EDUCATION POLICY-MAKERS

- Publish a national strategy for engaged research in Ireland to position Ireland as a European and international leader in this area.

- Assign leadership to strategically implement engaged research policies, with responsibility for advancing the enabling infrastructure to promote engaged research at a national level.
- Adopt a nationally agreed definition of engaged research.
- Promote nationally agreed guidelines for best practice in engaged research.
- Create nationally agreed metrics that characterise engaged research practice with societal impact.
- Resource a national hub to inform, fund, and offer capacity-building to support societal innovation through engaged research.
- Develop a national 'clearing house of expertise' for engaged research that could contribute to the development of engaged research networks in Ireland and attract international researchers to Ireland.
- Create an inter-institutional/organisational national database of engaged researcher case studies and researcher/support staff profiles.
- Create a national engaged research 'methods toolbox' as a resource for transdisciplinary and inter-institutional collaborations.
- Publish a data management protocol for engaged research.
- Publish an intellectual property protocol for societal innovation.

RECOMMENDATIONS FOR RESEARCH FUNDING ORGANISATIONS:

- Align funding calls to societal needs articulated by public or professional service and product users, policy-makers, civil and civic society organisations, members of the public, and researchers.
- Allow longer project timelines for engaged research projects.
- Include funding for pre-proposal design and consultation and post-project impact assessment.
- Earmark funding for existing programme or service evaluation research.
- Offer societal innovation vouchers for engaged research.
- Fund project management for larger-scale engaged research projects.
- Fund support staff to sustain engagement between partners between and during funded research projects.
- Fund national inter-institutional collaborations to provide leverage for smaller-scale projects to develop into impactful larger-scale projects that address issues of public concern across Ireland.

When we undertake engaged research, it enriches and broadens academic thinking, refining ideas and ensuring their relevance. It reduces duplication of efforts and improves the timeliness of discoveries, often propelling research and research teams further along the pathway to impact. Engaged research favours excellence through collaborative rather than competitive approaches across departments, institutions, and sectors, emphasising the flow of ideas across society rather than just within disciplinary groups. Frankly, we need more of this.

TECHNOLOGICAL UNIVERSITIES AND THE RESEARCH ECOSYSTEM

Supporting research, innovation, and engagement in Ireland's new universities



Jennifer Brennan

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Since the Technological Universities (TU) Act was signed into law in April 2018, the most common question people ask me at work is: What does this mean for research and innovation in the sector? The legislation sets out clear expectations for substantial growth in research, development, innovation, and engagement (RDIE) in these new universities. Put simply, it means more: more postgraduate research students, more research-active academic staff, more research outcomes that support and engage industry and the community, and above all, more impact, particularly in the regions where these new universities will be located.

The technological higher education sector currently consists of fourteen institutes of technology (IoTs). Over the next three to five years, the sector will transform to encompass four technological universities (in the south-east, south-west, north-west, and Dublin) and four IoTs. Ireland's first technological university (TU) will be established in January 2019: the Technological University Dublin, formed by merging the IoTs in Blanchardstown, Dublin, and Tallaght. This transformation, supported by the legislation that underpins it, will scale, broaden, and deepen the RDIE work already ongoing in the sector.

The expansion of RDIE activities began around the turn of the millennium, catalysed by successive cycles of investment through the Programme for Research in Third-Level Institutions. This expansion has been accelerated in institutes preparing for TU applications, but it is occurring across the entire sector due to recognition of the central role of integrated teaching and research in the life of a higher education institution. In the ten years up to 2014, research expenditure in the sector tripled. Enrolments on postgraduate research degree programmes have grown by 40% since 2012, at a time when national enrolment figures were declining.

Another sign of growth is the increasing participation of the institutes in national research and innovation centres. Currently, they are partnering in ten of the seventeen Science Foundation Ireland (SFI) Centres and nine of the fourteen Technology Centres supported by Enterprise Ireland and the IDA. These partnerships take advantage of the institutes' expertise in areas such as ICT, photonics, pharmaceuticals, renewable energy, and materials. In particular, the institutes have a strong role in the two new manufacturing centres being funded by SFI: Confirm and I-Form. Researchers from the IoTs in Athlone, Cork, Limerick, Sligo, and Waterford will join with university and industry partners to develop the latest technologies in smart and advanced manufacturing.

But what characterises the type of RDIE activities that are performed in the technological higher education sector? What will they look like in the new technological universities? For me, the phrases that best illustrate the type of activities are 'mission-oriented' and 'close to the user'. RDIE activities are always performed with the end user in mind, and are often performed with those end users. The best-known example of this focus is the important work the sector does to support enterprise development.

Each institute hosts an innovation hub, where budding entrepreneurs can take part in the New Frontiers entrepreneur development programme. The hubs provide incubation space for spin-out and spin-in companies, which can benefit from enterprise development supports, including tailored advice on applying for research and innovation funding. These companies can also benefit from the research and innovation expertise of the Technology Gateways, a network of fifteen centres of R&D excellence hosted by the institutes in partnership with Enterprise Ireland.

When companies are looking for solutions to research and innovation problems, the Technology Gateway network is well placed to deliver successful outcomes for them. It is an entry point into the RDIE expertise of the institutes. The network covers a very broad range of industry-relevant research areas and is designed so that expertise from different Gateways can be pulled together to deliver on projects for industry clients. Projects can be small or large and can involve collaborative research work between the company and the institute, or consultancy work by the institute for the company. The Gateways completed €26 million worth of projects in 2013–2017, with industry providing around 50% of the funding.

The Finn Lough bubble domes are a unique accommodation experience, featuring 180-degree transparent walls so travellers can immerse themselves in nature and can sleep in comfort under the stars.

One interesting example of a Technology Gateway project is the technology that the Wireless Sensor Applied Research (WiSAR) Gateway based at Letterkenny Institute of Technology developed for the Finn Lough Bubble Domes based in Donegal near the Fermanagh Lakelands. The bubble domes are a unique accommodation experience, featuring 180-degree transparent walls so travellers can immerse themselves in nature and can sleep in comfort

under the stars. But the domes are prone to deflation, which affects their transparency and the occupants' experience. WiSAR developed and retrofitted a unique sensor system based on Internet of Things technology, which identifies when the air pressure has dropped below a critical level and instructs the air pump to refill the dome.

Another essential aspect of the RDIE work of the sector is to support local communities. This 'engaged research' involves staff, and students at all stages of their education. Many undergraduate programmes involve a structured research project with a community partner. These projects deliver for the community partner but also support the student's educational needs. At the larger end of the scale, there are many collaborative research projects with civic or community partners. For example, researchers from Dublin Institute of Technology are collaborating with the Jesuit Centre for Faith and Justice on a project whose outcomes will support young adults in

prison and upon release. These projects, whether student-led or staff-led, often lead to significant social innovations.

The supports offered by institutes to business also extend to social enterprises, which are developing new ideas, services, and models to better address social issues. One is MyAccessHub, a company founded by Institute of Technology Tralee graduates Gearoid Kearney and Miriam O'Sullivan. MyAccessHub uses technology to help businesses reduce or eliminate barriers that typically prevent neurodiverse people from being successful employees or satisfied customers. Its founders participated in the New Frontiers entrepreneur development programme at IT Tralee and identified it as a key milestone. They continue to work with IT Tralee to develop new technology to enhance their business offering.

Working with international partners is a central aspect of RDIE in the technological higher education sector. The institutes have a strong track record of securing European funding to support these partnerships, with over 25 per cent of annual research expenditure being supported by EU funds. The IoTs in Cork and Waterford are ranked among the top ten Irish higher-education performers in Horizon 2020, the EU framework programme for research and innovation. Institutes are particularly active in securing funding from INTERREG, which supports European regional cooperation.

For example, Dundalk Institute of Technology is leading on a €7.7 million INTERREG project designed to better understand and alleviate the impact of lung disease. The project links Dundalk's Smooth Muscle Research Centre with researchers from Queen's University Belfast and the University of Western Scotland. Further afield, institute researchers are building partnerships with Brazilian universities. This includes the Horizon 2020 EUBrasilCloudForum project, where researchers from the TSSG research institute in Waterford Institute of Technology are partnering with EU and Brazilian universities to formulate a common strategy and approach to cloud computing in the EU and Brazil.

Working with international partners is a central aspect of research, development, innovation, and engagement (RDIE) in the technological higher education sector.

These examples give a flavour of the kind of RDIE activities that the sector is currently engaged in. So much more could be showcased, including substantial work in design and the creative industries at locations such as the design core research centre in IT Carlow, the Crawford College of Art and Design in Cork IT, and Dun Laoghaire Institute of Art, Design and Technology. The common thread is the 'mission-oriented', 'close to the user' nature of the work. With a strong focus on problem-solving and social and technological development and innovation, the RDIE undertaken in the sector is intended to advance human knowledge, address societal challenges, and make a real impact on people's lives.

The challenge for this revitalised technological higher education sector is to find a way to continue to grow, broaden, and deepen the range of RDIE activities that they perform, so they can transform into the truly research-informed institutions described in the TU legislation. Enabling this growth will require government to provide dedicated funding for RDIE activities

via the recurrent grant. It will require changes to the workload model for academic staff, allowing them time to begin or engage further in RDIE. Working conditions for research staff will need to be improved, providing a clear pathway for the most talented to progress in the institution and offering tailored training so that researchers can move into the wider labour market. National research funders must remove the barriers that, though often inadvertently, prevent the sector's researchers from applying to their funding calls.

All stakeholders in the national research and innovation ecosystem will have to recognise the strong contribution the sector can make to that system, and examine how the talents of the sector's researchers can be better supported so the work they do can be harnessed for the benefit of Ireland's economy and society. The sector is well aware of the internal reforms required, and the Technological Higher Education Association will support them with those changes. We will also work on their behalf to ensure that external stakeholders make the required changes to enable the sector.

The advent of technological universities can only result in a substantial increase in the technological higher education sector's contribution to national research and innovation efforts. Ireland's stated ambition to become a global innovation leader will only be achieved if all parts of the innovation ecosystem are enabled. Through its past and present achievements, the technological higher education sector has consistently shown that it can deliver on research and innovation outcomes that have a real impact on business and the wider community. If properly supported to make a larger contribution, I have no doubt that these new universities will rise to the challenge.

Dublin Institute for Advanced Studies (DIAS) launched its new four-year strategy on 20 November 2018.



Pictured at the launch l-r: **Professor Ruairí Ó hUiginn**, Director, School of Celtic Studies, **Professor Werner Nahm**, Director, School of Theoretical Physics, **Dr Eucharia Meehan**, CEO and Registrar, Dublin Institute of Advanced Studies, **Professor Chris Bean**, Head of Geophysics, **Professor Peter Gallagher**, Head of Astronomy and Astrophysics. Pic: Marc O'Sullivan

GENDER MATTERS

Creating our future



Caitriona Creely

Programme Manager,
Investigator-Initiated
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Research Board.
Leads Gender
Implementation Plan.

I recently attended a conference celebrating the 75th anniversary of Erwin Schrödinger's 'What is Life' lectures. The physics Nobel-prize winner lived in Dublin for many years, and, while director of the School of Theoretical Physics in the Dublin Institute for Advanced Studies, gave lectures which greatly influenced the development of molecular biology.¹ Having begun my research career in physics, with many lectures held in the eponymous theatre in Trinity, I was curious to see what the contributions would be. The conference did not disappoint; there was plenty to engage the mind and imagination, and inspiring lectures over the two days.

At the opening session, co-organiser Luke O'Neill of Trinity College Dublin recalled TCD's celebration of the 50th anniversary of the same lectures, held in 1993. He highlighted that out of twelve speakers, not one was female, a situation which would be unthinkable today! In the intervening years, acceptance of the need for women to be visible and actively participating, especially in STEMM (Science, Technology, Engineering, Mathematics, and Medicine), has increased hugely.

Prof. O'Neill wanted to acknowledge in particular the work of his colleague and co-organiser Dr Tomás Ryan in aiming for at least 40 per cent female speakers, which was evident from the line-up. I was heartened that the attending secondary school students witnessed the passion and intellect displayed by male and female, senior and more junior contributors, and the emphasis on how collaboration between countries and disciplines has been key to driving developments in biology in the last 75 years.

Over the two-day conference, I had the pleasure of hearing five Nobel laureates speak, one of whom was a woman: the incredibly impressive Ada Yonath. After the announcement of the 2017 Nobel prizes, with nine laureates – all men – across physics, chemistry, and physiology of medicine, the vice chair of the board of directors of the Nobel Foundation, Göran Hansson, spoke directly on the issue of the dearth of female winners.² He emphasised that all winners are drawn from a pool of nominees, so the Foundation is dependent on receiving nominations of women for the prize.

The selection process takes almost a year, and nomination to the science prizes is by invitation only. The names of nominees and other information about the nominations cannot be revealed until 50 years later. Hansson said that starting in 2018, the Nobel committee would encourage the nomination of women scientists and consider ethnic and geographic diversity. If such an intervention has an effect, it will be on the pool of candidates. It remains to be seen how this will

affect the number of female laureates, and how long it will take for changes to be evident.

GENDER EQUALITY TASKFORCE

In August 2018, TCD hosted the tenth European Conference on Gender Equality in Higher Education. Established in 1998, the conference provides an international forum to discuss and exchange information and experiences on the challenges related to gender in academia and to promoting gender equality. The theme this year was 'Gender in academia and research: Countering persistent and emerging challenges to equality'. It was the first time the conference was held in Ireland.

Minister of State for Higher Education, Mary Mitchell O'Connor, opened proceedings. She said, 'The hosting of this conference places an international focus on what we in Ireland are doing in our higher education sector to effect meaningful and sustainable change in achieving gender equality.' The Minister noted that 'improvements in recent years have been marginal, and there still exists a significant lack of representation of women on key decision-making bodies in the institutions and at senior levels of academic staff.'³ This is borne out by the latest gender-disaggregated figures on the staffing of Irish higher education institutions (HEIs) in universities, colleges, and institutes of technology (IoTs), published by the Higher Education Authority (HEA) during the summer.⁴

At the time of writing, all seven Irish universities now hold Athena Swan Bronze status, and several IoTs and colleges are applying.

Minister O'Connor launched a Gender Equality Taskforce on 6 November 2017⁵ to drive and accelerate implementation of the recommendations in the HEA National Review of Gender Equality in Irish Higher Education Institutions, published in June 2016.⁶ The report from the task force is expected in autumn 2018. The Health Research Board (HRB) fed into the task force at various points, including giving an update on our practices as part of the fact-finding phase in December 2017.

I participated in the gender task force stakeholder event in January, where attendees were asked their views on recommendations from the HEA expert group report: how they could best be implemented and strengthened. This included discussions on gender-specific targets and quotas, mentoring and promotion, recruitment, caring and return-to-work policies, and equality and diversity training. The workshop was mainly for HEIs, and attendees heard first-hand the diversity of activities at institution level aimed at promoting gender equality, including many examples of good practice.

The event included a detailed discussion on the Athena Swan charter, which was established 'to encourage and recognise commitment to advancing the careers of women in science, technology, engineering, maths and medicine (STEMM) ... in higher education and research.'⁷ The charter was launched in Ireland in 2015, supported by the HEA.

As research funders, HRB, SFI (Science Foundation Ireland), and IRC (Irish Research Council) agreed a common approach on Athena Swan status in 2016, setting deadlines for HEIs to acquire award status in order to be eligible to receive awards. Many attendees at the stakeholder workshop had

been deeply engaged in the application process for Athena Swan awards. Feedback from attendees was that the lengthy process of applying for Athena Swan status was viewed as painful but positive, and that having the wealth of data collected through application provides a powerful tool to convince senior decision-makers where a specific problem does exist.

At the time of writing, all seven Irish universities now hold Athena Swan Bronze status, and several IoTs and colleges are applying. Maynooth University was awarded under the expanded charter – that is, including arts, humanities, social sciences, business, and law (AHSSBL), covering professional and support roles, and including experiences of trans staff and students.

Irish HEIs currently may apply under the original process, focusing on women in STEMM in academia (known as the ‘pre-May 2015’ process in the UK), but by November 2020 all applicants from Ireland must use the expanded process. The Irish funders will keep the timing and requirements for Athena Swan status under review, in particular due to differences in when institutions were awarded, and whether the award was made under the original charter of STEMM only, or under the expanded charter.

MOVING THE DIAL: FUNDER PRACTICES

At the Conference on Gender Equality in Higher Education, I participated in a panel discussion on Gender in Research Funding, with colleagues from the IRC, SFI, and the Swedish Research Council (SRC). Chaired by Dr Anne Pépin, senior policy officer in the Gender Sector in the European Commission Directorate for Research and Innovation, we presented examples of successful practice at each funder, highlighted current European collaborative networks and communities of practice to address gender equality, and explored challenges to gender equality from the perspective of funders.

IRC director Peter Brown noted that their intervention of gender-blinding of applications for early-career awards undergoing international peer review has had a positive impact on success rates for women. Marion Boland, head of research policy in SFI, highlighted their Starting Investigator Research Grant, where the number of applications from male candidates nominated by the research body was capped at six out of a possible twelve. She noted that applicants are reviewed for excellence and impact regardless of gender, and that the success rates were on a par.

The Swedish Research Council was represented by its senior advisor, Carl Jacobsson. The SRC supports basic research in all disciplines and has a role in research policy, analysis, and communication. It uses peer review groups to assess over 6,000 research applications annually. The SRC incorporates gender-equality observers at selected peer review groups, and their reports are used to train its peer reviewers, decision-makers, and staff. This intervention has improved the review process and led to more equal success rates for female and male applicants in recent years.

IRC director Peter Brown noted that their intervention of gender-blinding of applications for early-career awards undergoing international peer review has had a positive impact on success rates for women.

A number of European Commission-funded projects were discussed at the session. SFI will be a seed partner for Ireland and UK region in the ACT project,⁸ funded under Horizon 2020, whose partners will set up and coordinate a community of practice among research funders across Europe. Marion Boland will lead that engagement in the coming months. Anne Pépin was looking forward to a new project on gender gaps and biases in the allocation of grants, funded under the 2018 Science with and for Society programme, which should kick off by the end of 2018. This will generate better understanding of remaining institutional barriers contributing to gender gaps in research funding, and of the policy changes required to remove such barriers.

Since publication of the Health Research Board gender policy in June 2016, HRB has reported to the board annually on gender statistics of awards made, and panel composition, which we then publish on our website. HRB aims to promote gender equality as it relates to decision-making in allocating research funding, and to ensure our processes align with international best practice.

Unlike some funders in STEMM, HRB schemes typically attract more female applicants, roughly 60%. Our data shows that success rates for male and female applicants are about equal. HRB does not use standing panels to make funding recommendations to our board. Instead, we convene separate review panels, constituted according to the expertise needed to review applications to a specific scheme, or to conduct interim review of certain awards.⁹ Our gender policy sets a target of 40% of the underrepresented gender (male or female) in our panels, which we are achieving overall. We also aim over the course of a year to have balanced representation in the chairs for our review panels; this is more difficult, as each panel has a single chair, but we monitor it to achieve balance.

In January 2018, HRB had an internal workshop focusing on how we assess research grant applications, in particular how we develop and use assessment criteria.

SPOTLIGHT ON ASSESSMENT CRITERIA

In 2016–17 HRB undertook an external review of our call processes and documentation, and incorporated a live review of some HRB panels: an observer attended review proceedings and reported back to us. While they did not uncover specific gender bias, they did note areas that could be strengthened in the review process. One is assessment criteria: their length, amount, and level of ambiguity.

The report submitted to HRB, and published on our website, noted that experienced reviewers interviewed reported that ‘HRB criteria “feel” familiar’, which carries the risk that reviewers may base their ratings not on the HRB criteria but on those of another funder more familiar to them.¹⁰ Also highlighted was that an assessment criterion that is long, with multiple components, ‘can be interpreted in different ways by different reviewers, with the salient points for them typically being the ones that are remembered and considered’.

As a result, in January 2018 we had an internal workshop, facilitated by the same provider, focusing on how we assess research grant applications,

in particular how we develop and use assessment criteria. Behaviourally anchored rating scales (BARS) use behavioural examples of performance at different points on a scale.¹¹ Commonly used as a tool to improve objectivity when rating candidates for jobs, the approach uses indicators of competence, matched to statements which describe ineffective, effective, or highly effective indicators. It involves much preparatory work developing and refining criteria, which are simplified and distilled to reduce ambiguity. Rather than using a numerical score, for each criterion the reviewers select the narrative which best describes that aspect of the application. The BARS approach has to be carried through in all documentation and guidance for reviewers, and then on the day of the panel meetings when recommendations for awards are made.

The BARS approach works best in our processes for schemes where there are fewer applicants, and this year it has been used in a number of schemes. If a full BARS treatment cannot be undertaken, for example in higher-volume schemes such as our Investigator-Led Projects, we focus on two areas: refining the assessment criteria, and developing a narrative descriptor for scores. This approach has been used in schemes this year: it helps reduce the incidence of panel members interpreting scores differently, and has garnered positive feedback from panel members. I highlighted this work during the Gender in Research Funding panel discussion as an example of good practice.

Thinking about how we develop assessment criteria and challenging beliefs about the level of objectivity we achieve has been a very positive exercise. Improving decision-making by increasing objectivity of HRB assessment criteria is a work in progress, and must of course be tailored to the aims and objectives of each scheme.

One near-term goal for HEI awardees of Athena Swan will be renewal of their bronze status.

MOVING FORWARD

I've touched on some work this year on the gender equality agenda in research and higher education, detailed a piece of work undertaken by Health Research Board to improve our review processes, and mentioned other funder practices that are making a positive difference.

I was struck by a comment from one attendee at the gender equality task force workshop: that applying for Athena Swan status shone a light on the inequalities that exist across our higher education system. How to tackle these inequalities is something to which we can make a positive contribution at different levels: as institutions, funders, employers, colleagues.

One near-term goal for HEI awardees of Athena Swan will be renewal of their bronze status. Funders will work closely together to ensure continued momentum towards achieving this certification. We are also working with SFI, IRC, and HEA on implementing our respective gender strategies, to identify specific areas for common approaches and to share learnings from our agencies on interventions aimed at gender equality.

Data presented by HRB head of pre-award Anne Cody to the Athena Swan committee in June 2018 showed that success rates were higher for men applying for larger HRB research grants (over €500,000) from 2016 to mid-2018, and that many more men hold these larger grants. HRB will consider

the issue of larger awards, in line with our gender policy, to ensure women are not at a disadvantage in securing senior-level or strategic awards, and that the systems we use to review these applications in particular will support fair decision-making.

In conclusion, imagine attending the 100th anniversary of the Schrödinger talks, in 2043. Will the attending students and viewers of the event worldwide see an equal number of male and female Nobel laureates on the stage? Will the audience smile to think that targets such as aiming for 40% female speakers were once necessary? Hopefully that will be the case. Right now there is much work to be done to create that future.

FOOTNOTES

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Pictured at the launch of the Celtic Studies Summer School, run by the School of Celtic Studies at Dublin Institute for Advanced Studies (DIAS) were (l-r): **Professor Liam Breatnach**, Director of the School of Celtic Studies, DIAS; **Mary Mitchell-O'Connor**, Minister for Higher Education; **Prof Vincent Cunnane**, Chairman of Council of DIAS.

NURTURING OUR KNOWLEDGE BASE FOR FUTURE INNOVATION

Informed curiosity and the pursuit of new ideas



Felicity Kelliher

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In the last few years, educators have become increasingly concerned about the devaluation of knowledge in an age when fact no longer trumps opinion. This has led the leaders of the Knowledge Quarter in London to ask:

What does it mean to be an 'expert' when the sheer scale of information available in this connected world has made us all curators of a vast bank of almost endless data, providing the answers to even the most obscure queries with nothing more than a tap and a swipe? How can the knowledge economy respond when facts are conflated with quick-fire internet memes, when slick presentation is more highly valued than genuine content, when the very notion of authentic truth has been devalued by the rolling news cycle and the dismissive cynicism of pseudoscience and special interest 'facts'? What, in short, is the future of Knowledge the concept, Knowledge the ideal, and Knowledge the quantifiable resource?

Knowledge Quarter Conference, 2018

Knowledge Quarter appear to lament universally available data and the democratisation of information, which they suggest leads to knowledge degradation. I disagree with this position. A revered knowledge base in the form of expertise may act as a barrier to data interrogation or to the acquisition of new information, while its outright dismissal can lead to the inevitable repeat of past mistakes. In contrast, embracing open online data access allows the human race to expand its search for meaning by releasing us from the assumptions that come from 'knowing' without question.

Nor is the World Wide Web the death knell of expertise. Online data may provide a basis for information, and information may be a catalyst to knowing, but its conversion requires understanding derived from experience, association, education, and the use of prior knowledge. Taking this perspective, data alone does not equate to answers. Rather, open online access to data helps inform us and, in doing so, gives us the power to search for new meaning in pursuit of knowledge and ultimately expertise.

CURIOSITY AND THE PURSUIT OF NEW INFORMATION

As educators, we have a critical role to play in nurturing a knowledge-supporting culture that balances past insight and unforeseen opportunity. When seeking opportunity, I believe the golden thread that links knowledge to innovation is informed curiosity in pursuit of novel ideas. Curiosity is an important first step in innovation. So how

do we instil perpetual curiosity, a thirst for knowledge, and a willingness to take risks – among ourselves and our students – in the search for innovation?

Let's think about this chronologically. It was once assumed the world was flat. This was widely accepted by ancient cultures, and some believed it as late as the seventeenth century – despite Pythagoras raising the idea of a domed earth in the sixth century bc and Aristotle providing empirical evidence of a spherical world c.330 bc. Interestingly, the twenty-first century has seen a significant rise in the number of 'flat earth' societies and believers, who use social media to engage with like minds.

If you did not know this story before, did you believe me? Or did you reach for the nearest internet-enabled device to verify it? You may have found both science and pseudoscience in your search, which would have given you comfort that the world is round or indeed is flat, depending on your view.

Regardless of the search outcome, the electronic platform you used gave you access to an immense databank, which you channelled into information propelled by your own curiosity. Those of you older than forty-five reached adulthood before this gateway existed. Those of you older than thirty-five remember dial-up lines where access could be restricted by the bandwidth available and the timing of your search based on the number of simultaneous users. Those of you in rural Ireland face similar problems today, regardless of your age, and we'll come back to that barrier later.

Curiosity is the important first step in innovation.

So, access to data and its conversion to information have been widely democratised; you no longer have to take my word for it. The result can help dismantle information asymmetry: your information likely equates to my own, based on your search and analysis of data on this topic. This removes an unhelpful power dynamic. I cease being teacher and become peer, where we can debate the flat/round earth in pursuit of an optimum explanation, with insight from both perspectives.

This conversation may draw us into the nuances of individual and collective human behaviour, or into a current popular concern that social media is corralling humans to interact only with those who reinforce their perspective. What's the true gain of this part of the journey? It gets us thinking.

FROM THOUGHT TO MEANING

Notice I haven't referred to what exists online as knowledge, merely data which is now easily accessible, at least by the relatively affluent who live in urban first-world democracies. While the Web can offer a myriad of facts and opinions, it is we who must decipher meaning from what we find. This is an important differentiation: it places the capacity to know with the individual, not the machine. As educators, our theoretical or practical understanding of a subject can help our students decipher meaning, while skills acquired through experience, discovery, learning, or education help both educator and student to conceptualise or create new knowledge.

Creating new knowledge involves complex cognitive processes underpinned by perception, communication, and reasoning. It also requires a willingness to take risks. Would you have the courage to challenge societal belief about the earth's shape, as Pythagoras and Aristotle did? I'm not sure I would. The penalty for challenging the status quo could be execution, as in Socrates' case for 'corrupting the youth of Athens'. Socrates pursued a logical trajectory to create new knowledge, when logic was not the norm. He challenged popular belief that physical beauty was the ultimate human skill, professing that intellectual capacity was the greater gift.

A truth-seeker, Socrates neither lectured on nor professed about what he knew, believing himself ignorant. He spoke in a dialectic way, asking questions of all city inhabitants equally – an uncommon practice at a time when it was assumed that the only worthy opinions were those of the wealthy or well positioned. Stimulating public debate with his probing approach, he compelled the audience to think through a problem to a logical and sometimes obvious conclusion. This was considered dangerous by powerful people and ultimately led to Socrates' death.

Let us step into the inquisitor's shoes for a moment. You may believe the world is spherical, but imagine if it were widely assumed flat by fellow educators on a global scale. What things have you taken for granted that are affected by this flipped perspective? Our cognition may be more socially bound than we think, embedded in what is acceptable based on language, culture, and traditions.

Socrates' stance of ignorance freed him to find new meaning through open dialogue. In doing so, he encouraged others to do the same. Being aware of our cognitive processes in this way helps to open our minds to seek the unknown or challenge the falsely believed. If a spherical world is far-fetched, it may be necessary to release perspectives we hold close, in an intellectual spring-clean, to facilitate a more open mind. By considering our biases and those of our peers when searching for answers, we may find more potential to conceive of the impossible, and pass that capability on to our students.

While the Web can offer a myriad of facts and opinions, it is we who must decipher meaning from what we find.

COMMUNICATING WITH THOSE BEYOND OUR COMFORT ZONE

Having built a rationale for a spherical-world movement, who would you solicit to spread this new knowledge? Humans primarily engage with people to whom we have strong ties. Outside of family, we choose others based on common ground: likeminded fellow travellers. We've been affiliating this way since long before the information age, but let us assume we would establish an online group, much like the flat-world societies mentioned earlier. Would you be willing to communicate this newfound insight beyond the group, regardless of response?

It is at this point that open communication occurs, when we step beyond our peers and engage the wider human landscape. We must accept that many people may distrust our perspective or dismiss it as illogical, irrational, or irrelevant, forcing most of us back to the safety of our inner circle. Yet it is those who stake their reputation and status within and beyond their

professional and personal communities that help propel new ideas into the general populace.

PROPELLING THE QUEST FOR FUTURE INNOVATION THROUGH THE SEARCH FOR NEW KNOWLEDGE

We've discussed the journey from curiosity to the search for unbridled data, which is then filtered to provide information to be debated and reasoned in pursuit of meaning, so we can embed it as knowledge in ourselves and others. We considered our capacity as educators to take risks when communicating new and sometimes controversial ideas to our students and the public. In doing so, educators seek to retain, hone, and build our curiosity and risk-taking prowess so that the authenticity of advice feeds our students' knowledge generation and innovation.

Those who debate about the near future believe that the maturing knowledge economy presents challenges and opportunities for our perception, use, and management of knowledge. Consider the earlier quote from the Knowledge Quarter through a research lens. We face data sets so large and unwieldy that they defy analysis using our customary tools and methods. Quantum computing will soon move from research labs into the real world, while eScience, an emerging approach of scientific experimentation with data generated from other experiments, is challenging and expanding our definitions of empirical research. Artificial intelligence and R&D management are emerging as new sectors, eradicating the need for expert advice in a number of fields.

Creative thinking, idea generation, and subsequent innovation are the domain and responsibility of us all.

While Knowledge Quarter appear to lament the democratisation of data and information, I believe there are opportunities for the future of knowledge by embracing this potential. Remember, it is we who decipher meaning from what we find in data trawls, so there is value in nurturing our unique human knowledge base for innovation. Innovation cannot be the responsibility only of commercial entities if it is to perpetuate human development, nor should it be limited to educators, scientists, or any other interest group. Creative thinking, idea generation, and subsequent innovation are the domain and responsibility of us all. I am consciously widening the

field of innovation beyond commercialisation, as this may curtail creative imagination and more elusive creative inspiration – necessary baselines to help develop the breadth and depth of ideas for future innovation to occur.

GENERATING NEW IDEAS IN OUR EDUCATIONAL SETTINGS

My proposed definition of innovation is simply the implementation of new ideas. Why is this important? Because what is ahead is not fully explained by what came before, and the challenges of the future are not the challenges of the past. Socrates believed ideas to be paramount, superseding senses. His approach and ultimate fate remind us that creative thinking is not synonymous with safe thinking, yet we often forget to encourage students to take risks when seeking new ideas.

Engaging students in curiosity-led enquiry, where no one has the answers, can alleviate the temptation to remain in safe waters and ideally lead to

collective exploration from which new ideas can be generated. Of course, this is only the first step. We want students to be not just creative but motivated to seek interesting solutions once the idea has emerged. Innovation education is helping us bridge the natural human need for certainty and the pursuit of the unknown among our students and ourselves, as we encourage each other to take educated risks to pursue and implement new ideas.

How might this work in practice? Ideation is one way that educators can help students to inform curiosity, generate ideas, and become accustomed to taking informed risks. This process, suitable for groups of all ages, requires students to reveal ideas in front of peers and tutors – an act of courage in itself. Our goal as educators is to promote divergent thinking, building students' ability to think about different ideas simultaneously, all connected to a topic or problem. We avoid the pursuit of logic or solutions in this phase, ensuring that absurdity has its rightful place in order to free the mind and reveal new links between abstract concepts.

Once this stage is exhausted, over as many iterations as are necessary to expose all new ideas, our goal shifts to promoting convergent thinking to help students individually or collectively evaluate the ideas produced in the earlier cycles of ideation. This stage is supported by analytical thinking, embracing informed curiosity and with a slow, deliberate interaction with data, information, and prior knowledge to select the optimum idea to implement.

Students are then exposed to rigorous critique from peers and tutors, offering them an opportunity to test their professional resilience in a safe environment. They are encouraged to defend their idea and justify a decision to either implement it as intended or change it based on this critique. Social networks can propel this beyond the classroom, offering an optimised individual-group interplay. By embedding criteria of societal contribution, one can further encourage citizenship behaviour among the students.

This process [ideation], suitable for groups of all ages, requires students to reveal ideas in front of peers and tutors – an act of courage in itself.

This approach gives us scope for trial and error to learn from experience. It promotes an organic innovation culture among school leavers and graduates that can potentially permeate Irish society and change global dynamics in the future. With the advent of open innovation, the internet offers a virtual place for innovators to collaborate in new and interesting ways by providing a backdrop for divergent, convergent, and analytical thinking. It opens the door to mutual inspiration, a rare and valuable entity that propels innovation within and beyond the knowledge economy – but only if our citizens have access to the online resource that can inform their curiosity.

Online access for all citizens, regardless of location, should be a given in a first-world country. The stalled roll-out of broadband in Ireland is a significant risk for the country's intellectual future. How are we to be curators of a vast bank of almost endless data if we don't have access? More importantly, how are we to move beyond the role of curator without access to the information that can generate new insight and meaning? It is

this curtailed access that poses the greater risk to our knowledge base for future innovation.

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ACKNOWLEDGEMENT

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Inaugural UK-Ireland Research Funders' Forum

On 20 November 2018, representatives from the Irish Research Council (IRC), Science Foundation Ireland (SFI), the Health Research Board (HRB), and UK Research and Innovation (UKRI), met in Dublin for the inaugural UK-Ireland Research Funders' Forum.



(L-R) **Michael Ryan**, Head of International, Science Foundation Ireland; **Peter Brown**, Director of the Irish Research Council; **Professor Jane Ohlmeyer**, Chair of the Irish Research Council; **Robin Barnett**, British Ambassador to Ireland; and **Professor Andrew Thompson**, Executive Chair, Arts Humanities Research Council, UK

THE NATIONAL FRAMEWORK FOR DOCTORAL EDUCATION

Anchor and launch pad for graduate education



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The National Framework for Doctoral Education (2015), the related Quality and Qualifications Ireland (QQI) Statutory Quality Assessment Guidelines for Research Degrees (2017), and the forthcoming Code of Practice for Research Degrees provide an integrated infrastructure for delineating the field of graduate education in Ireland, and for promoting quality within it. Taken as a whole, they have the potential to support cohesion in graduate education as both process and product, while also providing a catalyst for initiatives to share best practice and consultation about future developments in graduate education.

To realise this potential, it is vital that the National Framework for Doctoral Education operates as a living document, evolving and adapting in dynamic ways, informed by a robust evidence base and guided by ongoing engagement with key stakeholders. This gives rise to two key challenges, which provide the focus of this article.

The first is the need to collect data that can inform ongoing review of the implementation and impact of the Framework principles, including consideration of the experiences of students, supervisors, and other stakeholders. The second challenge is to ensure the Framework remains agile and effective in the context of the many tensions created by policy and funding trajectories and the increased framing of doctoral education as a key interface between the academy and the marketplace.

THE EVOLVING GRADUATE EDUCATION LANDSCAPE

Informed by the EUA Salzburg Principles for Doctoral Training (2005, 2010), the National Framework for Doctoral Education (2015) articulates a shared vision¹ of doctoral research as ‘deep engagement ... at the frontier of knowledge’ (HEA, 2015). It also highlights the need for transferable skills that encourage more application and dissemination of knowledge, fuel innovation, and support career diversification outside the academy.

As a touchstone document that promotes coherence, cooperation, and commitment to quality, the Framework is increasingly important in the context of growing complexity and diversity in the delivery

¹ The Framework is endorsed by key stakeholders in the higher education and research sectors in Ireland, including the Higher Education Authority, Quality and Qualifications Ireland, the Irish Universities Association, the Technological Higher Education Association Ireland, the Department of Education and Skills, the Department of Business, Enterprise and Innovation, the Irish Research Council, Science Foundation Ireland, the Royal Irish Academy, the Health Research Board, Enterprise Ireland, and Teagasc.

of graduate education. The emergence of new Technological Universities, funding programmes such as the SFI Centres for Research Training, and increasing internationalisation in PhD supervision and student mobility are indicative of this evolving landscape. The emergence of a stronger student voice in the graduate education sector is another energising development.

The Postgraduate Student Strategy (2018), recently launched by the Union of Students in Ireland, recognises the limited representation given to graduate students at institutional level. While acknowledging the challenges of engaging such a diverse group, it commits to increased advocacy to enhance the graduate student experience. This is an important initiative, as anecdotal and empirical evidence flag the isolation and anxiety experienced by some graduate students and their dissatisfaction with elements of their study environment.

The 2017 UK Postgraduate Researcher Experience Survey (PRES), for example, found the lowest satisfaction rates with research culture and many variations in quality of research culture between disciplines (Slight, 2017, p.4). The Irish Survey of Student Engagement 2018, which for the first time included students pursuing graduate research degrees, will bring important insights into the experiences of our graduate students. Finally, graduate education and supervision, which have been somewhat overlooked in institutional strategies on teaching and learning, have received much-needed attention with the launch of the NAIRTL Digital Badge in Supervision (2017).

The Postgraduate Student Strategy (2018), recently launched by USI, recognises the limited representation given to graduate students at institutional level.

Against the background of these changes, the launch in 2018 of a National Advisory Forum for Ireland's Framework for Doctoral Education is a key strategic move that will enable the Framework to evolve and adapt in dynamic ways, guided by collaborative and creative dialogue between key stakeholders. The Forum, co-chaired by the Higher Education Authority and QQI, has representation from student organisations, higher education institutions, research-performing organisations, funding bodies, and relevant Government departments and will invite employers and international experts for consultation.

Core functions of the Forum include sharing information and best practice at national level, monitoring international developments, and working collaboratively to shape policy and practice in doctoral education in Ireland. If the Forum delivers on these objectives, and facilitates an ongoing, critical, reflective, and data-driven review of the principles underpinning the Framework for Doctoral Education, it will breathe life into the Framework and render it a living document that anchors doctoral education while also serving as a launch pad for its further development.

DEVELOPING A DYNAMIC EVIDENCE AND PRACTICE BASE FOR GRADUATE EDUCATION

The National Framework for Doctoral Education has prompted institutional initiatives on the structures, policies, procedures, and practices that underpin graduate education. The extent to which such initiatives are embedded in everyday practices is unclear, as is the extent to which there are variations in practices within and between institutions. The impact of

such measures on student and faculty experiences of graduate training and supervision is also unknown.

This lack of an evidence base to inform the ongoing development of the Framework is a challenge that needs action. Vital data is unavailable on completion rates and times, trends in selection of training modules, rates of mobility, numbers of joint and dual awards, variants in doctoral types, and so on. Identifying agreed metrics and methods for collecting such data would support an evidence-based feedback loop, allow for shared learning, and inform review of the Framework principles.

It is imperative, however, that data collection is not limited to narrowly defined indicators of effectiveness and efficiency, or interpreted in ways that fail to capture differences between institutions, disciplines, and programmes. Data capture must also have a clear focus on the quality of the research produced and the quality of the student experience.

The knowledge gap on pedagogies in graduate education, including supervision and examination practices, must also be addressed. Supervisors need encouragement and support to reflectively explore and make public their work in graduate level teaching and assessment (Boud and Lee, 2005). If the scholarship of supervision is not developed, identification and refinement of quality criteria for supervision and graduate education cannot progress. Incentives to promote uptake of training, to support supervisors' continued development as reflective practitioners, and to facilitate peer-to-peer learning must be integrated into institutional teaching and learning agendas – and indeed into workload calculation and promotional schemes. Inter-institutional sharing and capture of graduate teaching experiences would provide critical mass for developing communities of best practice and provide a dynamic resource for the continued enhancement of the Framework document.

The knowledge gap on pedagogies in graduate education, including supervision and examination practices, must be addressed.

RESPONDING TO POLICY DRIVERS AND EMERGING FORMATS OF DOCTORAL RESEARCH

European and national research policy increasingly constructs knowledge production as a stimulant of economic growth, innovation, and entrepreneurship, and calls for greater application and commercialisation of research output (see Horizon 2020, Innovation 2020). This push towards applied knowledge, greater industry-university partnerships, and employability of doctoral graduates outside the academy continues unabated at both EU (Cuthbert and Molla, 2014) and national level.

Take for example the newly launched Eurodoc report 'Identifying Transferrable Skills and Competences to Enhance Early-Career Researchers' Employability and Competitiveness' (2018) and the current Horizon 2020 funding call on 'Research innovation needs and skills training in PhD programmes' (SwafS-08-2019), focused on closing the skills gap between research employment in academia and beyond. The new SFI funding for Centres for Research Training is a key example at national level, prioritising research in specified areas and industry engagement.

Potential challenges for graduate education created by this approach include contraction of the graduate research horizon, prioritisation of research with utilitarian relevance (as defined by short-term market needs), and more limited support for basic and blue skies research that is curiosity-driven. The implications for graduate education of this push towards industry-aligned programmes and training are usefully captured in De Boer et al.'s (2002) concept of 'unbundling' the PhD.

Unbundling refers to incitements to reconfigure or repackage PhDs to meet changing policy and funding drivers. The National Doctoral Framework itself embodies an element of unbundling, advocating the mix of knowledge and professional skills that constitute the structured PhD model. Other unbundled PhD formats include professional doctorates that combine coursework and thesis, and thematic-cohort-based programmes with elements of industry-based placement and training.

While it is undoubtedly possible to reconcile calls for applied, industry, or professionally informed research with a commitment to producing original knowledge, vigilance is required. Another core challenge for the Framework will be to balance calls for new-format PhDs with existing conceptions of what constitutes a PhD. New-format PhDs must be carefully scrutinised to ensure that the integrity of the award is not devalued by a proliferation of programme varieties. And we must not avoid the thorny question of whether we need qualifications outside of the PhD to address increasing diversity of knowledge needs and career aspirations.

European and national research policy increasingly constructs knowledge production as a stimulant of economic growth, innovation, and entrepreneurship.

Finally, we must consider the different value systems and experiences to which students may be exposed in programmes with increasing levels of industry collaboration. Research findings on these issues are mixed (Thune, 2009), suggesting a need for comprehensive monitoring of research training provided outside the academy. The Framework provides a context for addressing these inevitable challenges, which will continue to emerge in a policy context that is increasingly market-facing.

CONCLUSION

The National Framework for Doctoral Education, as a multi-stakeholder document, anchors a shared commitment to the cohesion and quality of the graduate research experience and the integrity of the PhD as an award. It serves as a launch pad for future innovation and evolution in the field. For it to continue as a living document, the principles underpinning it must be subject to ongoing and rigorous review, informed by a robust evidence base and systematic interrogation of the extent to which the integrity of doctoral research as deep engagement with a question at the frontier of knowledge is being upheld.

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President Higgins honours recipients of Future Research Leaders Award

On 25 January 2018, the five recipients of the SFI President of Ireland Future Research Leaders Award were honoured by President Michael D Higgins at a special ceremony in Áras an Uachtaráin in Dublin.

The five awards, representing a €7 million investment, will also support the additional recruitment of 15 research positions. Research supported by the awards will examine novel drug targeting for the treatment of multiple sclerosis and obesity-related diseases, regenerative medicine, immunology, tissue engineering, protein engineering, and memory storage in amnesia.

President Higgins, a passionate political voice, poet and academic, has been a long-standing advocate of inclusive citizenship and creativity, highlighting not only the positive contribution of science to society, but also the links between the creativity of artists and the innovation of scientists.

Equally, the President has stressed the importance of placing scientific research in a clear social, cultural and ethical context, saying that the benefits of scientific advances should be spread as widely as possible.

The awardees of the SFI President of Ireland Future Research Leaders Award are:

Dr Tomás Ryan, who was recruited from Massachusetts Institute of Technology (MIT) to Trinity College Dublin (TCD);

Dr Lydia Lynch, also based in TCD and recruited from Harvard University, USA;

Dr Claire McCoy, recruited to the Royal College of Surgeons (RCSI) from the Hudson Institute of Medical Research, Melbourne, Australia);

Prof John Laffey, recruited to the National University of Ireland Galway (NUI Galway) from St Michael's Hospital, Toronto, Canada

Dr Christina Kiel, recruited to University College Dublin (UCD) from the Centre de Regulació Genòmica (CRG), Barcelona.

Congratulating the awardees, Prof Mark Ferguson, Director General of Science Foundation Ireland and Chief Scientific Adviser to the Government of Ireland, said:

"The President of Ireland Future Research Leaders Award is designed to attract to Ireland outstanding new and emerging research talent."

"In supporting these talented and innovative individuals, we are delighted to recognise early career researchers who have already displayed exceptional leadership potential at the frontiers of knowledge."

"The development of leadership skills in these researchers early in their careers is vital to ensure research and innovation in Ireland continues to progress."



Pictured left to right: Prof John Laffey, Dr Claire McCoy, Prof Mark Ferguson, President Michael D. Higgins, Dr Christina Kiel, Dr Tomás Ryan and Dr Lydia Lynch. Picture by Jason Clarke.

Institute of Art, Design and Technology (IADT)

New Digital Media Building

Minister Mary Mitchell O'Connor and Dr Annie Doona, President IADT, at the announcement of funding for a new Digital Media Building at the Institute of Art, Design and Technology (IADT), Dun Laoghaire, Co Dublin. This building will support the growth of courses in the digital industries and will generate graduates for the emerging design and technology industries.



Women in Film

Second level students attending the Young Women in Film Masterclass at the National Film School at the Institute of Art, Design and Technology (IADT), Dun Laoghaire, Co Dublin.



Film Masterclass

Second level students attending the Young Women in Film Masterclass at the National Film School at the Institute of Art, Design and Technology (IADT), Dun Laoghaire, Co Dublin.





Launch of Early Childhood Research Centre at DCU



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