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Furthering the research impact of University College Dublin

Report of the Beyond Publications Committee

May 2014

This report contains the findings from the Beyond Publications project in relation to enhancing the understanding of UCD's research impact in national and international contexts.

Contents

1 Executive summary 2
2 Introduction 5
3 Context 10
4 Impact – what does it mean? 16
5 The Study of Impact - a mosaic of international approaches 29
6 The Research Impact of UCD 42
7 Recommendations for Implementing a UCD Research Impact System 65
8 Appendix A – Research Impact Survey 76
9 Appendix B – Impact Studies – methods and methodological challenges 78
10 Appendix C – Impact study methods – as discussed in the literature 83
11 Appendix D – REF & ERA Summary Table 88
12 Appendix E – Institutional Review Table 90
13 Appendix F– CASRAI Outputs 92
14 Appendix G - Impact Case Study Template 95
15 Appendix H - Sample Impact Case Studies 96

1 Executive summary

The 'Beyond Publications' project was set up by the UCD University Research Strategy Board (URSB) to investigate the definitions, evidence and systems for capturing outputs beyond publications, and the impacts and benefits of that research from the perspective of the university. Its findings are based on a literature review; a survey of UCD's academic staff, semi-structured interviews and a series of project steering committee meetings where senior academic staff discussed definitions, debated findings on methods, and explored recommendations for a system to capture impact at the university.

The reasoning behind the growing international move towards assessing research impact is undoubtedly complex, involving both political and socio-economic factors. In the literature on impact, four critical justifications for assessing research impact are generally cited:

(1) Higher Education Institutions overview - To enable research organisations to monitor and manage their performance and understand the contribution that they are making to communities.
(2) Accountability - To demonstrate the value of research to government, stakeholders, and the wider public.
(3) Inform funding - To understand the socio-economic value of research and subsequently inform funding decisions.
(4) Impact Journey - To understand the method and routes by which research leads to impacts, optimising the potential of research findings and developing better ways of delivering impact.

Since the economic downturn in Ireland in 2008, there has been an increased focus on the measurement of economic and societal impacts of research, particularly from government and funding agencies. Science Foundation Ireland (SFI) now requires statements of proposed impact that emphasise job creation and foreign direct investment in proposals for research funding.

Arguably, the broader role for university research in building a more just, inclusive and wiser society is greater than the economic and commercialisation bias favoured by policy makers. This currently is not part of the national narrative. While SFI has required its funded researchers to supply impact reports, there is no standardised approach across the universities in Ireland for addressing the broader picture of research impact. Critically, this provides a valuable opportunity for UCD to clarify its position on research impact, and implement an effective system for capturing research outputs and communicating their value and relevance in social, cultural and economic ways. The Beyond

Publications steering committee concluded unanimously that a 'do nothing' option was not an appropriate response to the opportunity presented. Internationally, there is no generally accepted agreement or methodology for the definition and assessment of impact. In broad terms impact can be described as:-

"the consequences of an action that affects people's lives in areas that matter to them"[1]

Internationally, combinations of the following measures are used by national agencies and universities to assess impact:-

- **Input Measures** – Include research funding, human resources, existing knowledge, equipment and facilities.
- **Output Measures** –refer to the measurement of the products of the research activity. "The most obvious output measure is publications, but processes or tools used to disseminate research can also be considered as a type of output indicator".
- **Expert reviews** – assesses research impact by obtaining information from groups of experts, for example the UK REF uses expert panels to rate the submissions from universities.
- **Surveys** – structured surveys can be used as an impact assessment measure. An example of this approach is the Impact Finder Tool, created by the RAND Corporation. The tool is implemented as a web questionnaire and collects information across a range of social, cultural and economic impacts.
- **Case Studies** – contain a narrative describing research impact with supporting metrics and references to detail the nature and scale of the impact.
- **Hindsight studies** – attempt to retrospectively trace an observed research impact to the research inputs, activities, output and outcomes that led to the impact.
- **Economic models** – are often used to assess value for money. Econometric analysis is used to assess research impact at a macro-level while cost-benefit analysis is often used to determine impact from research projects or programmes.

[1] ESF (2012) *The Challenges of Impact Assessment* (Pubd online) Available at: <http://www.dfg.de/download/pdf/dfg_im_profil/evaluation_statistik/programm_evaluation/impact_assessment_wg2.pdf> [Accessed 30 Mar 2014]

The UCD Beyond Publications steering committee came to the decision that UCD's focus on impact should be:

The contribution of UCD's research to the advancement of knowledge for the benefit of academia, the economy, society, culture, industry, public policy, health, the environment or quality of life.

In other words, the direct and indirect 'influence' of UCD's research or its 'effect on' individuals, communities, the creation of knowledge, the development of policy, or the creation of a new product, service or technology. This directly requires UCD to capture data on research inputs, activities, outputs, outcomes and impacts, **which it currently does not**.

Capturing the full range of outputs and outcomes that enable research impact to be shown and managed is a significant task that is being undertaken within many universities and institutions globally. The implementation of standards-based research information systems is a prerequisite to the capture and evaluation of impact. We recommend that systems are developed not just for capturing impact in isolation, but rather that they capture the entire range of research inputs, outputs, outcomes and the resultant impacts. Furthermore these systems must be able to capture the interactions between researchers, their institutions, and their collaborators, and link these with research outcomes or interim impacts to provide a network of data that can be shared with funding agencies and other evaluation bodies.

UCD faces a fundamental choice when implementing systems and supports for impact. Does it adopt a 'follower' approach and react to the definitions and information requirements for impact as defined by government departments, funding agencies and EU institutions, or does it do what leading research intensive universities around the world are doing and concentrate on being 'leaders' in the field by defining what impact means from a university perspective?

The Beyond Publications steering committee firmly believes that UCD should strive to be a leader in the field of impact capture, measurement and communication. This allows for the fullest picture of research impact to be developed and which is not focused solely on short term measures of impact such as employment and foreign direct investment. This approach means that the university must implement systems to capture additional outputs and indicators of impact retrospectively and prospectively.

2 Introduction

2.1 Background & Project Scope

The impact of research activity and its assessment is of increasing concern to universities and their individual researchers and research teams. While since 2007 UCD has developed the necessary expertise and experience in the capture and bibliometric assessment of research outputs, it has yet to develop a formal means to capture research impact of its activities in a broader sense.

In 2012 the University's Research Strategy Board (URSB) set up a subcommittee called 'Beyond Publications'. In this first stage of this project, the subcommittee reviewed and reported upon international best practice in the leading national systems of research management and evaluation, focusing on the capture and impact of a range of research outputs. The report was presented to, and fully endorsed by the University's Research Strategy Board (URSB), the University Management Team (UMT) and the Academic Council. It was agreed that the University would invest in progressing this work given its potentially high strategic value to UCD.

To assist this progression, the URSB recommended an urgent appraisal of ways to capture the range of research outputs and present comprehensively impact of UCD research activity. To this end, a second stage of the project 'Beyond Publications' was launched in April 2013 to:

- harness a wider range of research output beyond publications,
- expand the range of research outcomes UCD captures, and
- consider ways to quantify, capture and communicate research impact

2.2 Project Approach

A University-level steering committee was established and charged with the following tasks:

- Identify internal and external hurdles that could hinder the project.
- Ensure the project is on course to deliver the outputs and benefits as set out in the terms of reference.
- Act as an escalation point for resolution of issues that cannot be managed at other levels.
- Ensure that the project receives the required support from UCD's support services where possible.
- Sign-off on the completion of each stage of the project and related deliverables.
- Promote the project and its goals internally in UCD and externally
- Develop policies and make recommendations for the next phase of the project and the necessary investments.

The members of the steering committee were:

Name	College	Role
Prof. Alun Jones (Chair)	Human Sciences	Professor of Geography and VP Research Human Sciences.
Prof. Desmond Fitzgerald	UCD Research	VP for Research
Mr Liam Cleere	UCD Research	Senior Manager, Research Analytics & Reporting
Mr Jamie Laffan	UCD Research	Project Manager, Beyond Publications
Dr Aoibheann Gibbons	UCD Research	Director of Research Development
Prof. Lorraine Hanlon	Science	Associate Professor, School of Physics
Dr. Patrick Murphy	Science	Head of School of Mathematical Sciences
Prof. Jenny McElwain	Science	Associate Professor, School of Biology & Environmental Science
Prof David MacHugh	Agriculture & Veterinary Medicine	Associate Professor, School of Agriculture & Food Science
Prof. Gabriel Cooney	Arts & Celtic Studies	Professor of Celtic Archaeology, School of Archaeology
Prof. Margaret Kelleher	Arts & Celtic Studies	Prof Anglo-Irish Literature and Drama, School of English, Drama & Film.
Prof. Andy Prothero	Business	Associate Dean, School of Business
Prof. Brian Nolan	Human Sciences	College Principal, Human Sciences
Prof. Tony Fahey	Human Sciences	Professor of Social Policy, School of Applied Social Sciences

Name	College	Role
Dr. Barbara Dooley	Human Sciences	Senior Lecturer, School of Psychology & Vice-Principal for Teaching and Learning, College of Human Sciences
Dr. John Howard	Library/Human Sciences	University Librarian
Ms Sinead Riordan	Royal Irish Academy	Senior Policy Research Officer, Royal Irish Academy

Table 1 Beyond Publications Steering Committee

The approach adopted to this project was founded upon three sequential phases – Current State Assessment, Future State Options and Final Report delivery (see Figure 1).

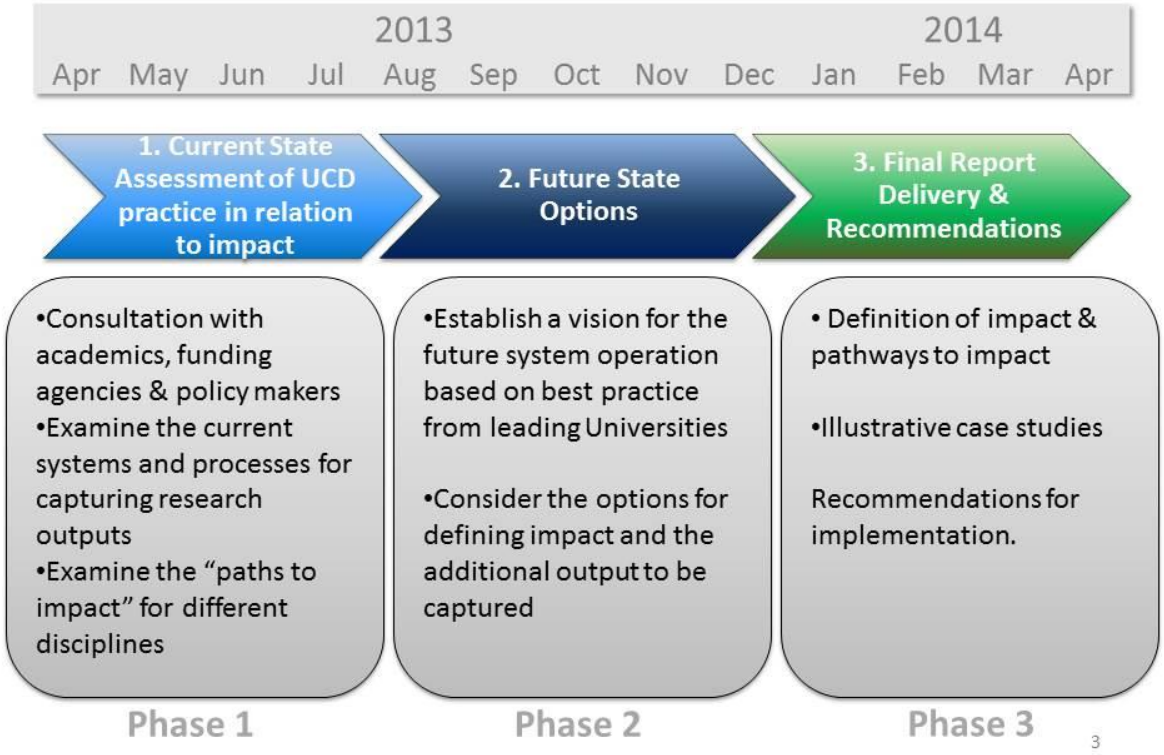

Figure 1 Approach for the Beyond Publications project

Phase1: Current state assessment of UCD practice in relation to impact

This phase focused upon the current situation in UCD for capturing research outputs and ways of assessing their impact. This involved detailed consultations with UCD academic staff and a

comprehensive review of international best practice (including international research assessment methodologies and approaches used by leading research intensive universities). An extensive semi-structured survey of over 700 UCD research staff was conducted in order to establish the range of outputs resulting from their research activities, and their views on the significance of research impact. A steering committee meeting chaired by Professor Alun Jones was held to review the results and agree upon the course of action for the subsequent phase of the project.

Phase 2: Future State

Based on the work completed in phase 1, this phase considered the options available for UCD in defining research impact, capturing the full range of UCD's research outputs, and the effective communication of UCD research impact. Throughout, the options considered were informed by best practice in other leading universities, international research councils and research assessment & evaluation bodies. An interim report on international best practice was presented to the steering committee and the URSB by Professor Jones in November 2012.

Phase 3: Final Report Delivery & Recommendations

The final phase of the project involved the creation of a writing group comprising members of the steering committee and other UCD senior academics. The key goal was to agree on definitions of impact, and prepare suitable case studies of research impact drawn from over 100 UCD researchers. A series of recommendations for the implementation of a research impact system at UCD were also made.

2.3 Structure of this report

1. **Executive Summary:** Provides a short summary of the report.
2. **Introduction:** This first section outlines the purpose, background and approach to the Beyond Publications project.
3. **Context:** describes the context for change, including internal and external change drivers and a summary of some of the key issues, which together provide an imperative for change.
4. **Impact – what does it mean?:** provides definitions for research impact and the pathways to impact and discusses the challenges involved with defining methods to evaluate impact.
5. **The Study of Impact: a mosaic of International Approaches:** describes the different approaches used in other countries to capture research impact
6. **Research Impact of UCD:** outlines UCD's definition of research impact and best practice for producing case studies.
7. **Recommendations for implementing a UCD Research Impact System:** contains a proposed implementation roadmap for impact at UCD.

3 Context

3.1 Why capture impact?

The reasoning behind the growing international move towards assessing research impact is undoubtedly complex, involving both political and socio-economic factors. There has been wide ranging criticism of this move in a number of jurisdictions. For example, in the UK it is important to emphasise that '*Not everyone within the higher education sector itself is convinced that evaluation of higher education activity is a worthwhile task*'[2]. Moreover the university and college union[3] organised a petition calling on the UK funding councils to withdraw the inclusion of impact assessment from the Research Excellence Framework (REF)[4] proposals. This petition was signed by 17,570 academics (52,409 academics were returned to the 2008 Research Assessment Exercise), including Nobel laureates and Fellows of the Royal Society[2].

However, despite these misgivings four critical justifications for assessing research impact are generally cited[5]:

"(1) ***HEIs overview****. To enable research organizations including HEIs to monitor and manage their performance and understand and disseminate the contribution that they are making to local, national, and international communities.*

(2) ***Accountability****. To demonstrate to government, stakeholders, and the wider public the value of research. In the UK for example there has been a drive through Higher Education Funding Council for England (HEFCE) and the Research Councils to account for the spending of public money by demonstrating the value of research to tax payers, voters, and the public in terms of socioeconomic benefits[6] (European Science Foundation 2009), in effect, justifying this expenditure[78]*

[2] Kelly, U. and McNicoll, I. (2011) *'National Co-ordinating Centre for Public Engagement', Through a Glass, Darkly: Measuring the Social Value of Universities* (Pubd online) <http://www.publicengagement.ac.uk/sites/default/files/80096%20NCCPE%20Social%20Value%20Report.pdf> [accessed 26 Oct 2013].
[3] University and College Union. (2011) *Statement on the Research Excellence Framework Proposals*, (Pubd online) <http://www.ucu.org.uk/media/pdf/n/q/ucu_REFstatement_finalsignatures.pdf> [accessed 26 Oct 2013].
[4] REF: Research Excellence Framework http://www.ref.ac.uk/ [accessed 26 Oct 2013].
[5] Penfield, T., Baker, M. Scoble, R. and Wykes, M. (2012) *Assessment, evaluations, and definitions of research impact: A review*, (Pubd online), <http://rev.oxfordjournals.org/content/early/2013/11/08/reseval.rvt021.abstract> [accessed 12 Mar 2014].

[6] European Science Foundation. (2009) *Evaluation in National Research Funding Agencies: Approaches, Experiences and Case Studies* (Pubd online)

(3) ***Inform funding****. To understand the socio-economic value of research and subsequently inform funding decisions. By evaluating the contribution that research makes to society and the economy, future funding can be allocated where it is perceived to bring about the desired impact. As Donovan (2011) comments*[9]*, 'Impact is a strong weapon for making an evidence based case to governments for enhanced research support'.*

(4) ***Understand****. To understand the method and routes by which research leads to impacts to maximize on the findings that come out of research and develop better ways of delivering impact."*

3.2 Irish Context

Unlike the UK's Research Excellence Framework (REF), Ireland does not have a national research assessment system. In Ireland, research impact has historically been expressed through bibliometric analysis of research publications in peer reviewed journals. An example of this approach is the national survey of the research performance of Irish universities jointly commissioned by the Higher Education Authority (HEA) and Forfás in 2008[10]. The Irish Universities Association (IUA) has also invested in bibliometric analysis as a means to measure research impact, by co-ordinating the provision of an analysis toolset provided by Thomson Reuters[11] for the universities. The IUA on their website neatly summarises Ireland's research impact based solely on bibliometrics as follows:

"In 1981, the impact of Irish research as measured by the number of citations per publication has risen from a very low level to exceed the world & EU average, joining nations including France, Germany and the UK. In that period the number of papers has increased by 100% whereas in Ireland

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http://www.esf.org/index.php?eID=tx_ccdamdl_file&p[file]=25668&p[dl]=1&p[pid]=6767&p[site]=European%20Science%20Foundation&p[t]=1351858982&hash=93e987c5832f10aeee3911bac23b4e0f&l=en [accessed 26 Oct 2012].

[7] Davies, H., Nutley, S. and Walter, I. (2005) *Assessing the Impact of Social Science Research: Conceptual, Methodological and Practical Issues* (Pubd online) <http://www.odi.org.uk/rapid/Events/ESRC/docs/background_paper.pdf> [accessed 26 Oct 2013].

[8] Hanney, S. and Gonza´ lez-Block, M. A. (2011) 'Yes, Research can Inform Health Policy; But can we Bridge the 'Do-Knowing it's been Done' Gap?', *Health Research Policy and Systems*, 9: 23.

[9] Donovan, C. (2008) 'The Australian Research Quality Framework: A live experiment in capturing the social, economic, environmental and cultural returns of publicly funded research'. In: Coryn, C. L. S. and Scriven, M. (eds) *Reforming the Evaluation of Research. New Directions for Evaluation*, 118, pp. 47–60.

[10] Forfás and HEA (2009) *Research Strengths in Ireland – a bibliometric study of the public research base*.

[11] Thomson Reuters (2014) *InCites Bibliometric analysis tool* http://thomsonreuters.com/incites/ [accessed 26 Oct 2013]

it has increased by 400%. At the same time, Ireland more than doubled its percentage share of world research papers. Currently Ireland produces 0.49% of all world research papers."

In Ireland, universities are periodically invited by Forfás to compile and present the outputs of their research activities for national research studies such as the 'Profile of Publicly Funded Research in Ireland 1998-2006'[12] and the National Research Prioritisation Exercise[13]. Irish universities are also required to undertake a self-evaluation of the quality of their academic activities, including research, in compliance with the Governance regulations of the Universities Act 1997. UCD Schools and Research Institutes are reviewed for overall quality on a regular cycle, and report on their research activities and outputs to an international review panel. This can be a largely manual process, supplemented by university held data on research activity and outputs.

3.2.1 Research Policy in Ireland

National research policy in Ireland is determined through multi-annual national development plans. In recent years the most influential policy is the Strategy for Science Technology and Innovation[14] (SSTI). This was the first integrated national policy for research that laid out a government investment plan from 2006 to 2013. It set a target of doubling Ph.D. numbers by 2013 as a primary indicator of Irish research performance and to justify the increased overall investment by the state in research.

Since the economic downturn in Ireland in 2008, there have been two major developments in research policy as a consequence of the setting up of an Innovation Task Force and a Strategy Group on Higher Education (Hunt Report[15]). While endorsing research investment, both of these emphasise the need to extract maximum value from funded research for Ireland's economy and society.

This change in policy emphasis is demonstrated by the Research Prioritisation process conducted by Forfás in 2011-2012 which sought to identify 10-20 "opportunity areas that should become the focus of publicly-funded R&D". This new focus away from bibliometric indicators and number of Ph.D.

[12] Forfás (2010) *Profile of Public Research Activity in Ireland 1998-2006* (Pubd online) <http://www.hea.ie/sites/default/files/profile_of_research_activity.pdf> [accessed 26 Oct 2013].
[13] Research Prioritisation Steering Group (2012) *Report of the Research Prioritisation Steering Group* (Pubd online) <http://www.djei.ie/publications/science/2012/research_prioritisation.pdf> [accessed 26 Oct 2013].
[14] Dept of Enterprise, Trade and Employment (2006) *Strategy for Science, Technology and Innovation* (Pubd online) <http://www.djei.ie/publications/science/2006/sciencestrategy.pdf> [accessed 26 Oct 2013].
[15] Strategy Group on Higher Education (2011) *National Strategy for Higher Education to 2030* (Pubd online) <http://www.hea.ie/sites/default/files/national_strategy_for_higher_education_2030.pdf> [accessed 26 Oct 2013].

students to the measurement of economic and societal impacts of research can be seen in the criteria for choosing the priority areas. They should:

> *"Present significant market opportunity for Ireland in terms of likely economic impact (i.e. link to markets of relevance to the existing enterprise base and/or likely enterprise base of the future). Contribute to addressing an important societal challenge (e.g. around health, energy, environment, food security) and Ireland's approach to the challenge"*[16].

3.2.2 Irish Research Funding Agency Context

In line with this national policy, Science Foundation Ireland (SFI) and the Health Research Board (HRB) in particular, now require Principal Investigators to provide qualitative statements and quantitative evidence of proposed impact from research funded projects. Within this, a particular emphasis is placed on commercialisation activities and ultimately job creation within the State. This point is confirmed through a survey of UCD academic staff (Appendix A Research Impact Survey) which was conducted as part of this project and revealed that 47% of respondents already are reporting on research impact to funding agencies.

Arguably, the broader role for university research in building a more just, inclusive and wiser society is greater than the economic and commercialization bias favoured by policy makers. This currently is not part of the national narrative. While SFI has required its funded researchers to supply impact reports, there is no standardised approach across the universities in Ireland for addressing the broader picture of research impact. Critically, this provides a valuable opportunity for UCD to clarify its particular position on research impact, and implement an effective system for capturing research outputs and communicating their value and relevance in social, cultural and economic ways. For example, the survey conducted by the Beyond Publications team, showed that a large proportion of the research output of UCD's staff is currently not captured by the university's existing information systems. See Figure 2 on the next page.

[16] Irish Universities Association (2012) *Research Policy* http://www.iua.ie/research-innovation/research-policy/ [accessed 10th March 2014]

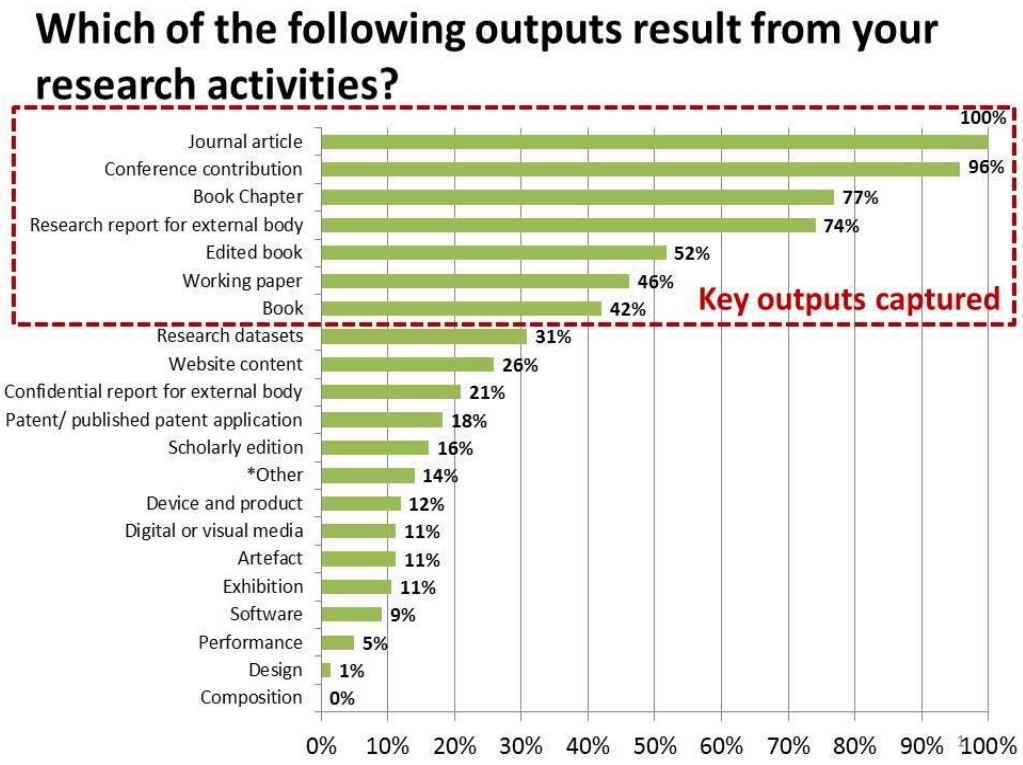


Figure 2 Outputs captured in current information systems

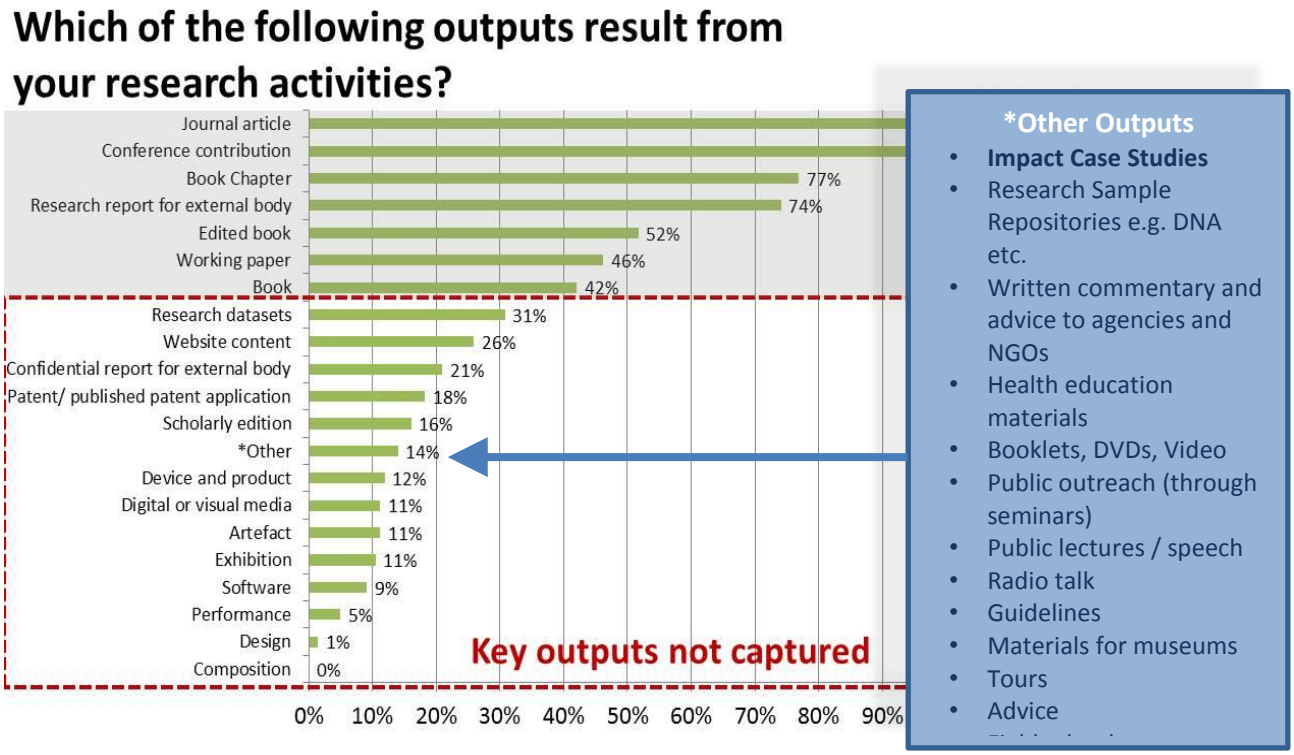


Figure 3 Outputs not captured

3.3 Why UCD need to do something

Acknowledging international debates over research impact and its capture, the Beyond Publications steering committee discussed at length the wisdom of UCD pursuing its own research impact agenda. It concluded unanimously that a 'do nothing' option was not appropriate. UCD need to act because of the following reasons:

- UCD need to be best positioned and fully equipped to communicate the value & relevance of research to funders & other key stakeholders such as policy makers, industry partners and the general public. For example, SFI proposals now require the integration of fully developed impact statements. They need to be specific and provide as much information as possible, so that SFI and external reviewers can accurately assess the potential impact of the proposed research.

- Without action, UCD's bias towards publications as indicators of research excellence will continue, and bibliometric analysis will remain the sole yardstick of impact measurement. This will disadvantage a number of colleges and disciplines.

- UCD's research reputation will significantly improve by communicating research impact effectively, especially in the context of international university rankings that use reputation surveys as part of their methodologies.

- UCD needs to learn how to tell its research impact story, especially in relation to best practice observed at international competitor research intensive universities.

4 Impact – what does it mean?

4.1 Concepts and definitions

Internationally, there is no generally accepted agreement or methodology for the definition and assessment of impact. In broad terms impact can be described as:-

"the consequences of an action that affects people's lives in areas that matter to them"[17]

The European Science Foundation (ESF) clarifies this broad statement by suggesting that research impact has a number of important attributes, these include:

- The consequences would not have occurred without the original action.
- Impact does not necessarily have to be beneficial or intended.
- Impact should not be seen as the final consequence of an action.

Additionally, there is no common agreement internationally on whether impact should be considered from both academic and socio-economic perspectives, or how it should be expressed through measurement, or on the precise ways to determine its value and worth across scales, sites and stakeholders as well as over time.

This absence of common international agreement is reflected in the following national responses to research impact and its measurement. For example, in the Netherlands social impact is considered as being a function of 'productive interactions': direct or personal interactions; indirect interactions through texts or artefacts; and financial interactions through money or 'in kind' contributions, and is defined as follows:

"Social impact of scientific research refers to measurable effects of the work of a research group or program or a research funding instrument in a relevant social domain. The effect regards the human well being ('quality of life') and or the social relations between people or organizations"[18].

[17] ESF (2012) *The Challenges of Impact Assessment* (Pubd online) <http://www.dfg.de/download/pdf/dfg_im_profil/evaluation_statistik/programm_evaluation/impact_assessment_wg2.pdf> [Accessed 30 Mar 2014]
[18] Spaapen, J. et al. (2010) *SIAMPI final report* (Pubd online) <http://www.siampi.eu/Content/SIAMPI_Final%20report.pdf> [Accessed 12 May 2013]

Meanwhile in the UK, the Research Excellence Framework (REF) defines impact[19] 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.

Impact includes, but is not limited to, an effect on, change or benefit to:

- *the activity, attitude, awareness, behaviour, capacity, opportunity, performance, policy, practice, process or understanding*
- *of an audience, beneficiary, community, constituency, organisation or individuals*
- *in any geographic location whether locally, regionally, nationally or internationally.*

Impact includes the reduction or prevention of harm, risk, cost or other negative effects".

The Research Councils UK makes an important distinction between academic impact and socio-economic impact in the following ways[20]:

*"**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 impacts:** The demonstrable contribution that excellent research makes to society and the economy. Economic and societal impacts embrace all the extremely diverse ways in which research-related knowledge and skills benefit individuals, organisations and nations by:*

- *fostering global economic performance, and specifically the economic competitiveness of the United Kingdom,*
- *increasing the effectiveness of public services and policy,*
- *enhancing quality of life, health and creative output."*

[19] HEFCE (2011) *Assessment Framework and Guidance on Submissions* <http://www.ref.ac.uk/media/ref/content/pub/assessmentframeworkandguidanceonsubmissions/02_11.pdf> [Accessed 12 May 2013]
[20] Research Councils UK (2014) *What do Research Councils mean by Impact?* http://www.rcuk.ac.uk/ke/impacts/meanbyimpact/ [accessed 10th March 2014]

The Beyond Publications steering committee agreed that the distinction between academic and socio-economic impacts is a key building block for the UCD definition of impact and it recommended that we pursue both.

The steering committee recognise that impacts from research can be generated through a range of diverse pathways, take many forms, become apparent at different stages in the research journey, and can be measured in many different ways. A non-exhaustive selection of the pathways to impact is illustrated below.

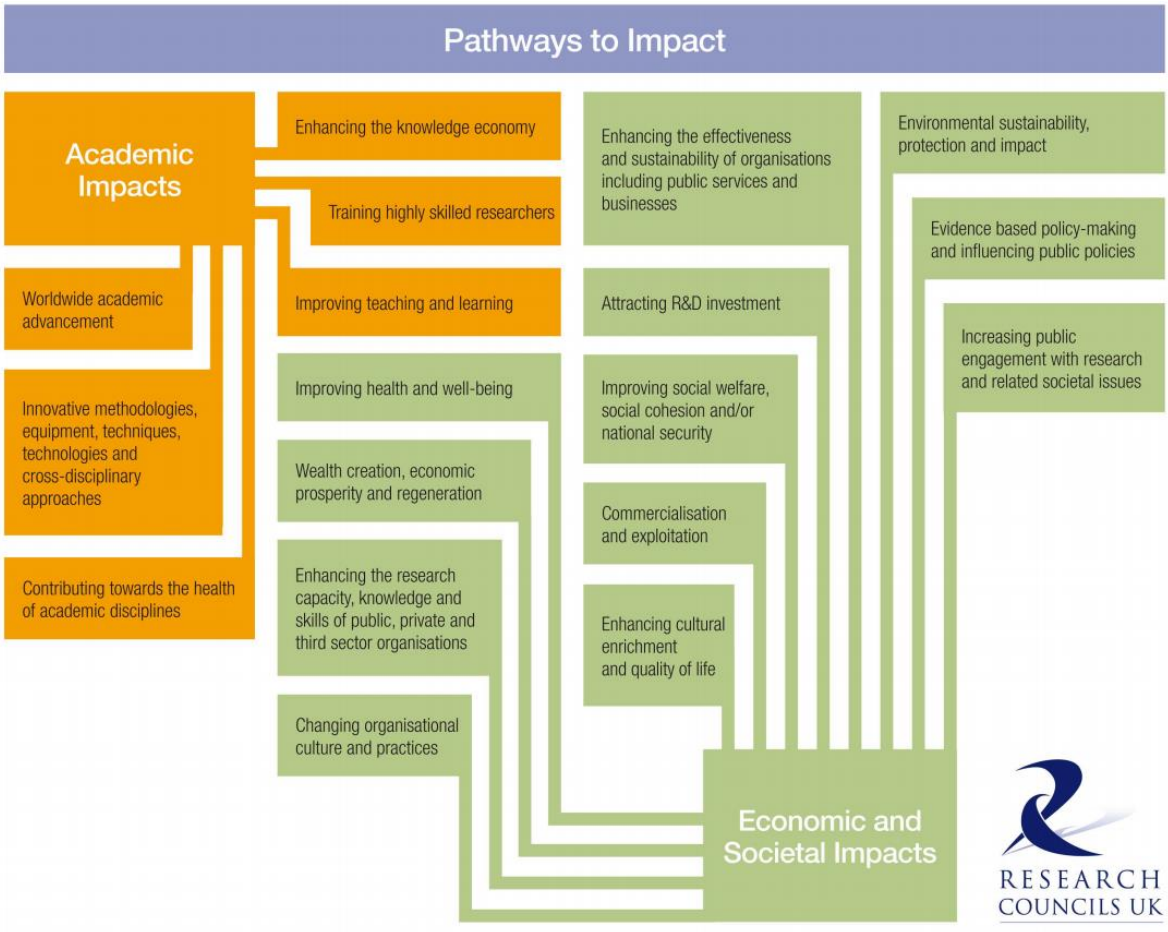


Figure 4 Pathways to impact[21]

[21]Research Councils UK (2014) *What do Research Councils mean by Impact?* http://www.rcuk.ac.uk/ke/impacts/meanbyimpact/ [accessed 10th March 2014]

4.2 European Science Foundation (ESF) classification of impact

Impact can be divided into several categories and can include both scientific and societal impacts[22]. It is important to clarify which form of impact is core to the work when planning for an impact study or assessment. ESF classify various forms of impact as outlined alphabetically below:

- **Cultural impact:** contribution to understanding of ideas and reality, values and beliefs.
- **Economic impact:** contribution to the sale price of products, a firm's costs and revenues (micro level), and economic returns either through economic growth or productivity growth (macro level).
- **Environmental impact:** contribution to the management of the environment, for example, natural resources, environmental pollution, climate and meteorology.
- **Health impact:** contribution to public health, life expectancy, prevention of illnesses and quality of life.
- **Political impact:** contribution to how policy makers act and how policies are constructed and to political stability.
- **Scientific impact:** contribution to the subsequent progress of knowledge, the formation of disciplines, training and capacity building.
- **Social impact:** contribution to community welfare, quality of life, behaviour, practices and activities of people and groups.
- **Technological impact:** contribution to the creation of product, process and service innovations.
- **Training impacts:** contribution to curricula, pedagogical tools, qualifications.

Impacts are consequences of an action, and they can be academic, economic and/or societal. Therefore, before a study is undertaken, it is useful to clarify what classification of impact one is focused on (as outlined above).

[22] ESF (2012) *The Challenges of Impact Assessment* p7 (Pubd online) <http://www.dfg.de/download/pdf/dfg_im_profil/evaluation_statistik/programm_evaluation/impact_assessment_wg2.pdf> [Accessed 30 Mar 2014]

For example, examining the cultural impacts of research offers promising opportunities for Arts and Humanities disciplines despite initial concerns over this in the UK's REF exercise. There, scholars were anxious over what the exercise would prove, but as the Head of English REF panel explained:

"universities put in some really convincing case studies and showed how Arts and Humanities departments had been engaging very heavily in outreach programmes and were able to marshal quite a lot of impact evidence"..."We were surprised by the variety of examples and the quality of evidence that people were able to provide...Including impact in the exercise will do a lot to promote the value of arts subjects to the national economy at a time of general funding cuts" [23].

To this end, the UK's Arts and Humanities Research Council (AHRC) has specifically addressed ways of strengthening research impact along four axes: informing public policy; knowledge exchange and partnerships; public engagement; and extending international influence. Exposing cutting-edge research in Arts and Humanities to national and European public policy makers is supported through multiple stakeholder seminars, commissioned reports, and internships across a wide range of subject disciplines and government activities. Knowledge exchange and partnerships are designed to create opportunities and incentives that increase the flow, value, and impact of world-class arts and humanities research from academia to the UK's private, cultural, and public sectors.

Here, AHRC has concentrated the majority of its knowledge exchange funding into centres of excellence - Knowledge Exchange Hubs – to facilitate interaction between arts and humanities research and the Creative Economy, and to translate and create significant benefit. Public Engagement - seen as the engagement of researchers with the general public for the benefit of both might be described as "*a vital part of a country's cultural wealth*"- engaging millions of people through the exhibitions they visit, the music they listen to, the books they read and the plays and films they watch. The two-way exchange of ideas, information and insights, between researchers and the general public is considered part of the journey to impact.

Connecting communities with researchers is a fundamental goal and championed by the AHRC in terms of its support for researchers working with community heritage groups, broadcasters and media groups, and schools. Additionally, AHRC aims to strengthen the impact of the research it funds through its international strategy and specifically networking and cross-border collaborations. Leading UK universities, such as Oxford, have showcased the impact of their Arts and Humanities research activities through well-crafted case studies.

[23] http://www.theguardian.com/education/2011/mar/01/research-excellence-framework-academics

Penfield et al. (2012) provide a comprehensive review of the classification of impact highlighting both academic and non-academic impacts[24]. The non-academic impacts of academic research conventionally fall into 'established' categories of practice, policy, and wider social and economic impacts[25] (Scoble, Dickson, Fisher and Hanney, (2009)) with the environment sometimes included - rather opaquely - within the 'social' dimension. Examination of impact measures (Table 2) suggests a high degree of commonality between the higher-tier impact categories identified by research funders and researcher so far, although the terminology used often varies. Definitions of the indicators underpinning the measures are often not specified. This lack of prescription allows a more open, inclusive and often qualitative, approach to the description of impacts.

[24] Penfield, T., Baker, M. Scoble, R. and Wykes, M. (2012) *Assessment, evaluations, and definitions of research impact: A review*, (Pubd online), <http://rev.oxfordjournals.org/content/early/2013/11/08/reseval.rvt021.abstract> [accessed 12 Mar 2014].
[25] Scoble. R., Dickson, K., Fisher, J. and Hanney, S.R. (2009) *Research Impact Evaluation, a Wider Context: Findings from a Research Impact Pilot.*

	ESF (2012)	RCUK (2011)	HEFCE (2012)	Horton (2012)	Cooke and Nadim (2011)	Godin and Dore (2004) in Scoble (2010)
Policy	▪ Political: How policy makers act and how policies are constructed and to political stability	▪ Evidence-based policy-making and influencing public bodies and legislation ▪ Public services	▪ Public policy, law and services		▪ Changes to clinical policy ▪ Improved policy making ▪ Influence on public policy debate	▪ Policy: policy makers, citizens, national security, public programmes.
Practice		▪ Evidence based policy in practice; practitioners and professional practice.	▪ Practitioners and services		▪ Improved patient care ▪ Improved public services	
Social	▪ Cultural: understanding of ideas and reality, values and beliefs. ▪ Social: Community welfare, quality of life, behaviour, practices and activities of people and groups ▪ Environmental: management of the environment ▪ Health: public health, life expectancy, prevention of illnesses and quality of life	▪ Cultural enrichment, quality of life, health and well-being. ▪ Social welfare, social cohesion and/or national security. ▪ Environmental sustainability, protection and impact reduction. ▪ Public awareness and understanding of science, economic and societal issues.	▪ Cultural life and creativity ▪ Health and welfare ▪ Environment ▪ International development ▪ Civil society ▪ Education ▪ Public discourse	▪ Cultural ▪ Educational ▪ Environmental ▪ Health ▪ Happiness ▪ Safety	▪ Cultural enrichment ▪ Environmental sustainability ▪ Improved health outcomes ▪ Changes to public behaviour (health) ▪ Social equity/inclusion and cohesion ▪ National security	▪ Culture: knowledge, know-how, attitudes, values ▪ Society: welfare, discourses and actions of groups ▪ Health: public health, health systems ▪ Environment: management of natural resources and the environment; climate and meteorology ▪ Symbolic: legitimacy, credibility, visibility, notoriety

Table 2 Typologies of categories of impact[26]

[26] Hilary Stevens, Andrew Dean and Michael Wykes, (2013) *Final report of the DESCRIBE project*, Exeter University

	ESF (2012)	RCUK (2011)	HEFCE (2012)	Horton (2012)	Cooke and Nadim (2011)	Godin and Dore (2004)
Economic	▪ Technological: creation of product, process and service innovations ▪ Economic: sale price of products, a firm's costs and revenues (micro level), and economic returns either through economic growth or productivity growth (macro level).	▪ Wealth creation and economic prosperity (*i.e.* creation and growth of companies and jobs; business revenue and innovative capacity. ▪ R&D investment from global business ▪ Regeneration & economic d'ment ▪ Commercialisation and exploitation of scientific knowledge, spin out companies, new processes, products & services.	▪ Economy ▪ Commerce ▪ Production ▪ Organisational	▪ Wealth ▪ Economic	▪ Improving performance of existing businesses ▪ New products or processes ▪ New businesses ▪ Collaboration ▪ Knowledge transfer ▪ Staff movement academia-industry ▪ R&D investment from global business ▪ Post-doc jobs ▪ Competitiveness ▪ Employment or revenue ▪ Healthcare costs	▪ Technology: products and processes, services, know-how ▪ Economy: production, financing, investments, commercialisation, budget
Capacity building	▪ Scientific knowledge: progress of knowledge formulation of disciplines, training and capacity building. ▪ Training: curricula, pedagogical tools, qualifications.	▪ Organisational culture and practices ▪ Research capacity, knowledge and skills of businesses and organisations ▪ Efficiency, performance and sustainability of businesses/organ. ▪ Training of skilled people for non-academic professions.	▪ Production	▪ People ▪ Mixed other		▪ Science: knowledge, research activities, training ▪ Organisation: planning, work admin., human res. ▪ Training: curricula, pedagogical tools, qualifications, graduates, insertion into job market, etc.

Table 3 Typologies of categories of impact[27]

[27] Hilary Stevens, Andrew Dean and Michael Wykes, (2013) *Final report of the DESCRIBE project*, Exeter University

4.3 Outputs, Outcomes & Impacts

There is much confusion in the understanding of research impact not least in the terminology of outputs, outcomes, and impacts and their interrelationships. Specifically, this has made the interpretation, expression, and communication of research activity problematic. A distinction is drawn between outputs, outcomes and impacts of research. For example, Jeffery (2013) distinguishes between them as follows:

- *"**Outputs** are products of research; typically :*
  - *publications: scholarly publications (but not forgetting grey literature)*
  - *products: prototype artefacts, research datasets, software;*
  - *patents.*
- ***Outcomes** 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;*
- ***Impact** is the contribution of the research on the economy and society including business, health, environment, social cohesion etc. Examples are wealth creation (spin-out company capitalisation, number of employees); environmental benefit (river now 10% cleaner than before); healthcare (10,000 lives saved per year because of the drug developed by the research); social cohesion (policy developed in the research provides improved social networking among pensioners)"*[28].

The Beyond Publications steering committee identified two key elements in the understanding of research impact:-

- The precise linkages between inputs, activities, outputs, outcomes and impacts
- The significance of time to the understanding of research impact

These are shown in Figure 5.

These two elements are often viewed through the lens of impact as a 'journey'.

[28] Jeffery, K (2013) *Report on UCD Research Information*, p9

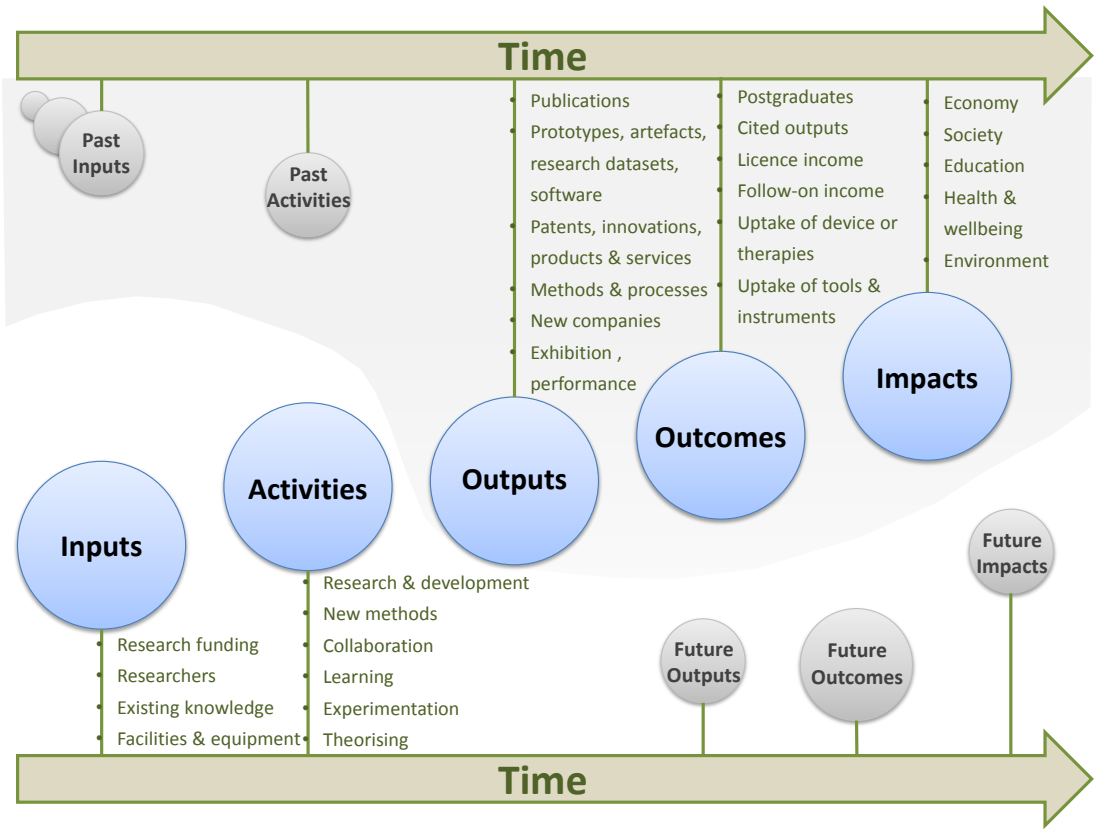


Figure 5 Linkage of inputs, activities, outputs, outcomes & impacts over time

4.4 Impact as a journey

Horton (2013) contends that the impact journey entails "*tracing research impact over time including identification of distinctive stages in its development, and its subsequent diffusion between disciplines and the wider society*"[29]. The impact journey is presented in Table 4. The impact journey commences with 'inputs' represented by a research hypothesis, question or theory, the formulation of which results in a change in ideas. Research activities are then directed or applied to these inputs, and knowledge is created. This knowledge is expressed through the production of publications or other means ('outputs'). These outputs are then translated ('translation') and used ('usage') by others with subsequent potential for a change in understanding and behaviour. The final stages of the Horton model capture the potential impacts of research use on the conditions of a specific group and the wider population. Conventionally, research is said to have impact if measured consequences can be attributed to the research at the translation, usage and impact stages.

[29] Horton, A. (2013) *Impact as a Journey – with Audience. A thought piece*. Brunel University Business School

	Inputs	Activities	Outputs	Translation	Usage	General Impact	Specific Impact
Description	Ideas, theories hypotheses	Discovery/ understanding	Engagement with others, especially users, communication	Translation/brokerage /mediation /mobilisation/influence	Utilization/implementation/ /execution /agency/application	More good things Fewer bad things New options	Specific benefits accruing to specific groups
The Storyline	Our interest/the problem was... and we had the expertise in...	So we researched .... in order to ...	*Through the use of ...* *we ensured the right people know about our results*	*Through dialogue with....* *the implications became clear in different contexts*	Our research was used/adopted /adapted /applied/trialled /tested by...	The general benefit was...	The specific benefits were .... and accrued to....
Result	*Change in ideas*	*Change in knowledge*	*Change in knowledge distribution*	*Change in understanding*	*Change in behaviour*	*Change in condition*	*Change specific in condition*
Specificity	Discipline	Discipline	Discipline	Discipline & Application	Discipline & Application	Application	Application
Reach	Proximate	Proximate	Proximate	Systemic	Systemic	Systemic	Systemic
Most Common Type	Knowledge	Knowledge, People/capacity	Knowledge, People/capacity	Knowledge, People/capacity	People/capacity, social, economic	Social and economic	Social and economic
Development	Impact plans	Impact expectations	Impact intentions	Impact opportunities	Impact potential	Impact emerging	Impact reality

Table 4 Impact journey Source: Horton (2013) [30]

[30] Horton, A. (2013) *Impact as a Journey – with Audience. A thought piece*. Brunel University Business School

4.5 Impact studies –methodological challenges

The methodological challenges in capturing research impact have been well documented in recent years. A study undertaken by the University of Exeter in May 2013 (entitled the Describe Project) set out six principal challenges. Briefly, these are:

1) Time - tracking the routes to impact.
2) Attribution – the extent to which impact have resulted from research outcomes.
3) Co-production of research – difficulties isolating the precise impact of a specific research funder project.
4) Assessment problems – how to differentiate and scale various research impacts.
5) Costs of assessing research impact – amount of time and financial resources necessary to capture and demonstrate research impact may be excessive.
6) Counter factual reasoning – measuring the difference between research consequences and what would have happened anyway.

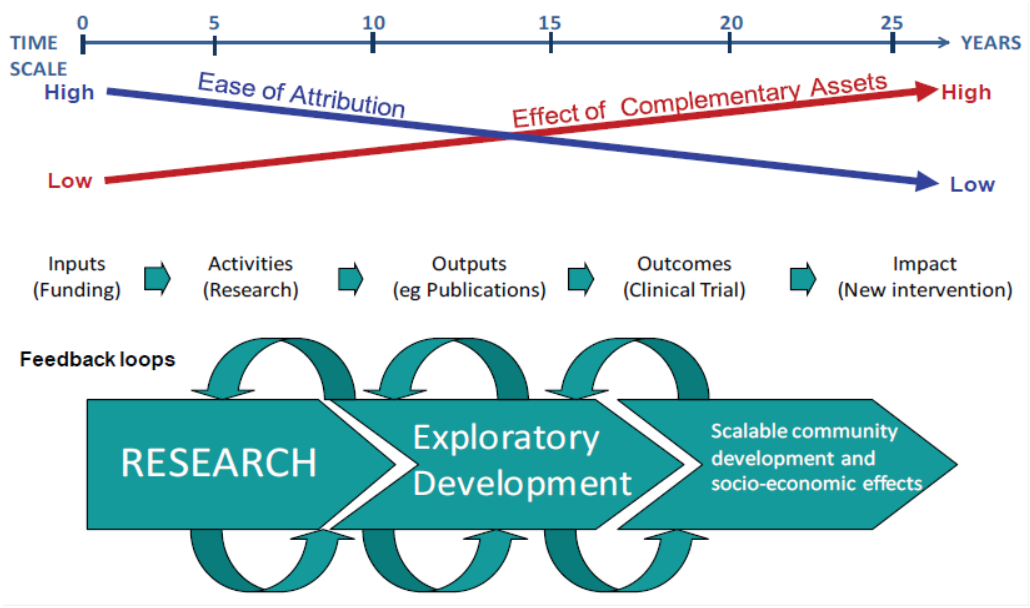


Figure 6 Time, Attribution, Impact, Source: Hughes (2012)[31]

[31] Hughes, A. (2012) *'University: Industry Links and Impacts Analysis'*. A presentation at the MRC Economic Impact Workshop, London, 26th Oct 2011 reproduced in the MRC (2012) Measuring the link between research and economic impact: Report of an MRC Consultation and Workshop, Medical Research Council, Swindon, pp30-35.

A more complete discussion on the methodological challenges relating to research impact can be found in Appendix B.

Drawing upon these challenges, there are manifestly major implications for UCD in pursuing a research impact agenda.

- Current deficiencies in UCD's systems prevent the capture of additional outputs and outcomes for research impact as indicated in *Figure 3Outputs not captured.*
- Academic investment in the exercise of research impact (time, support and personal rewards).
- Linking these outputs to people, sponsors, organisations and stakeholder groups over time.
- Measuring the precise impact of these research activities with due sensitivities to the university's financial circumstances.

These are addressed fully in *Chapter 7, Recommendations for Implementing a UCD Research Impact System*.

5 The Study of Impact - a mosaic of international approaches

5.1 Evaluating Research in Context (ERiC) (The Netherlands)[32]

Since the early 1990s, and in line with many other European countries, academic research in the Netherlands has been evaluated every few years. This has used a common protocol, known as the Standard Evaluation Protocol, and in recent years the assessment of societal relevance has been given a much more prominent role within this.

To refine the means and mechanisms to capture the societal impact of research a number of Dutch organisations are now collaborating on a project entitled 'Evaluating Research in Context' ('ERiC)'. ERiC is a partnership between the Netherlands Association of Universities of Applied Sciences (HBO-raad), the Royal Netherlands Academy of Arts and Sciences (KNAW), the Netherlands Organisation for Scientific Research (NWO), the Association of Universities in the Netherlands (VSNU) and the Rathenau Institute's Science System Assessment department.

The growing focus in the Netherlands, as elsewhere, on articulating the societal relevance of research, is seen as part of a general political trend towards underlining the importance of academic research to "the private and public sectors (industry, education, policymakers, health care etc.), to efforts to tackle societal issues (such as innovation, climate change, social cohesion, globalisation, healthcare) and to education and training". Critically, societal relevance of research is now a central component in the standard evaluation protocol for the period up to 2015.

Definitions of societal relevance are central to this exercise. Here, societal relevance is considered as the degree to which research "contributes to and creates an understanding of the development of societal sectors and practice (such as industry, education, policy making, healthcare) and the goals they aim to achieve, and to resolving problems and issues (such as climate change and social cohesion)". In addition, there is a "well-founded expectation that the research will provide such a contribution in the short or long term". Consequently, societal relevance is viewed both prospectively-and retrospectively, though it is acknowledged that the evaluation of societal relevance of research in the long term presents many serious challenges in both methodological and auditing terms.

[32] *Evaluating Research in Context (ERiC),* (2007), The Netherlands, Netherlands Association of Universities of Applied Sciences (HBO-raad), the Royal Netherlands Academy of Arts and Sciences (KNAW), the Netherlands Organisation for Scientific Research (NOW), the Association of Universities in the Netherlands (VSNU) and the Rathneau Institute's Science System department. ERiC

Stakeholders are considered key to the evaluation of societal relevance of academic research in the Netherlands. The notion of 'productive interaction' between academic researchers and societal stakeholders is a mainstay of the ERiC work. Such interaction is seen to take place either when the research agenda is defined, during the research itself, or afterwards, when the results are communicated to stakeholders. This leads the ERiC groups to claim that " A summary of instances of such interaction is therefore an essential element of the information on a research group's performance…[and that]…if productive interaction exists between research groups and stakeholders there is more reason to expect that the research will sooner or later have a societal impact".

With productive interaction between academic research and societal stakeholders considered the bedrock for societal relevance, the ERiC group sets out a detailed four-step method for its evaluation. Step 1 involves a review of the research group's mission and objectives and what societal contributions the research group is "willing and able to make and what strategy it has adopted in order to do so". Step 2 is a description of the societal relevance of the research and this is undertaken in response to four key questions- i) what substantive results did the research yield that could be of importance to society? ii) How has the knowledge been disseminated among societal stakeholders? iii) What evidence is there of interest and appreciation on the part of societal stakeholders? And, iv) What effects have the research results had? Once this has been completed, Step 3 involves a compilation of this information based on agreed indicators of societal relevance. The indicators reflect various aspects of societal relevance, in particular what is described as "the spread of research results", the degree of interest in and appreciation of the research among societal stakeholders, and actual use of the research results. Here, ERiC advises a limited set of indicators, drawing on readily available or collectable data within the timeframe set, that may offer potential for benchmarking, and are disciplinary-context sensitive. Step 4 envisages the setting up of an evaluation committee to give its opinions on the societal relevance of the research. Chiefly, this involves formal invitations to specific stakeholder group and leading experts in the subject area for structured discussions with scientists from within the research group on the research and its societal impact.

There are a number of issues that emerge from the system devised by the ERiC group. First, impact is conceived as including academic publications and their effects on teaching and professional courses. Second, the close linkages between researchers and stakeholders expected in this model could potentially have negative outcomes not least in terms of the research questions posed, the subsequent direction of research enquiry, and the processing and publication of results emanating from it. Third, while ERiC highlights the observable effects of research, it does not consider that there may not be any such in the

short term, or, and possibly a more likely situation, that the research provides inconclusive findings. Finally, ERiC does not address any new media outlets as part of contemporary research contexts.

5.2 Research Excellence Framework (REF) (United Kingdom)[33]

In the United Kingdom, the Research Excellence Framework (REF) (the successor to the Research Assessment Exercise (RAE 2008)) now includes "an explicit element to assess the non-academic impact of research". This impact is defined 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". The scope and calibration of impact extend to any effect, change or benefit to the "activity, attitude, awareness, behaviour, capacity, opportunity, performance, policy, practice, process or understanding… of an audience, beneficiary, community, constituency, organisation or individuals…in any geographic location whether locally, regionally, nationally or internationally". While on the one hand the definition is sufficiently broad ranged to capture impact's multi dimensionality, on the other, REF specifically excludes "impacts on research or the advancement of academic knowledge within Higher Education; and impacts on teaching or other activities within the submitting Higher Education Institution". In this sense it differs significantly from the ERiC model.

A number of demands are placed upon HEIs by the REF with regard to submission requirements for impact. In summary, REF focuses upon the assessment of impact of the Unit's research (Department, Centre, etc.), and **not** the impact of individuals or individual research outputs. Attention is therefore centered on the Unit's approach to supporting and enabling impact from its research, involving description of specific impact case studies underpinned by "excellent research". For the Unit, the submission must include case studies of the strongest examples of impact and how these relate to the Unit's overall approach to enabling impact from its research.

Not surprisingly, the inclusion of research impact in REF has spawned much academic debate. This has included concerns over how research makes a 'material and distinct' contribution to the impact, ways of

[33] *Research Evaluation Framework (REF),* (2011), The UK, Higher Education Funding Council for England (HEFCE), Scottish Funding Council, Higher Education Funding Council for Wales (hefcw) and Department for Employment and Learning. REF

explaining and furnishing evidence of the nature and extent of the impact (Who/what was affected? How were they affected? When were they affected?), as well as establishing robust mechanisms by which claims about impact can be verified by 'independent' sources. Additionally, there remain long-standing concerns over the impact an exercise like REF itself has upon the skewing of research activity to immediate impact forms, giving momentum to the popularization of certain types of 'research' activity and the use of 'proxy' measures for impact assessment.

5.3 Evaluation Agency for Research and Higher Education (AERES) (France)[34]

AERES is an independent administrative authority established by the French government in 2007 and is tasked with evaluating the country's research units and HEIs. Its principal role is to improve the quality of the French research and higher education system through an evaluation of the missions and activities of research units and HEIs. Its status as an independent agency frees it from direct/indirect pressures from government authorities and evaluated institutions. AERES acts in complete transparency with all its evaluative activities publicly available. Its reports on evaluated institutions are published in full on its website. The objectives of its evaluations are seen as offering HEIs/research units key information for building future research strategy, furnishing government with data to make financial allocations and human resource decisions, and providing ***"civil society with reliable and transparent information about the activities of higher education and research institutions***". Such reports include data on individuals' productivity rates (*taux de produisant*) and institutional assessment of most significant research publications. AERES's evaluation methods and operating principles are based on two key strands- a self-evaluation by the HEI and, on the basis of this, a review conducted by AERES involving an on-site visit. For each HEI/Research Unit, AERES specifically considers its research strategy in terms of "exploitation, transfer and assistance with public decisions".

AERES has not shied away from controversy since its inception in 2007. In 2008 it offered a devastating critique of the country's National Institute for Health and Medical Research (INSERM), and in 2010 presented equally critical, though albeit more muted, evaluation reports on the French Atomic Energy

[34] *Evaluation Agency for Research and Higher Education (AERES), (*2007), France, Government independent administrative authority.AERES

Commission (CEA) and the French National Institute for Agricultural Research (INRA). In this latter report, AERES recommended greater efforts to increase INRA's international visibility, a streamlining of the agency's organizational structure, and the **development of more detailed socio-economic measurements of the impact of INRA's work** (see www.aeres-evaluation.fr).

5.4 Excellence in Research (ERA) (Australia)[35]

ERA 2012 aims to identify and promote excellence across the full spectrum of research activity in Australian HEIs. Evaluation is undertaken by Research Evaluation Committees (RECs) comprising experienced, internationally recognised experts. Each evaluation is informed by four broad categories of quantitative indicators:

1. Indicators of research quality publishing behaviour, citation analysis, ERA peer review, and peer reviewed Australian and international research income;
2. Indicators of research volume and activity: total research outputs, research income and other research items within the context of the profile of eligible researchers;
3. Indicators of research application: research commercialisation income, patents, Plant Breeder's Rights, and registered designs;
4. Indicators of recognition: a range of esteem measures. (e.g. editor of a prestigious work of reference; fellowship of a learned academy; membership of a statutory committee, etc.).

While not specifically requesting data on research impact, ERA does permit each HEI to submit succinct written Explanatory Statements to contextualise the data that the institution has submitted about the research performance of disciplines at the institution. Such statements enable institutions to identify additional factors that may need to be taken into account in order to make an informed evaluation. These may include:

• Overview—a brief outline of any background information relevant to the performance and development of the disciplines under consideration. This may include a description of research focus and reasons for trends or shifts in research focus (e.g. institutional restructure);

[35] *Excellence in Research (ERA*, (2012), Australia, Australian Government, Australian Research Council. ERA

• Publication Profile—a description of research strengths (including an explanation of those which are underrepresented by the indicators) and an explanation of discipline specific publishing trends (e.g. those that would come about from a particular applied or regional focus);

• Capacity and Environment—a profile of staffing (including identification of any significant changes in overall, not individual, staff or resources over time) and the effect of the staffing profile on research activity; a description of research group compositions; and information on support for Early Career Researchers and Higher Degree by Research (HDR) students (including how they have contributed to the production of the research outputs submitted);

• Collaboration—across disciplines and/or with researchers at other institutions or agencies (both within Australia and overseas);

• Spectrum of activity—identification of the range of research activity undertaken in the relevant disciplines, such as pure basic research, strategic basic research, applied research, experimental development and so on; as well as, if applicable, information about interdisciplinary trends; and

• Other—any other information the institution feels should be included to explain the data submitted or to further elucidate the research activity undertaken and enable an informed evaluation. This may include additional recognition factors not captured in the submission (such as awards/prizes).

While ERA has generated considerable data on research income, outputs, and research environments within Australian HEIs, there has been growing concern over the **absence of research impact measures.** The Group of Eight (Go8)[36] which markets itself as the group of 'Australia's Leading Universities' (University of Adelaide, Australian National University, University of Melbourne, Monash University, University of New South Wales, University of Queensland, University of Sydney, University of Western Australia) argues that "research impact measures would complement the ERA assessment…improve the operation of the national innovation system…and demonstrate to the public that research funds are well spent". In September 2011 the G08 published a positional paper on 'Measuring the impact of research-the context for metric development'. Within this a number of salient points are worthy of mention.

[36] *The Group of Eight (Go8),* (2011), Australia, University of Adelaide, Australian National University, University of Melbourne, Monash University, University of New South Wales, Univesity of Queensland, University of Sydney, University of Western Australia. Go8

They contend that "*while the demand for increasing information on the impact of research is reasonable, supplying the necessary data is neither simple nor easy*" leading them to conclude that ***"Discussions about the impact of research and how to measure it are even more problematic than discussions about excellence and what we mean by it***".

They recognise that the impact of research can be "negative or indirect", that "in most cases impact is the result of actions by parties other than the researchers themselves", "all research builds upon earlier research", "there can be different perspectives about the worth of an impact", and that "measuring impact can distort behaviour".

Having set out these concerns the G08 concedes that "any estimate is at best a very rough guide and that the results of any [research impact] assessment can vary widely, depending on the time frame used to allow for impact". Undeterred, the G08 argue that in order to assess research impact, it is necessary to agree on what form the impact can take in order to assist "in developing a framework for identifying possible ways to provide measures (if only partial measures) of research impact". Here they suggest that "some paths to impact are more visible and provide easier measures than others: counting the number of patents granted, licence agreements, or the income received from them…is relatively easy. It is much more difficult to demonstrate that a book presenting the results of research directly to the public has had an impact, for example, by improving health and lifestyle, developing a greater sense of social tolerance or reducing energy consumption or waste".

A number of points are raised in their subsequent discussion-

- "Impact studies tend to focus more on technology and less on conceptual developments and theoretical insights"
- "One measure of impact is the willingness of outside agencies and parties to invest further in the research and its development"
- "One measure of impact is financial return for the institution"
- "Overall national economic impact of research is difficult to estimate…empirical estimates of the effects of R&D on Australian productivity are unreliable. Any assessment therefore requires a high degree of judgment"
- "A major problem with measuring social impact is that the routes through which research can influence individual behaviour or inform social policy are often very diffuse"

- "There is often a more direct link between environment research and improved environmental outcomes than is the case for many social impacts of research"
- "There are intangible impacts of research that may be difficult to measure but are just as important. Research in areas such as history, archaeology, and the biology of indigenous plants and animals can add to a sense of national and cultural identity"

Tentatively, the G08 propose a number of methods for measuring impact, though admit that "***none can provide unambiguous or unarguable results***" even in terms of the evaluation of the same project, program or institution at different times or over different time spans. Significantly, they acknowledge that "different approaches can appeal to different audiences" citing "an econometric analysis that excites the Treasury is not necessarily the best way to convince the general public that governments should fund research".

Nine methods are outlined by them for capturing research impact. These are:

A) Output measures and benchmarking: (academic publications and their citations, other publications including "client reports, technical manuals, the media, newsletters, submissions to government and communications directed towards the general community". However, G08 suggests that none of these is an impact in the narrow sense but, rather, indicate a willingness to have the Research "used".

B) Expert review: the setting up of expert panels with relevant experience in different areas of potential impact. Such panels can be used in conjunction with other methods to temper shortcomings.

C) Anecdotal evidence: not relying on detailed analysis but nonetheless "identifying some of the benefits that research is producing".

D) Case Studies: using the detailed analysis of individual projects to explore the ways in which research "produced an economic or other outcome that contributed to national well-being". Case studies are necessarily retrospective and draw upon anecdotal and quantifiable data.

E) Cost-benefit analysis: normally considers particular research projects or programs. Seen as often less rich in detail, although richer in quantitative data, than case studies. Collating the data necessary for even a single project can be difficult and time consuming.

F) Hindsight Studies: start with an impact and work backwards to identify what contribution(s) research made. Setting the temporal parameters for such studies is seen as a major difficulty.

G) Stakeholder surveys: Stakeholder perceptions of impact, though often "qualitative, anecdotal and unsophisticated". However, "willingness of a University to work with outside agencies to achieve impact can be valuable in a political context".

H) Commercialisation surveys: collection of quantitative data on technology transfer, spin off companies, patents and IP rights. Such surveys are considered to provide "a very narrow perspective on research impact".

I) Econometric analysis: use of empirical data to explore the economy-wide consequences of changing investment in research and the economic impacts of research performed in different sectors.

5.5 Performance Based Research Fund (PBRF) (New Zealand)[37]

The Tertiary Education Advisory Commission recommended in 2001 the introduction of a performance-based research fund for HEI. This led to the establishment in July 2002 of a PBRF working group which proposed a detailed design and implementation of a performance-based system. This was subsequently used in the first Quality Evaluation of New Zealand HEIs in 2003, informed the second evaluation in 2006, and currently underpins the on-going 2012 evaluation.

The primary purpose of the Performance-Based Research Fund (PBRF]) is to ensure that excellent research in the tertiary education sector is encouraged and rewarded. This entails assessing the research performance of HEIs and then funding them on the basis of their performance. Each Quality Evaluation assesses the quality of research conducted at HEIs and funding is allocated accordingly. Quality is determined by an assessment of research degree completion numbers, the amount of external research funding an institution achieves and an evaluation of the individual research performance of all academic staff teaching on degrees or employed to conduct research.

Each academic staff member is required (with some exceptions) to submit an Evidence Portfolio which records their research outputs, contribution to research environment, and peer esteem. They are then assessed as A, B, C or R category. The A indicates international standing, B national, C local and R research inactive or active at a lower level.

[37] *Performance Based Research Fund (PBRF,* (2012), New Zealand, The Tertiary Education Advisory Commission**.** PBRF

From 2006 two new categories, C(NE) and R(NE) were introduced, for new and emerging researchers who have not yet had the benefit of a full six year census period. Each staff member is assigned a numerical grade (in 2006 5 for an A, 3 for a B, 1 for a C or C (NE), and 0 for R and R (NE)). This is used to calculate an overall score. Since the numerical scores assigned for the 2003 assessment and that for the 2006 assessment differed, the results of the two assessments are not entirely comparable, despite the 2006 assessment being designed to be a partial round.

The PBRF model has three elements:

- Quality Evaluation: to reward and encourage the quality of researchers—60 % of the fund
- Research Degree Completions: to reflect research degree completions—25% of the fund
- External Research Income: to reflect external research income—15 %t of the fund.

Under the quality evaluation element excellence is seen as "not just about the production of high quality research articles, books, exhibitions and other forms of research output" but also includes **"*The production and creation of leading-edge knowledge…the application of that knowledge…the dissemination of that knowledge to students and the wider community*"**

5.6 National Research Council (NRC) (Canada)[38]

A 'Standard on Evaluation' has been established by the Canadian government. This standard applies to evaluations of research programs and is based upon the principles of quality, neutrality and utility**.** The objective of the standard is to set minimum requirements for the conduct of evaluations be it the evaluation protocol itself, evaluation planning and design, evaluation of project management, and evaluation reporting and use. In sum, the evaluation is intended to produce credible and timely results that **"*inform decision making, support program improvements, and demonstrate accountability*".**

Evaluations are expected to incorporate sufficient and appropriate consultation, including with major stakeholders, and where appropriate, apply the advice and guidance of specialists and other experts. In addition, peer review, advisory, or steering committee groups are used where necessary to input to evaluation planning. Three main concerns underpin the evaluation: programme relevance, success and

[38] *'Standard on Evaluation' - National Research Council (NRC),* (2009), Canada, National Research Council, Government of Canada. NRC

cost effectiveness. Through the operation of a 'Standard on Evaluation' the Canadian government is seeking to create "***a comprehensive and reliable base of evaluation evidence*** *than is used to support policy and program improvement, expenditure management, cabinet decision making, and public reporting*"

5.7 Other Specific Disciplinary/Sectoral Evaluations

5.7.1 Business[39]

Ten Business Schools from Europe, Australia and the US have participated in an exploratory study on the 'Impact of Research' led by the University of Tennessee. The study is intended to assist a business school understand better "*the connection between the research activities it supports and the School's mission, target objectives, and* ***stakeholders***". In this light, the school can "***better articulate the added value its investments in scholarship provide to important stakeholder groups***".

Three objectives are set out by the study**:**

- Defining Research Expectations
- Exploring Possible Measures/Metrics to assess whether expectations are being achieved
- Using and communicating what was learned ("*are we effectively communicating about our scholarship to relevant audiences?*")

In terms of metrics, the study makes a number of recommendations. Specifically, a range of methods to assess impact is proposed, including narrative and qualitative information to accompany quantitative measures. Any measure selected, it is argued, must be relevant and cost-effective. A note of caution about the need to assess carefully the costs and benefits of assessing research impact is also raised in the study. The difficulty **"*is not in finding possible measures but in exploring reliable and manageable measures. Moreover, it would be expected that seemingly similar metrics might be defined and applied differently at schools with diverse missions*".** This is not however unproblematic. Tensions are seen as likely to develop between a School's desire to benchmark against other institutions and its wish to develop measures that are unique to the School's own areas of focus and intended research impact.

[39] '*Impact of Research' – Exploratory Study*, (2012), AACSB International *Impact of Research - Exploratory Study - AACSB*

5.7.2 Health[40]

A thought proving paper on measuring the social, health and economic impacts of health research investments globally appeared in the Canadian Medical Journal in spring 2009. It concludes that no common validated method for measuring return on investments yet exists in the Health sector due to perceived "issues of complexity combined with major gaps in methodology [that]… limit the ability to link health research products to outcomes at a relevant level (e.g. to be useful to stakeholders: individual funders, decision makers, institutions, researchers or clinicians)".

Two main approaches have been deployed in various country-specific contexts to measure the impact of Health research investment. Broadly, one is a 'top-down' econometric calculation which considers monetized improvements in life expectancy and quality of life following health research investment, and the other, a 'bottom-up' approach [a payback model] that tracks new knowledge in phases from its production to a knowledge pool, and then on to secondary outputs, adoption and final outcomes. This 'payback model' has received growing attention in a number of Health sector contexts including UK arthritis research, and has also been applied to eight diverse cases in areas of pain, obstetrics, heart attacks, dentistry and neurobiology in Ireland. In this latter application, the strengths of the approach were seen to be the production of detailed results, the close tracking of outputs and outcomes, and longer term program enhancement. On the downside, concern was expressed over the small number of cases thereby making generalization difficult, the high labour intensiveness of the approach and its excessive financial cost.

Some generic issues of measuring impact are documented in the Canadian study. First, is the 'attribution issue', that is the inability to determine the exact contribution of research investment to health, health care, or social and economic prosperity. Second, is the counterfactual argument, that is, what would have happened if the research had not been conducted? Third, is the time lag for knowledge translation and how best to account for it? Finally, the Canadian study highlights in all cases the need to establish a **"*clear definition of what to measure and how to capture impacts in meaningful terms*".**

[40] '*Health Research: measuring the social, health and economic benefits'*, (2009), Cryril, F. and Nason, E., Canadian Medical Journal Health Research - Measuring the social, health and economic benefits - CMJ

5.7.3 European Science Foundation[41]

The ESF has conducted and reported in 2009-2010 upon an ex-post evaluation of funding schemes and research programmes in Europe. Principally, the intention was to document various practices and expectations of evaluation, chart differences in national arrangements and develop an inventory of best practice in evaluation exercises. Some commonalities in evaluation approach were seen to exist across Europe with particular evaluations falling into one of five categories: evaluation of research grant (to a single PI or research team); funding schemes; evaluation of research fields or scientific disciplines in a country; evaluation of funding policies or particular strategic issues; evaluation of the research funding agency itself.

Within the wide-ranging ESF report a case study of the economic impact of the UK Arts and Humanities Research Council (AHRC) is set out. Price Waterhouse Coopers was commissioned to demonstrate the economic and social impacts of AHRC funded research. While net economic impacts were more readily calculated the report concluded that **"*wider benefits of the research were not captured***". Similar misgivings were reported in case studies of the Finnish research environment where it is acknowledged a "*variety of indicators are available to address inputs, outputs and activities of science, technology and innovation, **but a lack of satisfactory indicator data [exist] about the social and economic impacts***".

While the ESF's concludes that **"*showing impact is becoming more and more important*"** how to achieve this end is still very much in question.

[41] '*Evaluation in National Research Funding Agencies: approaches, experiences and case studies. A report of the ESF Member Organisation Forum on Ex-Post Evaluation of Funding Schemes and Research Programmes*', (2009 – 2012), European Science Foundation Evaluation in National Research Funding Agencies - ESF

6 The Research Impact of UCD

6.1 UCD's focus on Impact

The UCD Beyond Publications steering committee came to the decision that UCD's focus on impact should be:

> **The contribution of UCD's research to the advancement of knowledge for the benefit of academia, the economy, society, culture, industry, public policy, health, the environment or quality of life.**

In other words, the direct and indirect 'influence' of UCD's research or its 'effect on' individuals, communities, the creation of knowledge, the development of policy, or the creation of a new product, service or technology. This directly requires UCD to capture data on research inputs, activities, outputs, outcomes and impacts, **which it currently does not**.

6.2 The measurement of impact

There are a number of approaches described in Section 4 of this document for the assessment of impact. It is possible to categorise the approaches in many ways, for example, on the basis of the intended audience for the impact, the type of impact, what type of data is being gathered (quantitive or qualitive or a mixture of both) and whether the level of aggregation is a at national, funding agency, university or specific research programme level. Internationally, combinations of the following measures are used by national agencies and universities to assess impact:-

- **Input Measures** – Include research funding, human resources, existing knowledge, equipment and facilities.
- **Output Measures** –refer to the measurement of the products of the research activity. "*The most obvious output measure is publications, but processes or tools used to disseminate research can also be considered as a type of output indicator*"[42].

[42] ESF (2010) *The Challenges of Impact Assessment* p13 (Pubd online) <http://www.dfg.de/download/pdf/dfg_im_profil/evaluation_statistik/programm_evaluation/impact_assessment_wg2.pdf> [Accessed 30 Mar 2014]

- **Expert reviews** – assesses research impact by obtaining information from groups of experts, for example the UK REF uses expert panels to rate the submissions from universities.
- **Surveys** – structured surveys can be used as an impact assessment measure. An example of this approach if the Impact Finder Tool, created by the RAND corporation. The tool is implemented as a web questionnaire and collects information across a range of social, cultural and economic impacts[43].
- **Case Studies** – contain a narrative describing research impact with supporting metrics and references to detail the nature and scale of the impact
- **Hindsight studies –** attempt to retrospectively trace an observed research impact to the research inputs, activities, output and outcomes that led to the impact.
- **Economic models** – are often used to assess value for money. Econometric analysis is used to assess research impact at a macro-level while cost-benefit analysis is often used to determine impact from research projects or programmes.

Appendix C – contains a more complete discussion on the above listed impact measures.

As can be seen from the variety of measures outlined above, the assessment of impact requires the systematic capture of research inputs, activities, outputs, outcomes and impacts data in both numerical and textual formats. The ability to link these data to people and institutions at a particular time is of the utmost importance for impact assessment, particularly in the case of hindsight studies and retrospective economic studies.

It is important to note that a combination of measures is often used in the assessment of impact. In the UK REF for example, a combination of input and output measures is gathered together with case studies from each institution. These submissions are then assessed by expert panels and rated for excellence. The measures used for assessment depend upon the questions that either, government, funders or the universities themselves are trying to answer.

[43] Rand Corporation (2014) *Impact Finder Tool* http://www.rand.org/randeurope/research/projects/impactfinder.html [accessed 10th March 2014]

The table below is adapted from the ESF[44], and it gives some indication of which measures to use for answering certain questions. The questions are given for illustrative purposes and should not be taken to be an exhaustive list.

Impact assessment methods	
Relevant Questions	**Methods for Answering Questions**
How much has been spent thus far? Does the progress achieved thus far match expectations based on those expenditures?	• Cost-benefit analysis
How are resources to be transformed into desired outputs and outcomes?	• Peer review/Expert judgment • Case study • Econometric studies
Is the programme's research of high scientific quality? Is it relevant, productive and well managed?	• Peer review/Expert judgment
What relationships are developing? Is the programme strengthening the research network?	• Network analysis • Before-and-after applications
What additional project-related relationships have developed among researchers?	• Network analysis • Before-and-after applications
How are programme mechanisms, processes, and/or activities working? How can they be strengthened?	• Monitoring activities • Case study - descriptive/exploratory • Econometric studies
What are the programme's codified knowledge outputs?	• Bibliometrics
How does the programme's output productivity compare with similar programmes?	• Benchmarking
How noteworthy are the resulting patents? What are the hot trends? Are there important regional impacts?	• Hot-spot patent analysis
To what extent have the programme's outputs been commercialised?	• Indicators •Technology commercialisation tracking

[44] ESF (2012) *The Challenges of Impact Assessment* p 18 (Pubd online) <http://www.dfg.de/download/pdf/dfg_im_profil/evaluation_statistik/programm_evaluation/impact_assessment_wg2.pdf> [Accessed 30 Mar 2014]

Impact assessment methods	
Relevant Questions	**Methods for Answering Questions**
What factors are influencing industry's adoption/lack of adoption of the programme's technologies?	• Case study - descriptive/explanatory
What are the realised benefits and costs of the technology to date? What share of net benefits from the technology is attributed to the programme?	• Benefit-cost analysis
How is the programme working thus far?	• Case study - descriptive/explanatory
Are there one or more noteworthy consequences that can be shown to link back directly to the research?	• Hindsight studies, Historical tracing (including citation analysis)
If we had it to do all over again, would we have launched the programme or initiative?	• Peer review/Expert judgment supported by multiple retrospective evaluation methods
What benefits are there for society in general? Is the action (e.g., a research programme) showing value for money?	• Economic models (on an aggregate level) • Case studies (based on research projects, for example, the payback model)
How does research affect policy makers?	• The SIAMPI approach
What health gains does research create?	• The payback framework
How is the knowledge produced used in policy?	• Interviews, document analysis

Table 5 Impact assessment methods

6.3 How leading research intensive universities are managing impact

The Beyond Publications committee came to the conclusion that for UCD to further its understanding of impact as well as its capture and dissemination, this would necessitate a review of impact practice in comparable research intensive universities. To this end the Beyond Publications project reviewed 30 universities, including Oxford, Cambridge, UCL, Harvard, MIT and Melbourne, to gain an understanding of the range of impact related data collected and to discover the various methods used to express research impact.

Internationally, there are clear differences in the drivers for collection and the mechanisms for measurement as described in *Chapter 5, The Study of Impact – a mosaic of international approaches*. However some common themes have emerged.

Firstly, research impact takes centre stage in setting strategic goals for the institutions, as evidenced by the many references to impact found in their strategic plans.

Secondly, for the universities that are subject to national research evaluations, there is a necessity to capture electronic records on research inputs, activities, outputs, outcomes and impact. Universities typically implement purpose built research information systems to help gather, store and submit these records to the national evaluation bodies. In addition to research evaluations, there is an ever increasing awareness of the need for quality research information systems at leading universities:

- research managers and administrators require structured research data for the management, measurement and analysis of research activity, the benchmarking of research outputs and outcomes against other institutions and as an aid decision making.
- research funding agencies require quality research information to optimise their funding processes and to report back to government on research impacts.
- entrepreneurs and technology transfer organisations need to search for novel ideas, new technologies and be able to identify previously completed similar research.
- the media and the general public require information on research results and benefits of research in appropriate contexts.

These systems are being continuously developed by universities in conjunction with system vendors, funders and policy makers to support research management and create competitive advantage. For a summary of data collection in the UK (REF) and the Australian (ERA) national systems see Appendix D.

These examples demonstrate the scale of information required to establish credible impact representation in these countries.

A final common theme identified is the use of case studies by a large number of universities to showcase their research impact. Impact case studies are used to communicate research agendas and successes to stakeholders such as policy makers, funding agencies, industry, alumni and the wider public.

As a way of expressing progress against their strategies, the universities are grouping their case studies under their strategic research priority areas. For example, many Universities state that their research purpose is to solve 'Grand Challenges' and therefore evidence this by communicating impact through the case studies method organised in thematic grouping, (see Appendix E for a summary table).

Case studies have high visibility on institutional websites, often listing impact on their homepages with links to collections of case studies. It was clear from this review that case studies were an important vehicle to demonstrate research impact and the values of an institution and its researchers.

The Beyond Publications steering committee agreed that the case study method furnished an important and effective means to showcase the impact of UCD research across all disciplines.

6.4 The Structure of Case Studies

This section provides a summary of the key findings associated with the presentation of research impact through case studies. The project reviewed over 100 impact case studies from universities around the world. There are a number of common features of research impact case studies.

6.4.1 General

1. Case studies are audience specific and communicate the research benefit to the stakeholders. In this way they can be a tool to promote and appreciate the value of the research outcomes.
2. There is significant planning and resources required to facilitate case study production for intended audiences.

3. The case studies are underpinned by extensive information management systems and devoted resources, both human and technological at the university level.

6.4.2 Case study Structure

There are specific features of the case study approach to showcase research impact:

1. Generally case studies are restricted to one page in length.
2. Case study templates are the most common way to harvest the narrative of research impact.
3. Typically templates were structured as follows:
    - Title of case study
    - Include the ability to attach images
    - Contain a summary of the research and impact
    - Description of the research
    - Detailed description of the impact
    - Publication references to the research
4. Language used provided a coherent narrative and could be understood by a non-expert audience.
5. Collections of case studies were thematically grouped under areas of society or in systems of advanced maturity under strategic priorities of the institution.
6. Good case studies contained evidence of the impact or corroborating sources such as:
    - Testimonials or quotes from named individuals that were impacted by the research
    - Quantitative data points as factual statements of the reach of the benefits from the research
    - Links to online supporting material such as videos or exhibitions
    - Links to policy documents where the research has made a contribution or influence government policy
    - Reference to peer reviewed article or award associated with the research

The following attributes are commonly identified, in what can be generally considered a weaker case study:

- Generalised or vague with a lack of necessary information on the claims of impact
- Excessive publication lists or web references, to cost of detail for a descriptive narrative

- Lack of coherence and structure making the impact story hard to follow
- Claiming potential impact

6.4.3 International examples

The international use of case studies is central to communicating and recording the impact of research projects. Depending on the purpose and the audience, the collection of case studies is conducted with varying degrees of rigour and thus the analysis used to describe impact also varies to demonstrate the type of impact; be it societal, economic or academic.

By their nature case studies are retrospective, as they describe an effect that has happened and will usually draw on a qualitative narrative as well as quantitative data. There is also much written on the significant research required in preparation of a comprehensive impact case study and this involves resources other than those working on the research.

A less comprehensive impact case study and commonly found in the review, are case studies on prospective impact rather than demonstrated verifiable impact. The requirement for demonstrated impact will need further highlighting as impact is what has happened from the research and not what may happen. Aligned to this, indicators of impact or case studies would require a mechanism for verification of claimed impact and there are various options and examples of this, including self-evaluation, peer review or submission to a governing authority.

Case studies are however seen to have many advantages and these were also expressed by the steering committee. In particular they provide an opportunity to address holistically the communication of the extensive benefits of university research to a wider audience and express the significant and often untold contribution academics and universities make to society. This would also play an important role in developing the understanding of the process of research, combined with the value and values provided to the stakeholders involved.

6.5 Good practice in case studies[45]

Looking back to understand the recent economic crisis

The G20 London Summit in 2009 bore a striking resemblance to the World Economic Conference of 1933. Understanding the history of this event and the League of Nations, the international organisation which was the forerunner of the UN, has demonstrated that history can be essential in modern policy making. An academic from the University of Oxford is a world expert in the area and has been contributing her knowledge to economic policy and education.

UNIVERSITY OF OXFORD

www.ox.ac.uk/oxfordimpacts

The League of Nations (1919–46) was an international organisation which had the primary goal of preventing war. But it also dealt with issues relating to economic and financial collaboration, international working conditions and global health. Although it failed to avert the Second World War, the League represented a significant shift in the ideas about international relations and organisation. Its history helped to underline the importance of economic and financial co-ordination and co-operation to the prospects of prosperity and peace. The organisation helped to incubate ideas that led to the World Bank, the International Monetary Fund and ECOSOC that transformed the world after 1945 when the United Nations replaced the League of Nations.

Dr Patricia Clavin, from the History Faculty and Jesus College at the University of Oxford, is an expert on the League of Nations and the role it played in the world's developing diplomatic structure. Her knowledge on the League and the world economic downturn in the 1930s has been informing current economic policy. Dr Clavin briefs US departments of state, the UN and the International Labour Organisation on what they can learn from their own history about how to manage financial crises.

Dr Clavin's input has also helped to shape the way that international peacekeeping is taught in schools and the history of the League of Nations is now an increasingly popular element of the GCSE curriculum.

Dr Clavin also manages the League of Nations Network of over 100 academics who collaborate to continue understanding the history of the League of Nations, which is a rich resource for understanding the processes underpinning globalisation and the emergence of modern conceptions about 'rights'. The network also acts as a lobbying group, exchanging and promoting information about access to UN resources and records.

'This research provides a unique perspective on international co-operation during the Great Depression and World War II. For the ILO, confronted with the current global economic crisis, her pioneer work is especially valuable as it allows understanding of the activities of the organization in a larger historical context.'

Emmanuel Reynaud, Director of the Century Project at the International Labour Organization

www.history.ox.ac.uk/mehrc

Funded by: Arts and Humanities Research Council and the University of Oxford John Fell Research Fund.

23

Case Study Structures

1. case studies restricted in length

2. Case study templates, consistent structure

3. Typically template structure as follows:
   - Title of case study
   - Images attached
   - Contained a summary of the research and impact
   - Description of the research
   - Detailed description of the impact
   - References to the research

4. Language used provided a coherent narrative and can be understood by a non-expert audience

5. Case studies are thematically grouped on web site

6. Contains evidence of the impact or corroborating sources such as:
   - Testimonials or quotes from named individuals that were impacted by the research.
   - Quantitative data points as factual statements of the reach of the benefits from the research

[45] University of Oxford (2014) *Research Impacts: Looking back to understand the recent economic crisis* (Pubd online) http://d2uwzav5gtex9t.cloudfront.net/oxfordimpactspdf/Looking_back_to_understand_the_recent_economic_crisis.pdf [accessed 10th March 2014]

6.6 Academic Impact Case Study

In academia, as in society, success is often measured by how often people are talking about or referring to your work. Over the last 10 years, UCD researchers have doubled the annual number of publications produced. In this time period, UCD has come from having publication impact below world averages in 2003 to 46% above world averages in 2012

UCD researchers have produced a number of publications that are highly cited or referenced. More than 70 scientific publications by UCD researchers have been cited over 200 times. These highly cited studies have emerged from across the full range of scientific areas and reflect the world-class research taking place in UCD. As an example of academic impact, Prof Des Higgins has over 100,000 total citations; making him the most cited Irish, and one of the most cited researchers in the world, for his work on DNA sequence comparisons.

CASE STUDY: Clustal Omega: the ultimate alignment programme?[46]

How would you compare the sequence of a histone protein across 10,000 different species? Until recently the question was partly an abstract one because the technology for generating sequences was slow and expensive.

Modern approaches to aligning very large numbers of sequences have been hitting a bottleneck when facing such large data sets. They are either fast yet generate unacceptably poor quality alignments or they are accurate yet prohibitively intensive of computing power.
Prof Des Higgins and his collaborators in Europe, Asia and the USA addressed these issues using Clustal Omega, an improved multiple alignment programme.

Clustal Omega can align virtually any number of protein sequences quickly and delivers accurate alignments. One novel aspect is the use of vectors to reduce the complexity of a key step in the algorithm, dramatically reducing the processing time. Currently, the programme is designed to align protein sequences (not nucleic acids) but can run on a personal computer or over a server.
Prof Higgins is a biologist by training whose initial research necessitated the use of computers. He needed to be able to make comparisons between DNA sequences; cataloguing similarities and

[46] UCD Conway Institute (2014) *Clustal Omega: The ultimate alignment programme?* (Pubd Online) http://www.ucd.ie/conway/media/latestnews/newstitle,108214,en.html [Accessed 10th March 2014]

differences.

He was one of the authors of the original Clustal programme used to align protein sequences that was innovatively designed to work on personal computers, greatly increased its use among scientists.

He and his research team in UCD Conway have continued to make improvements to the programme with the second version released in 2007 and the latest version, Clustal Omega, released in November 2011. The programme is now used in molecular biology laboratories worldwide.

6.7 Preliminary harvesting of societal and economic case studies of impact at UCD

At the URSB project update on the 3rd March and at previous steering committee meetings, agreement on a preliminary harvesting of case studies of research impact was recommended. Central to the exploration of how to harvest case studies was the early work by the steering committee case study team. This work and ensuing discussion, led to the development of a draft template and draft guidelines to aid the writing of case studies in a standardised way.

Meetings also took place with a number of schools and college research committees, such as the College of Human Sciences, Research and Innovation Committee and with Nova UCD. At these meetings requests were made to submit examples of possible impact case studies to be considered by the Beyond Publications report. During this review consideration was also given to 25 examples of impact provided by staff to the Beyond Publications Project in June 2013.

In total, over 100 potential case studies were collected and these were thematically ordered into the following categories: Health and Wellbeing, Public Policy and Communities, Industry and Economy, Science Technology and Digital, Environment & Sustainability and Culture Arts and the Media. These categories have been used in a variety of other universities. See Figure 7 for volume of preliminary case study harvesting by thematic category.

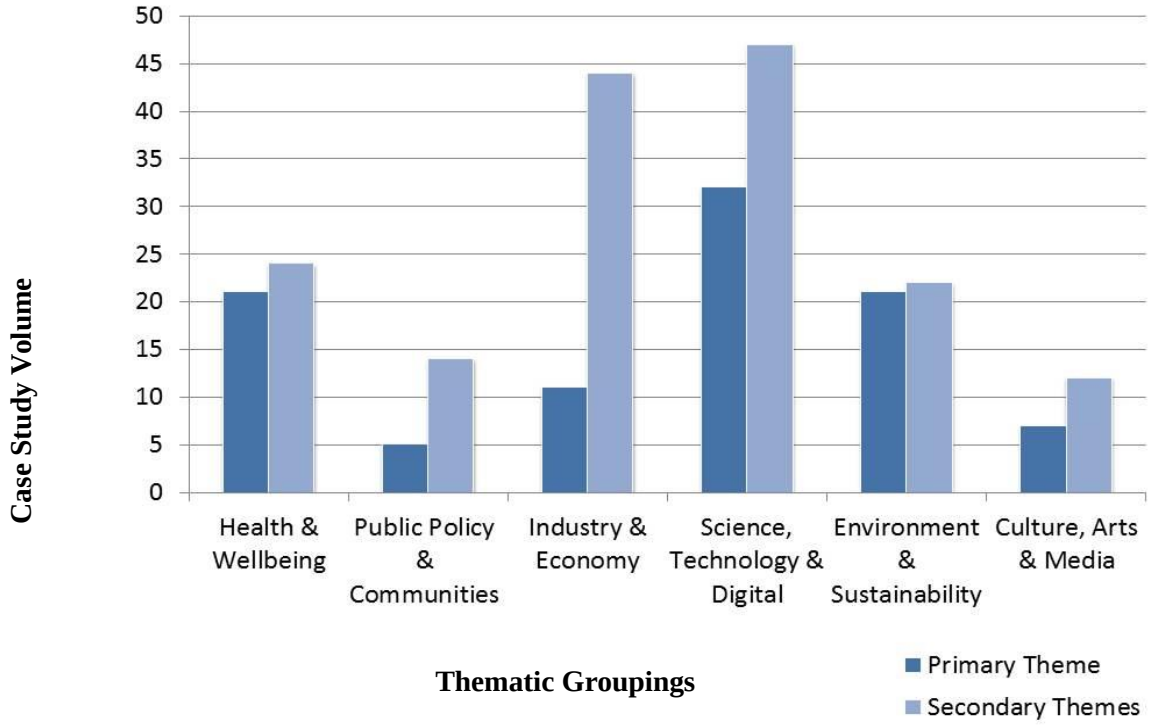


Figure 7 Case Studies per thematic categories.

A number of key points emerged from this preliminary harvesting:

- UCD has a wide range of potential case studies
- The writing of impact case studies tended to focus on the prospective rather than retrospective research impacts. Reflecting the current emphasis of EU and national funding agencies.
- The exercise clearly demonstrated a wide variety of impact journeys.
- Researchers highlighted how the writing of case studies would benefit from professional assistance.
- Definition of terms is key to developing a common understanding of impact

6.8 UCD preliminary harvesting of case studies

What follows are examples of case studies resulting from a preliminary harvesting in UCD. The case studies illustrate how UCD's research is making an impact on society and its direct contribution to solving a number of socio-economic problems. However, they also highlight that we do not currently have an objective means of measuring impact.

The socio-economic problem / Socio-economic context	**The solution**
Youth Mental Health in Ireland: The Statistics • One in six Irish people aged 11-13 and one in five Irish people aged 19-24 experience mental health problems.[47] • Ireland ranks fourth highest in the EU in terms of deaths by suicide amongst young people.[48] • Almost 75% of all serious mental health difficulties first emerge between the ages of 15 and 25.[49]	**Making a difference; UCD's School of Psychology** • Dr. Barbara Dooley is Research Director of Headstrong, the National Centre for Youth Mental Health in Ireland. In 2012 the UCD School of Psychology & Headstrong conducted the country's most substantial research project ever on youth mental health with the *My World Survey*[50] Over 14,000 people aged 12-25 years were surveyed. • Dooley is currently working to develop the first evidence-based youth mental health app, *Copesmart.* It will be piloted in secondary schools in 2014. • *Pesky Gnats* is a computer game designed by Dr. Gary O' Reilly to make Cognitive Behavioural Therapy more accessible for adolescents being treated for anxiety and depression.

[47] Royal College of Surgeons (2013) *The Mental Health Of Young People in Ireland* (Pubd online) http://www.meas.ie/assets/Uploads/20131009042046PERL-ResearchReport041013PRI.pdf [accessed 5th April 2014]
[48] National Office for Suicide Prevention (2012) *Annual Report* (Pubd online) http://www.nosp.ie/annual_report_2012.pdf [accessed 5th April 2014]
[49] Dooley, Barbara A., Fitzgerald, Amanda: *My World Survey: National Study of Youth Mental Health in Ireland.* Headstrong and UCD School of Psychology, 2012-05 (Pubd Online) http://hdl.handle.net/10197/4286 [Accessed March 2014]
[50] Dooley, Barbara A., Fitzgerald, Amanda: *My World Survey: National Study of Youth Mental Health in Ireland.* Headstrong and UCD School of Psychology, 2012-05 (Pubd Online) http://hdl.handle.net/10197/4286 [Accessed March 2014]

Ireland; internationally renowned for horse-racing and breeding	**A ground-breaking discovery; the speed gene**
• In Ireland, the thoroughbred industry directly employs approximately 14,000 individuals and thousands more indirectly. • It made a direct economic contribution of nearly €1 .1 billion to the Irish economy in 2012.[51] • We are the third largest breeder of thoroughbreds in the world. But thoroughbred breeding is an expensive business… Image: Dr. Emmline Hill by Nick Bradshaw	• In 2009 UCD's Dr. Emmeline Hill discovered the 'speed gene', a gene that can identify the best racing distance for individual thoroughbred horses. • The scientific publication describing the 'speed gene' was the world's first description of a gene contributing to a specific athletic trait in racehorses. • Later that year, Hill co-founded the spin-out *Equinome* with breeder / trainer Jim Bolger. • Equinome has now commercialised three genetic tests - *Equinome Speed Gene Test, Equinome Elite Performance Test and Equinome Projected Height Test*, which allow breeders, stallion managers, trainers and bloodstock agents to maximise the genetic potential and commercial value of their horses through better-informed decision-making. • *Equinome* headquartered at Nova UCD has six employees, a branch in Australia, a client base spread over 15 countries and a licensing agreement with the official laboratory to the Japanese racing industry. It has developed the world's first online marketplace for the sharing of genomic profiles in advance of horse purchases.

[51] Irish Thoroughbred Breeders' Association (2013) *Analysis of the Economic Impact of the Irish Thoroughbred Industry.* (Pubd online) http://www.itba.info/wp-content/uploads/2013/07/Dukes-Report-II-October-2013-Update.pdf [accessed 3rd April 2014]

Infertility in cattle: The Facts	Improving Fertility, enhancing the dairy sector
• The dairy sector is responsible for over a quarter of all food exports in Ireland. The leading problem facing the industry is the progressing decline in cow fertility. • Infertility is a serious problem with common aspects in several species. E.g. only about 25% of humans and 35% of dairy cows produce live offspring after each insemination, natural or artificial.[52]	• Over 60 scientists investigate aspects of female infertility in cattle at UCD's Reproductive Biology Research Cluster directed by Professor Alex Evans. • The objective is to develop approaches and technologies to improve fertility in dairy cows. A boost in herd production could hugely enhance the dairy sector. • Their research also has implications for the treatment of infertility in other species, particularly humans.
 Image: On the road home by Emer Kennedy, UCD School of Agriculture, Food Science & Veterinary Medicine	

[52] Evans, ACO and Mc Loughlin, N (2008) "Infertility in cattle" Science and Technology Issue 1 pp38

Mobile phones; a billion dollar industry	At the forefront of technological developments….
• The Money: The total global mobile handset market is expected to reach US$341.4 billion by 2015. Smartphone sales will account for 75.8% of the overall mobile handset revenue.[53] • The Time-Saving Technology: Advancements in smartphone applications now save people on average 88 minutes a day or 22 days a year.[54]	• Leading advancements in the mobile phone industry back in 1999 was *Changing Worlds*, a UCD spin-out company co-founded by Professor Barry Smyth. • *ChangingWorlds* mobile technology powered the mobile internet experience for hundreds of millions of subscribers around the world. The patented technology built subscriber's profiles based on user behaviour and usage patterns. No input was required by the user meaning less clicks and more time. e.g. A sports enthusiast would automatically see a link to sports fixtures on his homepage. • The *Changing Worlds* Mobile Portal platform was rolled out to over 50 mobile network operators worldwide. Over 160 jobs were created. • In 2008 Changing Worlds was acquired for $60m by US-based CRM software service company Amdocs. • From 1999 - 2013 *ChangingWorlds* and then Amdocs maintained close research links with UCD, funding a number of projects, and leading to a wide range of joint research outputs including publications and patents.

[53] Markets and Markets (2011) *World Mobile phone & Smartphone Market (2010 – 2015)* (Pubd online) http://www.prweb.com/releases/mobile-phone-market/smartphone-market/prweb11242089.htm [Accessed 3rd April 2014]

[54] Harris Interactive (2013) Online survey on behalf of ClickSoftware *Savings of $12K Per Year for Smartphones App Users* (Pubd online) http://www.dailyfinance.com/2013/05/21/your-smartphone-could-be-worth-12000-new-survey-fi/ [accessed 3rd April 2014]

Higgs Boson Discovery, a breakthrough in Physics	**What part did UCD play in the particle puzzle?**
• In July 2012, research organisation CERN announced the discovery of the Higgs Boson, a missing particle in the model of physics that describes matter in the universe. • This has been heralded as the world's most important physics discovery in 80 years and is the culmination of 50 years of experimental searching. The next few years will be incredibly exciting, as the Higgs has the potential to reveal deep truths about the nature of the universe.	• Prof. Martin Grunewald developed the real-time filtering algorithms that found the Higgs boson on the CMS experiment at CERN. • Dr. Ronan Mc Nulty and Philip Ilten (UCD thesis) made the first measurement of the Higgs boson on the LHCb experiment. • The UCD group also published papers and theses about the production of W and Z bosons, whose mass is intimately connected with the Higgs, and into which the Higgs decays. • UCD were the only Irish university involved at CERN in the discovery of the Higgs.
Climate Change; the greenhouse effect	**Chemistry tackling climate change**
• Climate change is one of the most significant and challenging issues currently facing humanity. • Increased levels of greenhouse gases, such as carbon dioxide CO2, increase the amount of energy trapped in the atmosphere resulting in increased temperatures, melting of snow and ice and rising global average sea-level. • If not addressed, the projected impacts of climate change present a very serious risk of dangerous irreversible climate impacts at both global and national levels. Food production and ecosystems are particularly vulnerable.[55]	• CARISMA (Catalytic Routines for Small Molecule Activation) is an initiative led by UCD's Professor Martin Albrecht that aims to reduce the amount of CO2 generated by developing artificial catalysts. • It also aims to turn existing green-house gases into raw materials and resources. Imagine the consequences if water powered your car. Zero carbon car emissions would bring us one step closer to a cleaner environment. • The CARISMA project will draw on a wide range of expertise, forming a network of about 60 research groups from across Europe with the potential for worldwide impact.

[55] The Environmental Protection Agency (2014) *Climate Change* (Pubd online) http://www.epa.ie/irelandsenvironment/climatechange/#.U2yTG3lRH1o [accessed 3rd April 2014]

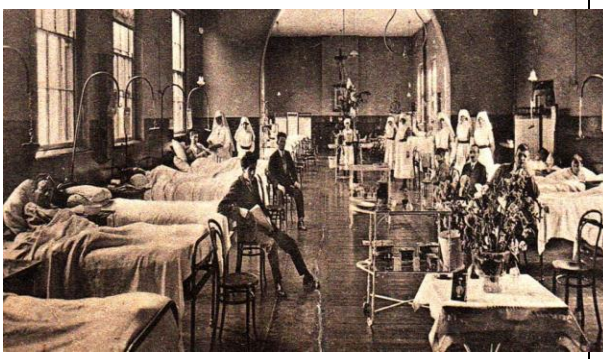
Water; the facts	UCD's Revolutionary Solution
• Is water the oil of the 21st century? As our global population grows, the demand for water increases, but as a result of climate change, energy scarcity and land use decisions, access to good quality water worldwide is diminished. • 41% of the world's population (2.7 billion people) live in areas that are subject to frequent water shortages.56 • It is essential to develop new technologies for supply and treatment of water that protect the environment and are resource efficient. Image: Gasping for Clean Water by Dr. Bas Boots, UCD School of Biosystems Engineering	• UCD spin-out Oxymem, led by Professor Eoin Casey, has developed a revolutionary system for waste-water plants that's up to four times more energy efficient than any other competitor world-wide. • The difference in Oxymem's technology is that they don't rely on a 'bubble' to deliver oxygen to the bacteria that break down the wastewater; instead they use a gas permeable membrane to transfer the oxygen. • Oxymem estimates the overall global market for waste-water treatment technology to be €4 billion at the moment and to grow to €6 billion by 2020.

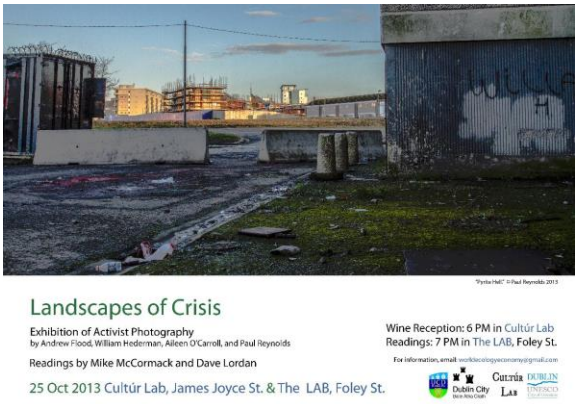
[56] World Resources Institute (2012) *World Water Day Understanding Water Risk (*Pubd Online) http://www.wri.org/blog/world-water-day-understanding-water-risk [accessed 3rd April 2014]

Bats: The Facts	BatLab; unlocking secrets about human health
• One fifth of all living mammals in the world are bats. • A bat can live up to ten times longer than is expected for its body size. • Bats are the only mammal that can fly. • Bats have unique senses such as echolocation i.e. being able to use sound to orient in complete darkness. • Studying a bat's genome can reveal secrets to healthy ageing and the genes involved in inherited diseases of the senses i.e. blindness and deafness. Image: The smallest mammal in the world by Dr. Emma Teeling and Iain Mackie, UCD School of Biology & Environmental Science	• Prof. Emma Teeling established the Laboratory of Molecular Evolution and Mammalian Phylogenetics in 2005 and is the Founding Director of the Centre for Irish Bat Research at University College Dublin (UCD). • One goal of Emma's research is to study unique model species to enable a better understanding of the structure and function of the human genome in order to inform medicine and molecular biology. Teeling investigates what a bat's long lifespan can teach us about healthy ageing and uses bats to understand inherited diseases of the senses such as blindness and deafness. • A second goal of Emma's research is to understand and therefore conserve natural populations and environments to promote ecosystem well-being and functioning. • In 2012, Emma received a prestigious European Research Council Starting Grant of €1.5 million over five years to further her investigations in evolutionary biology.

Corporate Governance; did excessive pride cause the banks to fall?	**Protecting our future…**
• Was the banking crisis of 2008 partly caused by CEO hubris as reported at the time? • Can personality traits of Chief Executive Officers (CEOs) be detected at-a-distance? • Should personality considerations be taken into account in the screening process for potential CEOs? Image: South Sea Bubble by Edward Matthew Ward http://commons.wikimedia.org/wiki/File%3ASouth_Sea_Bubble.jpg	• UCD's Professor Niamh Brennan and Master of Accounting student John Conroy analysed CEO letters to shareholders of a single bank over ten years for evidence of CEO personality traits, including narcissism, hubris and overconfidence. • The research found evidence of hubris in the CEO letters to shareholders, which became more pronounced the longer the CEO served. • Recommendations as a result of this research: • Personality considerations such as ego, sociopathic and psychopathic behaviour need to be taken into account in the screening process for potential CEOs. These symptoms might act as a warning to boards of directors in relation to the character traits they look for when recruiting CEOs. • One year since its publication in February 2013, Brennan's paper[57] had been downloaded from the journal website 859 times.

[57] Brennan, Niamh M. and Conroy, John P. [2013] Executive Hubris: The Case of a Bank CEO, *Accounting, Auditing & Accountability Journal*, 26(2): 172-195.

History and Policy papers bring past issues to current policy debates	History Hub – Connecting Past and Present
***History does not repeat, but it does rhyme* – Mark Twain** • Would an Irish republic exist today if not for the 1916 Easter Rising? • What is the impact of pay-TV on sport? • Why did the Irish health service develop in the way that it did? How did small, local hospitals become so important? And was the policy focus misplaced on hospitals rather than on people's health? • Would the 1950s style of bureaucratic diversity have prevented the 'groupthink' that became characteristic of the Central Bank and Department of Finance before the economic crash of 2008? • Did British policy responses to parades disputes during the 1990s peace process militate against a resolution of disputes which continue today?  Image: Postcard of St. Patrick's Ward, St. Vincent's Hospital by paddykilty.wordpress.com	• History Hub.ie is based at the School of History & Archives in UCD. It hosts and podcasts, digitised archival documents and papers written by historians on current affairs. • Access to the archival material gives people an understanding of the process of history writing. HistoryHub.ie goes further, delivering open access, peer reviewed research by leading historians in a format that is robust, topical, and accessible, thus bringing history to the modern day. • Access to such a wide source of materials (archival documents, policy papers, podcasts, original documentary videos) means history is no longer a 'closed book'. The site offers a unique opportunity to analyse the past and, most importantly, to learn from it. Active citizenship must be informed citizenship. HistoryHub.ie remains central to discourse in Ireland's modern democracy.

Global crisis	At the forefront of environmental humanities
• What is the relationship between mud-slides, poverty, and economic policy in the Philippines? • What impact has the de-regularisation and privatisation of 'natural' commodities such as water and oil had on our world and its environment? • In Ireland, how has the financial crisis and the housing collapse changed our living spaces and surroundings?  Image: Pyrite Hell by Paul Reynolds	• UCD is at the forefront of interdisciplinary research examining the intersections between environmental and economic crisis, and in particular, capitalism's transformations of cultural, environmental, and social landscapes. • Led by Dr Sharae Deckard from the School of English, Drama, and Film, UCD hosted a major academic symposium on 'World-Ecology, World-Economy, World-Literature' in 2013, which considered issues such as food and water security, energy regimes, disasters, and extreme weather. • In partnership with Dublin City Council, Dublin UNESCO City of Literature, and Cultúr Lab, the symposium was accompanied by a number of events open to the general public, including a photographic exhibition entitled 'Landscapes of Crisis', poetry readings, and discussion evenings.

War: The Facts	Ireland's first Centre for War Studies in UCD
• According to the Peace Pledge Union58, in recorded history since 3600 BC, over 14,500 major wars have killed close to four billion people – two-thirds of the current world population. • Since 1495, no 25-year period has been without war. • One out of every two casualties in war is a civilian caught in the crossfire. Image: 'The shell of the G.P.O. on Sackville Street (later O'Connell Street), Dublin in the aftermath of the 1916 Rising'. Source: National Library of Ireland on TheCommons. https://commons.wikimedia.org/wiki/File%3ALife_goes_on..._(6937669789).jpg	• When it comes to war studies, we learn about past atrocities to prevent history repeating itself. Founded in 2008 and led by Professor Robert Gerwarth, the Centre for War Studies in UCD promotes a wide range of international research activities focused on the origins, nature, and consequences of all war-related violence, from ancient times to the present day. • The Centre attracted the first ERC Grant ever in the Humanities in Ireland. It employs research staff from eight different countries and its output is translated into 25 languages.

[58] Peace Pledge Union (2014) Learn Peace: A Peace Pledge Union Project (Pubd Online) http://www.ppu.org.uk/learn/infodocs/st_war_peace.html [accessed 3rd April 2014]

7 Recommendations for Implementing a UCD Research Impact System

UCD faces a fundamental choice when implementing systems and supports for impact. Does it adopt a 'follower' approach and react to the definitions and information requirements for impact as defined by government departments, funding agencies and EU institutions or does it do what leading research intensive universities around the world are doing and concentrate on being 'leaders' in the field by defining what impact means from a university perspective?

The Beyond Publications steering committee firmly believes that UCD should strive to be a leader in the field of impact capture, measurement and communication. This allows for the fullest picture of research impact to be developed and one which is not focused solely on short term measures of impact such as employment and foreign direct investment. This approach means that the university must implement systems to capture additional outputs and indicators of impact retrospectively and prospectively.

7.1 Implementing systems for capturing research impact

Capturing the full range of outputs and outcomes that enable research impact to be shown and managed is a significant task that is being undertaken within many universities and institutions globally. To assist the tracking and collation of impact data, numerous systems are being developed internationally, including Star Metrics in the USA, the ERC (European Research Council) Research Information System, Lattes in Brazil as well as commercially available systems provided by Thomson Reuters, Elsevier, McMillian and their subsidiaries.[59]

7.1.1 Capturing additional outputs

What outputs, indicators, evidence, and impacts need to be captured within systems? There is a great deal of interest in collecting measures and indicators of impact. For example, the Consortia for Advancing

[59] Penfield, T., Baker, M. Scoble, R. and Wykes, M. (. (2012) *Assessment, evaluations, and definitions of research impact: A review*, (Pubd online), <http://rev.oxfordjournals.org/content/early/2013/11/08/reseval.rvt021.abstract> [accessed 12 Mar 2014]

Standards in Research Administration Information (CASRAI), has compiled a data dictionary with the aim of setting the standards for terminology to describe impact.

The 'Beyond Publications' survey of academic staff carried out in June 2013 has indicated that UCD's systems are not capable of capturing a large range of research outputs, as can be seen in Appendix A – Research Impact Survey. Furthermore when the current data captured by the UCD Research Management System is compared to the CASRAI standard dictionary, even more gaps are revealed in our capability to capture research outputs, see Appendix F – CASRAI outputs. **This report recommends that a system capable of capturing the full range of research outputs be implemented.**

7.1.2 Sharing of data

Increasingly, many funding agencies require periodic snapshots of research impact information. Ideally, systems within universities internationally should be able to share data, so that information resulting from collaborations can be accurately stored, direct comparisons between institutions can be made, and data can be easily transferred as researchers move between institutions. A shared language is required to achieve a compatible system. CERIF (Common European Research Information Format) was developed for this specific purpose and released in 1991. A number of projects and systems across Europe are now being developed as CERIF compatible.

As a result, UCD must become the long term owner of its data on research activity and impact, and be able to share these with other partners and stakeholder groups.

7.1.3 Linking inputs to outputs, outcomes and impacts

A system at **UCD needs to be able to capture evidence of the full journey from research to impact and the links between;** knowledge exchange, activities, inputs, outcomes, outputs and interim impacts. This database of evidence needs to establish both where impact can be directly attributed to a piece of research as well as various contributions to impact made during the journey.

Figure 8 demonstrates the information that a UCD system will need to capture and link.

(1) Research findings including outputs (e.g., presentations and publications)

(2) Communications and interactions with stakeholders and the wider public (emails, visits, workshops, media publicity, etc.)

(3) Feedback from stakeholders and communication summaries (e.g., testimonials and altmetrics)

(4) Research developments (based on stakeholder input and discussions)

(5) Outcomes (e.g., commercial and cultural, citations)

(6) Impacts (changes, e.g., behavioural and economic)

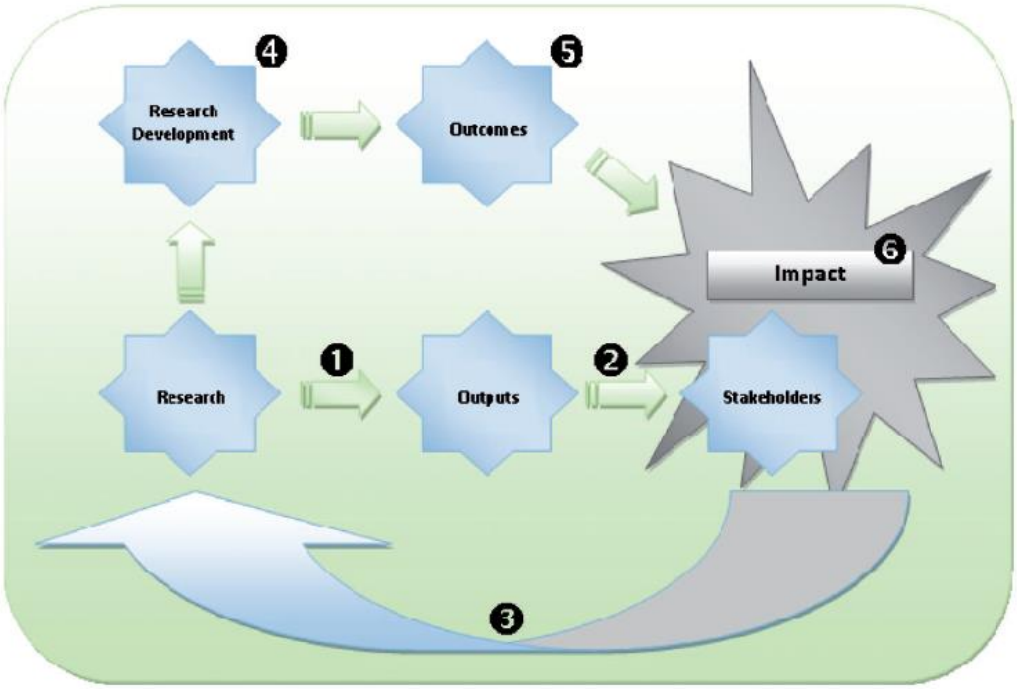


Figure 8 Overview of the types of information that systems need to capture and link[60]

[60] Penfield, T., Baker, M. Scoble, R. and Wykes, M. (. (2012) *Assessment, evaluations, and definitions of research impact: A review*, (Pubd online), <http://rev.oxfordjournals.org/content/early/2013/11/08/reseval.rvt021.abstract> [accessed 12 Mar 2014]

7.1.4 Metrics

Metrics are commonly used as a measure of impact. They can tell you, for example, how many jobs were provided, how much profit was made, how many times a website was visited, how many attended an exhibition etc. While metrics are undoubtedly a powerful form of evidence, they cannot convey the full measure of impact. Where possible, baseline or control data should also be captured, as information about the context of the data may give a valuable insight to the level of impact that has actually occurred.

Although metrics can provide evidence of quantitative changes or impacts resulting from research, they cannot adequately convey the qualitative impacts that take place and hence are not suitable for all of the impact we will encounter. In this case, it is appropriate to incorporate narratives as well as metrics within systems. This is the methodology employed by the Research Outcomes System and Researchfish system, both of which are commonly used by UK research councils to record impacts. **In order to contextualise metrics conveying research impact, UCD requires a system capable of capturing both the metrics themselves and the narratives to provide meaning for the metrics.**

7.1.5 Narratives

The first attempt to capture comprehensively the socio-economic impact of research across all disciplines was undertaken for the Australian Research Quality Framework (RQF), using a case study approach. The RQF pioneered the case study approach to assessing research impact, however, as a result of a government change in 2007, this framework was never implemented in Australia. The framework was subsequently taken up and adapted for the UK REF.

Narratives can be used to describe impact; the use of narratives enables a story to be told and the impact to be placed in context. Often a narrative is written with a reader from a particular stakeholder group in mind, so it will present a view of impact from that specific perspective. Relying on narratives to assess impact poses a risk, as they often lack the evidence required to judge whether the research and impact are accurately linked. Using a combination of narratives and metrics allows a complete, well-rounded picture of impact to be conveyed, again from a particular perspective but with the evidence available to corroborate the claims made. Case studies certainly showcase impact, but can they or should they be used to critically evaluate impact? Table 5 summarises some of the advantages and disadvantages of the case study approach.

Benefits	Considerations
Uses quantitative and qualitative data	Automated collation of evidence is difficult
Allows evidence to be contextualized and a story told	Incorporating perspective can make it difficult to assess critically
Enables assessment in the absence of quantitative data	Time-consuming to prepare and assess
Allows collation of unique datasets	Difficult to compare like with like
Preserves distinctive account or disciplinary perspective	Rewards those who can write well, and/or afford to pay for external input

Table 6 advantages and disadvantages of the case study approach[61]

7.1.6 Surveys and testimonies

One way in which change of opinion and user perceptions can be evidenced is by carrying out surveys or gathering stakeholder and user testimonies.

This might describe support for and development of research with end users, evidence of knowledge exchange, or perhaps a demonstration of change in public opinion as a result of research. It can be time-consuming to gather this type of evidence and also difficult if required retrospectively.

The ability to record and log these types of data is important for enabling the path from research to impact to be established and the development of systems that can capture this would be very valuable.

7.1.7 Citations (outside of academia) and documentation

Citations (outside of academia) and documentation can be used as evidence to demonstrate, for example, the use of research findings in developing new ideas and products. This could include a research citation in a policy document or a reference to a piece of research in a newspaper article. If there are several indicators of impact resulting from one piece of research, this may be enough evidence to justify that it has had an impact, although the causal relationship can be difficult to understand.

[61] Penfield, T., Baker, M. Scoble, R. and Wykes, M. (. (2012) *Assessment, evaluations, and definitions of research impact: A review*, (Pubd online), <http://rev.oxfordjournals.org/content/early/2013/11/08/reseval.rvt021.abstract> [accessed 12 Mar 2014]

Fast-moving developments in the field of altmetrics (or alternative metrics) have provided a better understanding of how research is viewed and used. It is possible to trace and review information that has been transferred electronically, to provide data on where and to whom research findings are going.

7.1.8 Recommendation

The development of tools and systems for assisting with impact capture and evaluation are of the utmost importance. We suggest that developing systems that focus on recording impact information alone will not provide all that is required to link research to the events and impacts that follow. Systems must capture any interactions between researchers, the institution, and external stakeholders and link these with research findings and outputs or interim impacts to provide a network of data.

In designing systems and tools for collating data related to impact, it is important to consider who will populate the database and ensure that the time and capability required for capture of information is taken into consideration. A system with the ability to capture data, interactions, and indicators as they emerge increases the chance of capturing all relevant information and tools required to enable academics to identify the impact of their research. It is important to note that the UK REF only considers impact based on research that has taken place within the institution submitting the case study. It would therefore be in an institution's interest to have a process by which all the necessary information is captured to enable a story to be developed in the absence of a researcher who may have left the employment of the institution.

In summary, UCD requires **an integrated system** that is:

- based on standards such as CERIF and CASRAI to allow for the sharing of comparable research data between collaborating institutions and funding agencies
- capable of capturing the full range of research activities and outputs as defined by the CASRAI standard and as indicated by the 'Beyond Publications' academic survey
- assisting in profiling and communicating research impact and influence
- recording formally defined (syntax and semantics) links between a researcher and their research outputs, outcomes, and impacts
- accommodating the capture and analysis of contextual narratives of research impacts
- able to record and log surveys and testimonies for enabling the path from research to impact to be described

- providing for the integration of new measures of academic publication impact through social media channels , open access, open data and new media analytics such as altmetrics

The overall vision is for the system to enable the automated aggregation, meta-analysis and publishing of selected qualitative and quantitative research impact information in order to enhance UCD's international reputation.

7.2 Implementing support services for researchers

A conceptual service delivery model for impact support services (see Figure 9 below) has been designed around the specific requirements of the researcher. The model provides a tiered support service for the researcher ranging from self-service through to full service fulfilment and advisory services.

This service delivery model is underpinned by a set of design principles:

- The impact support processes should be researcher-centric with a focus on reducing the administrative burden on academic staff;
- The processes should build and develop the research support competencies within central administration and in the college, school and institute structures;
- The processes should be designed to assure quality and standards are defined and met; and
- The processes should be future orientated, with specific attention paid to anticipated developments both within the University and in the sector in general.

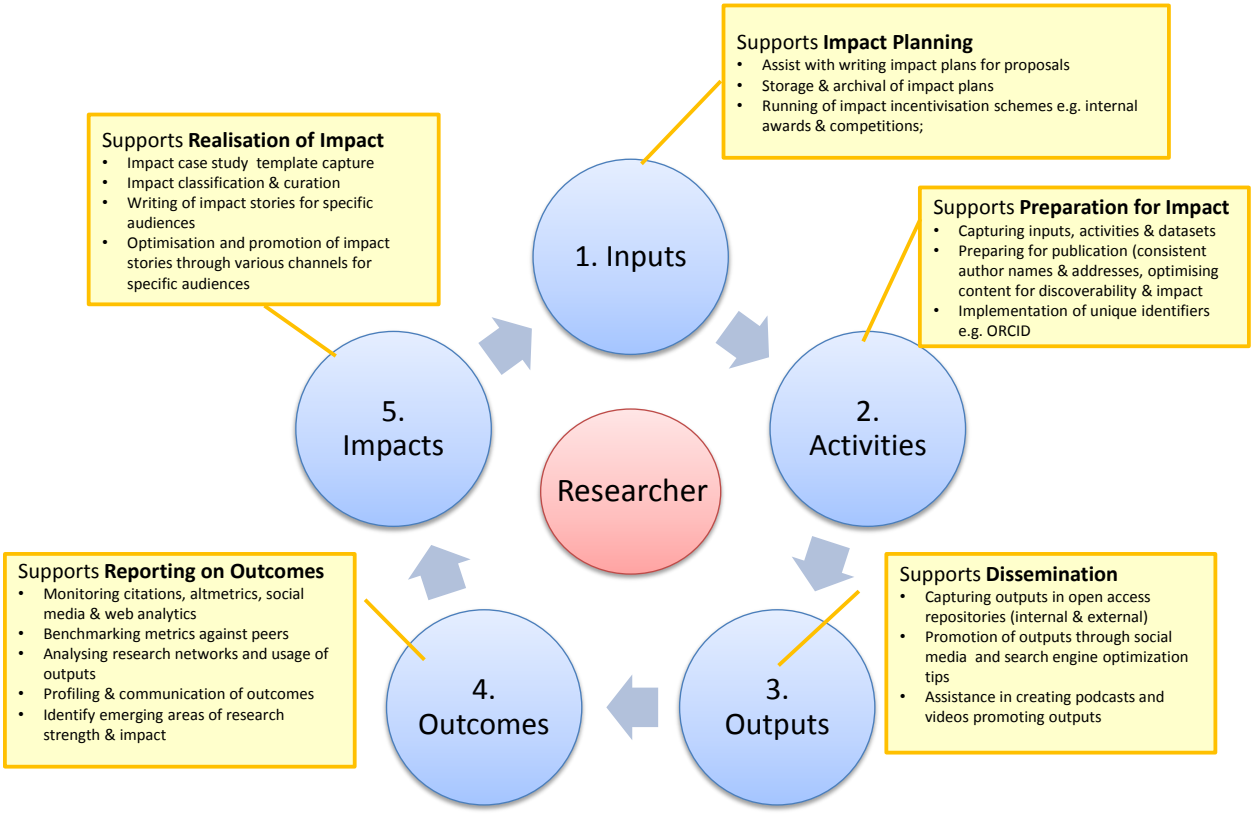


Figure 9 Impact services supporting the research journey

7.3 Implementation milestones and deliverables

The implementation and achievement of the service delivery model and vision will require a phased approach. In developing the roadmap for this change, a Business Maturity Model was used as a framework. The maturity model articulates the capabilities and competencies which an organisation exhibits at various points along a development continuum as illustrated below.

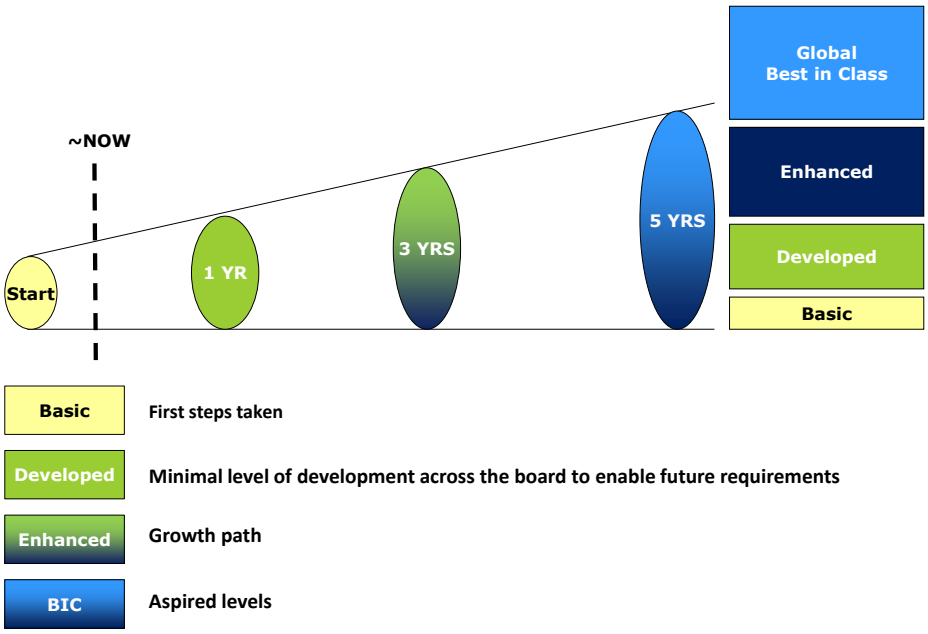


Figure 10 Maturity Model

The checkpoints of 1, 3 and 5 years represent critical points along the proposed development of research services within UCD. At each of the points the service is "maturing" toward a best in class operations. By year 5, a culture of continuous improvement will be embedded in the research impact services organisation such that it maintains its "best in class" maturity level within a dynamic environment.

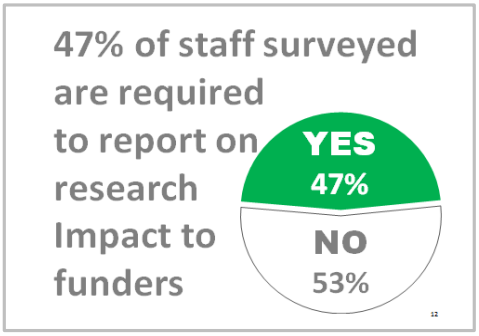
In order to attain the requisite competencies implied at each stage of maturity, the Beyond Publications project team has developed a five-year implementation plan. The plan aims to deliver a "developed" operating model within one year and an "enhanced" model within three years. The key deliverables and milestones for the planned programme are identified in Figure 11.

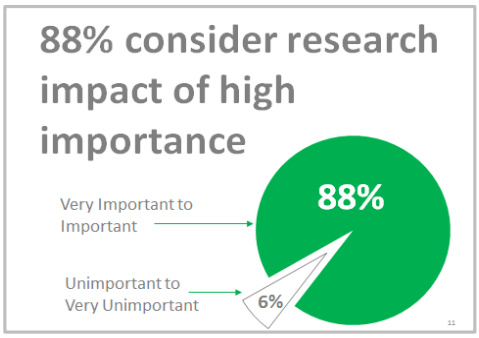
Area	Years 0-1	Years 1-3	Years 3-5
Strategy	▪ UCD Strategic plan complete ▪ Objectives, success criteria & priorities identified		▪ Preparation for next UCD Strategic plan
Process	▪ Policies & procedures documented ▪ **Impact planning** process fully implemented ▪ Initial **Impact preparation** process implemented ▪ Basic **Dissemination** support process in place ▪ **Reporting on outcomes** process in place for academic impact ▪ Baseline measurement is complete	▪ Advanced **Impact preparation** process implemented ▪ Advanced **Dissemination** support process in place ▪ Capturing of additional outputs & activities using international standards e.g. CASRAI ▪ **Impact realisation** process is implemented for Economic and Social Impact ▪ **Reporting on outcomes** impact trajectory & network monitoring in place	▪ Comprehensive corpus of research outputs and impact available ▪ Mature **Impact realisation** process is in place ▪ Knowledge management processes implemented ▪ Report on evaluation of UCD's Impact (Academic, Societal & Economic)
Organisation	▪ Project team in place ▪ Impact support organisation design complete ▪ Impact planning, preparation, dissemination & reporting team mobilised	▪ Full Impact process is implemented across all schools, colleges and institutes ▪ Impact incentivisation schemes in place e.g. internal awards & competitions	▪ UCD is a leader in the realisation and communication of impact ▪ Impact management and organisation embedded
Technology	▪ RMS Systems Review complete ▪ Data quality is improved ▪ Additional reporting tools implemented ▪ Unique personal identifier implemented e.g. ORCID ▪ Impact plans are archived in IR	▪ Impact Management System implemented ▪ Capture mechanisms for additional outputs, impacts and full text publications is vastly increased ▪ Reporting on outcomes is available to individual researchers	▪ Advanced impact reporting tools in place ▪ Collaborative information sharing with partners & funders is common ▪ Integrated research information across the sector

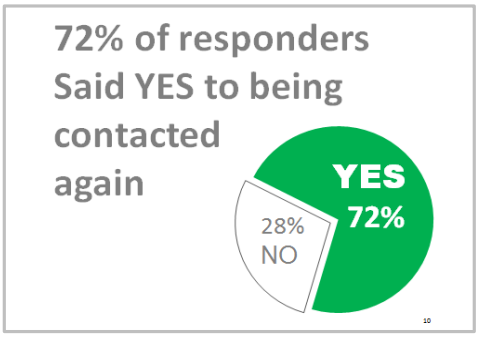
Figure 11 Milestones and deliverables

Appendices

8 Appendix A – Research Impact Survey

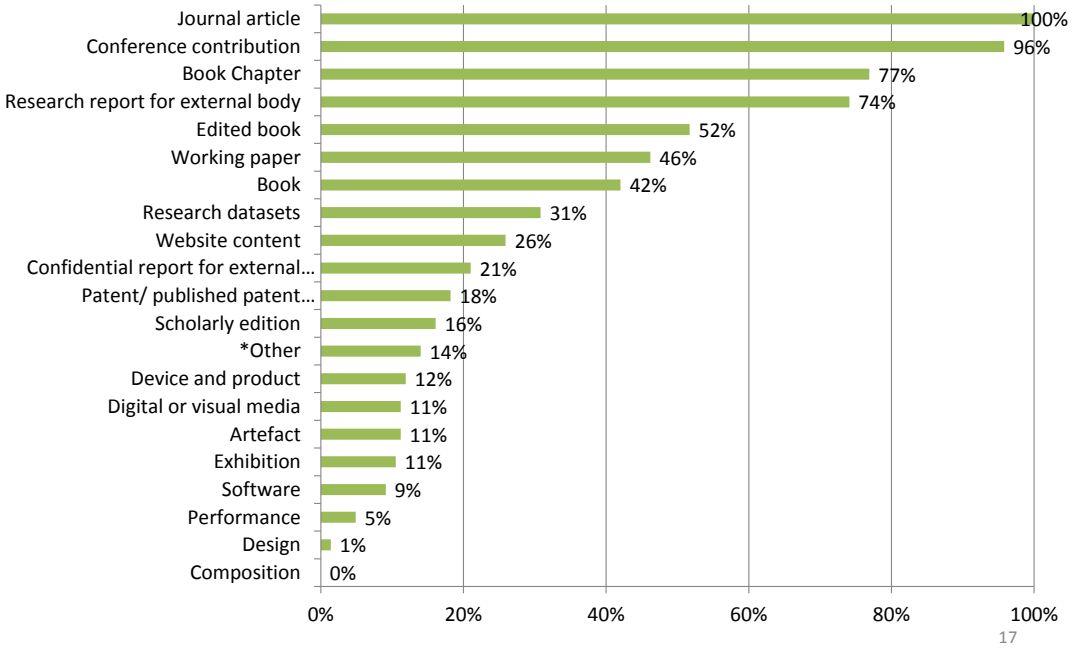






Capture All

Which of the following outputs result from your research activities?



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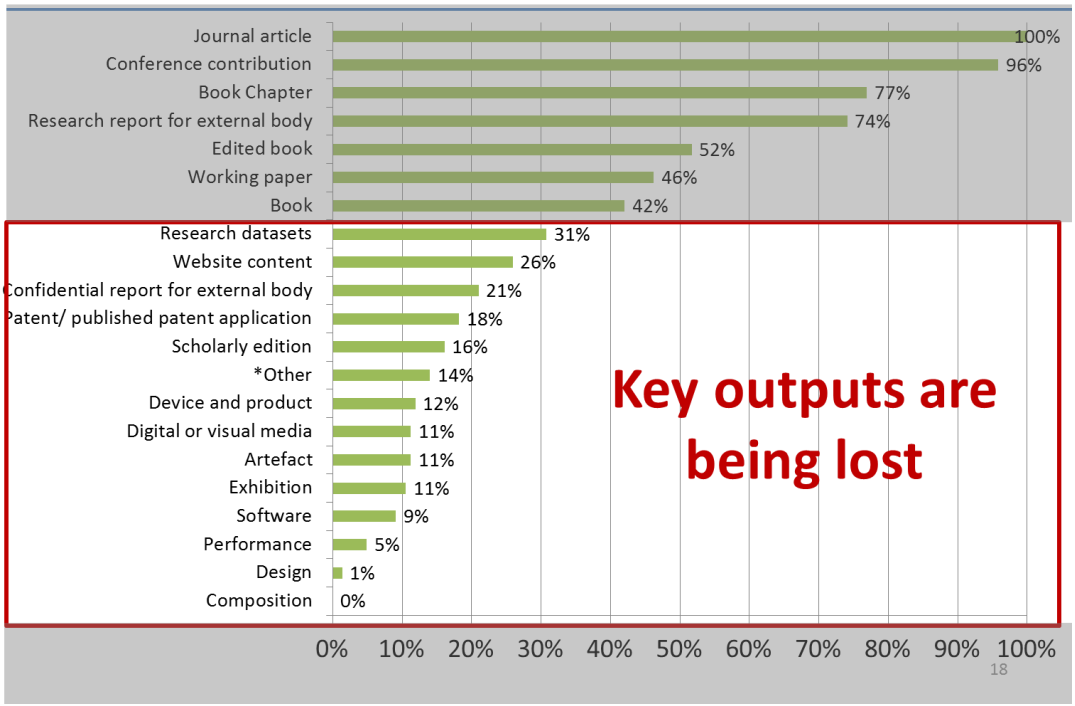

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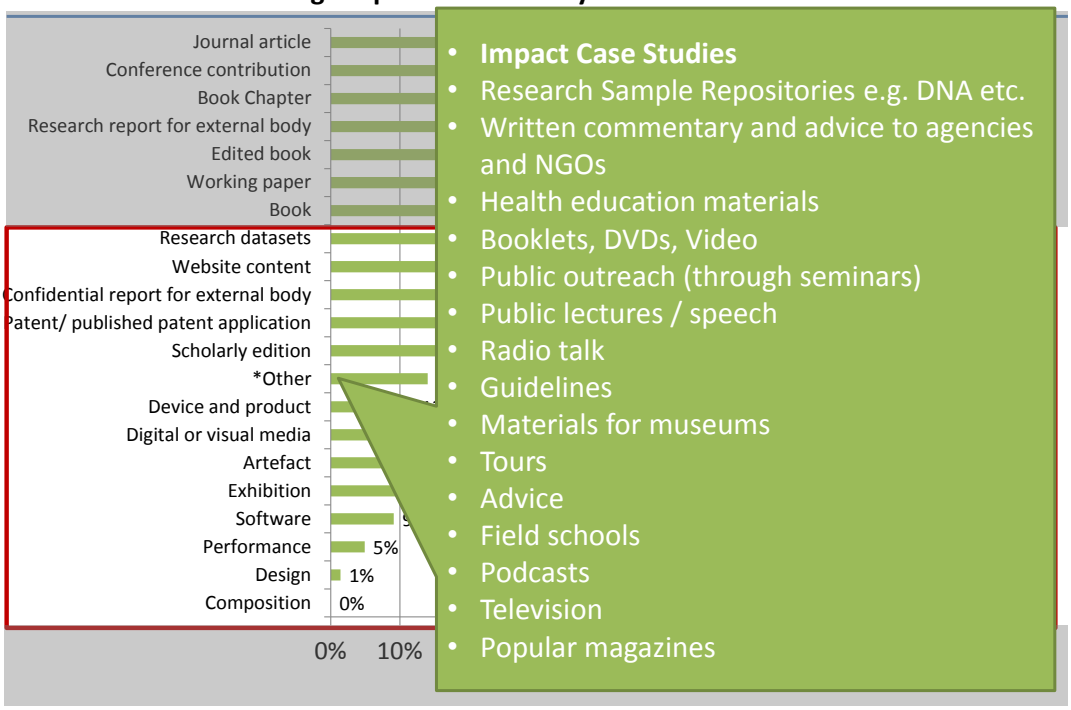


9 Appendix B – Impact Studies – methods and methodological challenges

This appendix is taken from Chapter 3 of "The Challenges of Impact Assessment"[62].

To assess impact of research poses serious methodological challenges and there are at least four crucial problems that have to be taken into consideration:

1) How to attribute the intervention to the observed effects.
2) How to determine counterfactual positions, i.e., would the observed effects have occurred anyway?
3) How to deal with the time lags between research and tangible outcomes, and the multiple stages in-between.
4) Where to focus the assessment, ranging from a research project to research in general.

The answers to these questions have a profound effect on the design and methodology of an impact study.

Attribution

The general idea behind attribution is to link impact to a certain instrument or action (e.g., a research programme). If it can be established that an observed phenomena (e.g., economic growth) is more or less dependent on the instrument or action, we can state that the observation is attributed to the action taken. However, the means of convincingly establishing an attribution may be insufficient, and some paths to impact are more obscure than others. To isolate the role played by a single actor or action, such as a research funder, is consequently cumbersome or more likely virtually impossible.

Thus, from a methodological point of view, it is very difficult to establish attribution. It is also more difficult if the object of analysis is on a macro level, i.e., overall economic impact, general improved health, etc., as there will be a multitude of factors affecting the outcome. Some impacts appear many years, even decades, after the research is carried out. This makes it even more difficult to deal with attribution.

The recommendation is to focus on contribution or the value of the research (Levitt *et al.* 2010, p. xiii), rather than attribution, of a funder, programme or project, i.e., to say that a funder has played a role in the

[62] ESF (2012) *The Challenges of Impact Assessment* (Pubd online) <http://www.dfg.de/download/pdf/dfg_im_profil/evaluation_statistik/programm_evaluation/impact_assessment_wg2.pdf> [Accessed 30 Mar 2014]

impacts of a research project it has funded, rather than determining the exact share of the impact that can be claimed.

There are two reasons to abandon attribution for contribution. Firstly, we know that the outcomes of research are very rarely the consequence of one singular research activity, and whether research transforms into impact is also dependent on factors and actors outside the research sector. Consequently, it is a false way to describe reality. Secondly, from a methodological point of view it is very difficult to attribute outcomes to inputs and it demands a number of assumptions (of which some surely will be over-simplified) (Cox 2010, pp. 10-15).

Research funders who wish to establish what difference their specific funding makes might still be interested in attribution, and rightly so. Attribution, rather than contribution, is also probably a better basis for making future strategic choices. But the urge to establish attribution should not stifle the possibilities of doing impact studies. So to raise attribution as a real obstacle for doing impact assessments is in some way misdirected. To strive for attribution is understandable, but the possibilities of the methods that can be used are limited. To conclude, there is not a clear-cut distinction between attribution and contribution but more of a sliding scale. As far as possible one should try to establish the magnitude of the influence of an action. But, this should not be done at the expense of the rigour of the methodology.

The counterfactual argument

Related to the question of attribution is the challenge of defining an appropriate counterfactual position. To determine the impact of an intervention, one must also estimate what would have happened if the intervention had not taken place, as it may be possible that the outcomes we are tracing might have occurred anyway. Even more difficult is the question of opportunity costs. Would the same resources have provided more impact if they had been invested in another research project or programme (Go8 2011, pp. 6-7)?

To establish a counterfactual position is relatively easily done in a laboratory setting where essential factors influencing the outcome can be held constant. Another way to establish a counterfactual position is to use a randomised controlled trial (RCT), a method often used in medical science. The key feature of a typical RCT is that the study subjects are randomly allocated to different groups, which are distinguished by how they are affected by the intervention or not. Hence, the results will show one (or more) group that is affected by the intervention and another group that is not affected. The differences that can be observed between the two groups can be described as the impact of the intervention.

Generally, methodological discussions on how to establish a counterfactual position are somewhat underdeveloped in impact assessments of research. Ramberg and Knall (2012) do extensively discuss the challenge of establishing a counterfactual position, but from a theoretical perspective. There are very few

examples of elaborating with counterfactual positions in impact assessments, and when assessing impact of research it is practically impossible to establish a counterfactual position based on experiments or quasi-experiments.

What other measures are then appropriate to establish a counterfactual position? There are various techniques available, which it is advisable to combine, to establish a satisfactory counterfactual position.

1) Interviews

One way is to interview researchers who have been financed or in other ways affected by the action or stakeholders who are likely to be affected by the action. They are in a position to judge what difference the action has made. In this way, it is possible to compare those have been exposed to an intervention with the situation before the exposure. However, this is also a source that has its weaknesses. Those who are interviewed may have difficulties remembering and estimating the impacts in an impartial manner.

2) Establish a model of the intervention logic Intervention logic models are often used in impact assessments. In such a model the search for impacts follows a description of how impact is created in an ideal situation. It involves a description of how impacts are thought to materialise. If impacts can be observed that fit into the intervention logic there is a good indication that the action has caused the impacts. A useful model must strike a balance between usefulness and realism. It cannot portray reality fully as that would obscure its purpose. At the same time it needs an adequate realism, otherwise it would be unlikely to produce interesting results. An intervention logic model needs to include expected outputs (or consequences) from research, and an idea of how diffusion of knowledge to society takes place and how actors can make use of the research, and finally the connection between these levels (Molas-Gallart, Tang and Morrow 2000, p. 174)

A much used intervention logical model is the payback framework (see Hanney *et al.* 2004), but there are also other examples (see Academy of Finland 2009, pp. 21–24; Molas-Gallart *et al.* 2000, p. 173). Using intervention logic gives the possibility to investigate if expected impacts do not materialise. And it makes it possible to distinguish if the lack of impact is caused by a flawed logic in how it is thought to be materialised or if there is a problem in the phase of implementation. There is really no contradiction between an intervention logic model and capturing impacts outside the expected logic of impact. In the design of the impact assessment it is advisable, depending on the aim of the study, to include elements where unexpected impacts can be captured.

3) Judgments by experts

Identify different actions (inputs), including others that are of primary interest to the impact assessment, and consequences (that may translate into impacts). Can impact be established or are the

consequences caused by something else? In this process it is possible to have experts to make judgments on what the situation would have been if the intervention had not occurred.

4) Establish control groups

If possible, try to use some form of control group. One way of constructing a control group could be to compare those who have been exposed to an intervention to the typical outcome in a group that has not been exposed to an intervention. This is almost a quasiexperimental design, but not as strict and controlled. It could, for example, be a comparison between researchers who were funded in a certain programme and those who were rejected. There are very few examples of some form of control group being used in impact studies, and it would be interesting to see a wider use of this technique.

Time lags

All studies acknowledge that the contributions of research often occur and manifest themselves over long timescales. The short-term impact of research can, furthermore, differ significantly from the long-term impact from the same research (Go8 2011, p. 4).

When is then a good time to measure impact? For how long should we be trying to identify impacts? There is, of course, no authoritative answer to these questions. On the one hand, there is a need for a sufficiently historic time window to allow impacts to occur. It might take a very long time before broader impacts from research appear, not least from basic research. In many cases it is not possible or even desirable to wait that long to conduct an assessment of impact. As impact evaluations are often intended to serve as a basis for strategic planning, the information may not be useful after a long period and is required immediately. On the other hand, collecting evidence is necessary, and this must be done without losing too much detailed information and data. What is the quality of records, the ability of researchers to recall their activities and stakeholders to remember how practice was influenced in a process that has proceeded for a number of years?

Ideally, an impact study with such a profile is best suited to be conducted alongside this process. But impact studies running for 10-20 years are not very likely, and there would be very few, if any, executed. Furthermore, in many cases, the question most likely to attract interest is what recent investments in research have led to.

How can this situation be dealt with? First of all, there is a need for studies that can be described as longitudinal, and which create a foundation for the future understanding of impact. These studies follow a long time frame and try to capture impacts in the long run as well as in the short run. This kind of study also describes the process from research to impact.

These longitudinal studies have, apart from their own aims, a certain purpose for impact evaluations that are not longitudinal. If you lay out the full process from research to impact you will hopefully notice that there are short-term indicators that are predictive of long-term impact. These early success indicators presuppose that you have detailed information about what causes impact.

The recommendation is to do more research and studies into the processes of how impact occurs. This would hopefully lead to good and solid models and theories of how research gives impact. And, even more hopefully, this could pave the way for finding short-term indicators that are predictive of long-term impact. This would in addition lessen the problem of the time lag, and thereby impact studies may play an even larger part in influencing the strategy of research funding. There is definitely some interesting work being done in this area, for example the SIAMPI model that will be elaborated in the next chapter (see also Canadian Academy of Health Sciences 2009; Luoma *et al.* 2011 for an analysis of indicators).

Another similar way to deal with the time lag is to see the impact in different phases, which will leave room for different approaches to analysing impacts:

a. Potential impact (short-term), for example research on knee surgery that has the potential to be more effective so that people can be rehabilitated faster and use less health care resources.
b. Action towards impact (medium-term), new guidelines on how to perform knee surgery.
c. Impact observed (long-term), operations are carried out according to the new guidelines which lead to benefits for the individual and society.

Micro/macro level

Another challenge in impact assessments is the object of analysis and what conclusions and recommendations that is possible form an impact assessment, and that depends a lot on what level the impact assessment is carried out.

A study from a macro perspective tries to answer the impact of research in general and the impacts of research are on a high level of aggregation, for example, economic wealth. A micro perspective on the other hand takes a specific research project as the point of departure. Of course, there are several approaches between the two extreme positions described above.

The obvious drawback with a macro approach is the difficulty of determining if the consequences observed really are impacts of the action assessed. A correlation is easier to establish with a micro approach, but the drawback of this approach lies in the difficulty of aggregating the results from a micro approach to a general level.

10 Appendix C – Impact study methods – as discussed in the literature

This appendix is taken from Chapter 4 of "The Challenges of Impact Assessment"[63].

Impact assessment methods and methodological challenges will be further discussed in relation to the reviews of the selected accomplished impact studies. As an introduction to these reviews we will in this part present some methodological approaches that have been discussed in studies of impact assessment. It is possible to categorise the methods or models in several ways, for example, on the basis of the type of impact, the level of aggregation (national research funding or specific research programmes), the expected audience for the results, whether the assessment is quantitative or qualitative, etc. Some methods can furthermore be used for different types of impact studies and for different purposes, and many of the more complex models presuppose that various methods are used in combination. This is also the case with most impact assessments. The aim here is to give a brief overview and the different methodological approaches are presented according to a simple grouping, which includes a mix of methods and what could be called impact assessment models.[64]

10.1 Input measures

Input measures do not identify impact but they can give vital information about the kinds of impact one might expect. On a national level the information about the prioritising between basic and applied research, between different research fields, etc., as well as information about the balance between different sources of research funding can serve as indicators. To understand the boundaries for possible impacts in this way can be an important and relevant starting point also for individual research funders.

10.2 Output measures

Output measures can be used to assess research productivity, and they can be seen as a stage in the road from research to impact. The most obvious output measure is publications, but processes or tools used to disseminate research can also be considered as a type of output indicator. Both types will be discussed in the following section.

[63] ESF (2012) *The Challenges of Impact Assessment* (Pubd online) <http://www.dfg.de/download/pdf/dfg_im_profil/evaluation_statistik/programm_evaluation/impact_assessment_wg2.pdf> [Accessed 30 Mar 2014]

[64] For this part a combination of several articles and reports has been used and they are all included in the list of references. Direct references will be given only when we are referring to specific information.

Bibliometrics

Today publications and especially citations tend to be looked upon as indicators of impact rather than merely output measures. Bibliometrics has experienced a rapid and immense development and the methods have become more sophisticated and more commonly used. The use of bibliometrics has, however, also been subjected to severe critique. The critique has highlighted several problematic issues. One shortcoming with these quantitative indicators is that they do not grasp the qualitative aspect of research excellence and although citations say something about the impact one must remember that the citations can be both positive and negative. Another problem is associated with the differences in publishing cultures that disadvantage some disciplines compared to others. In order to overcome this, field sensitive citation indexes have been constructed. Not all are convinced that this will solve the whole problem and in a critical essay on research evaluation, Claire Donovan (2007b, pp. 591-592) raises the question if the novel metrics should not be looked upon as palliatives. Still, bibliometrics seems to serve a certain function in impact assessment, at least for assessing research impact. When it comes to impact in a broader sense, other types of output measures should be used as indicators, which we will discuss next.

Dissemination of research and interaction between science and society

Different ways of disseminating research can be seen as output measures in that they can potentially lead to impact. "These can encompass the use of technology transfer mechanisms such as industry seminars, industry secondments … field days … participation in government committees and policy development processes, participation in industry and academy meetings and seminars, preparing popular publications, research consultancy work …" (Go8 2011, p. 12). In the reports from the impact pilot exercise for the REF 2014 in UK these kinds of indicators are presented as possible instruments that the universities can make use of for assessing impact - defined broadly to include social, economic, cultural, environmental, health and quality of life benefits (REF Pilot a 2009; b 2010; c 2010). Another UK example is discussed in an article by Matthew Kearnes and Matthias Wienroth on the Engineering and Physical Sciences Research Council (EPSRC) and its way of responding to the contemporary policy discourses concerning the impacts of public research funding. In order to supplement the methods of assessing research impact the EPSRC has introduced the notion of "pathways to impact". Kearnes and Wienroth interpret this shift in framing as an "… alternative theorisation of the relationship between research and socio-economic impact in which basic science is cast as 'underpinning' long-term social impacts and an attempt to generate new metrics that can quantify the cumulative and non-linear effects of a broad portfolio of publicly resourced research" (Kearnes and Wienroth 2011, p. 167).

The assessment of the dissemination of research can be seen as a type of formative or process oriented evaluation, in contrast to summative or outcome oriented evaluation. It is important to distinguish between these two types as they serve different purposes and require different methodological approaches. In a strict sense, process oriented evaluations do not measure effects of an intervention (Ramberg and Knall 2012).

The interaction between research and society has been the focus also for the FP7 SIAMPI project (see Spaapen and Van Drooge 2011). The SIAMPI approach is based on the concept of productive interactions as a way of assessing the social impact of research. The model assumes that for social impact to take place there needs to be contact between researchers and non-academic stakeholders. When this contact leads to an effort by the stakeholder to engage with research a productive interaction is considered to have

taken place. When the stakeholder does something new or in a different way based on these productive interactions, research can be said to have had an impact.

Another similar approach is developed in an article on "public value mapping" by Bozeman and Sarewitz.[65] The aim is to "… provide an alternative to 'market failure' thinking that has been so powerful in science policy-making" (Bozeman and Sarewitz 2011). They argue that to assess the capacity of research programmes to achieve (non-economical) social goals we need to map public values. Several methodologies can be used for this purpose, for example, the application of a set of criteria that makes it possible to identify public values failure, i.e., "… when neither the market nor public sector provides goods and services required to achieve public values" (Bozeman and Sarewitz 2011). The model has largely a case-based approach.

10.3 Expert reviews

One way of assessing the impact of research is to obtain information from groups of people that have special insight into the field in question. This form is often used in combination with other methods. The information can be gathered in different ways.

Expert panel

An expert panel with relevant experience can both contribute to estimating what difference research has made and to giving feedback on how possible pathways have been used. As in the case with peer review there are several methodological problems that have to be considered. One specific method using experts that is interesting in impact assessments is the Delphi method. It is a communication technique that uses experts, and the purpose is to get informed predictions. Opinion collection is achieved by conducting a series of surveys using questionnaires. The result of each survey will be presented to the group and the questionnaire used in the next round is built upon the result of the previous round.

Anecdotes

Even if anecdotal evidence cannot be quantified it can help to identify some aspects of research impact. Anecdotes that relate how a certain research project has benefited the society in some way also illustrate the variety of possible impacts.

10.4 Surveys

Stakeholder surveys

As stakeholders by definition represent certain interests, there are shortcomings with surveying to determine impact. However, there are also positive features: "… stakeholders' perceptions of impact and the willingness of a university to work with outside agencies can be valuable … Such surveys can also

[65] The article is published in a special feature issue of Minerva where the other articles present examples of implementation of "public value mapping"

help identify ways of increasing impact by improving linkages, changing perceptions and removing impediments to the flow, exchange and use of knowledge." (Go8 2011, p. 15).

Commercialisation surveys

"… commercialisation surveys normally collect quantitative data relating to matters such as the number of staff devoted to technology transfer, spin-off companies, patents and other IP rights applied for or granted, and licensing income." (Go8 2011, pp. 15-16). Although this kind of survey provides quantitative data, it has to be critically analysed due to different types of biases. "Moreover, commercialisation as measured by surveys provides a very narrow perspective on research impact even in the confined context of achieving impact through business." (Go8 2011. p. 16).

10.5 Case studies

Case study as a concept is defined and used in several ways. Looked upon as a method, case studies in themselves often encompass a combination of different quantitative and qualitative methods. What characterises case studies is the detailed analysis of individual research projects, programmes or individual research institutes, etc. In this way case studies, like some other non-experimental methods, allow for relevant contextual factors in contrast to RCT designs. Case studies have the advantage of giving detailed information in a process oriented manner. That the level of aggregation is low can, however, be a limitation of its usefulness. There is also much to gain especially as case studies often provide us with insights that can help us to develop a better understanding of the process of research impact. In other words a methodology well suited for formative or process oriented evaluation.

A general challenge with case studies is the selection of cases. If the aim of the study is to use the cases (e.g., research projects within a research programme) as representatives for a full research programme, care has to be taken so that the cases really mirror the full programme. But case studies can be used for other aims. For example, if the aim of the impact assessment is to investigate if excellent scientific research has more or less impact than good scientific research, cases should be selected that represent this. And if the aim is to get a better understanding of how research transforms into impact (or not) it is appropriate to select cases that are known to or are expected to generate impact.

In this context the relatively well-known "payback model" could be mentioned. The model is built around case studies, and is a tool to facilitate data collection (surveys, interviews and document studies) and provides a common structure for each case study, and thereby facilitates a cross-case analysis. It was originally designed to capture socioeconomic impact of health services research, but has been adapted and applied in a number of studies outside health and medical research. It consists of two elements. Firstly, there is a model of the research process (from research idea to impact on people and society) indicating when impacts can be expected. Secondly, there are categories of benefits from research in which paybacks or impacts can be classified. They include both benefits associated with the academic world (knowledge production and research capacity) and wider benefits for society. These paybacks exist in somewhat different categories depending on the focus of the impact assessment. In general terms they can be seen as (see Klautzer et al. 2011, compare with Hanney et al. 2004 where the payback categories are directed towards the health sector):

a. Knowledge (explicit and codified knowledge)
b. Impact on future research (capacity building, new methods, career development)
c. Impacts on policy (impact on policy making at national level within professional
d. bodies and organisations)
e. Impacts on practice (individual behaviour)
f. Wider social and economic impacts.

10.6 Hindsight studies

Hindsight studies are a very special type in that they aim to trace the links backwards from the identified impact to the research that contributed to the impact. Although hindsight studies can appear to be less problematic than foresight studies, the critical points – attribution, time frame and the counterfactual argument – are as relevant for these studies too.

10.7 Economic Models

One way to approach the interest in assessing value for money is different types of economic models. Public policy evaluation from an economist's viewpoint is concerned with the goals for public policy and priority settings. The computing power available today and the amount of statistics collected makes it possible to use complex systems modelling in studying the intricate ways in which science has an impact on society. While a regression-based quasi-experimental method is highly attractive for economists, agent-based and network-based models might provide a new and better way to assess and guide research and innovation policies (Ramberg and Knall 2012, pp. 13-16).

Econometric analysis

Econometric analysis is primarily used for assessing impacts of research on a macro level. Advanced numerical analysis techniques based on large amounts of data give information about the overall economic impact that can help justify government funding of research. It does not, however, capture the more intangible impacts of research and it is not applicable for assessing the performance of individual research agencies or research programmes.

Cost-benefit analysis

Cost-benefit analysis is suitable to assess impact from projects and programmes, but can also be used in a broader context. The objective is to compare the costs of investment in research to the estimated economical benefits of the research. There are many methodological challenges with cost-benefit analysis, such as such as the time frame and the attribution problem, and the quality of different studies can vary a lot. There is also the question of what kind of assumptions have to be made in order to define indicators and a model of causality. It is crucial that attention is paid to this kind of methodological challenge as the assumptions that the model is based on will highly influence the conclusions that can be drawn.

11 Appendix D – REF & ERA Summary Table

Summary of REF2014 Data Collection		
Information	**Overview**	**Collection**
Staff Information	REF1a/b/c: Information on staff in post on the census date, 31 October 2013, selected by the institution to be included in the submission.	Online Templates
Research Outputs sub-profile	Publications & Other Outputs All outputs included in a submission that are not sourced by the REF team or uploaded as PDFs to the submission system must be provided as physical outputs for assessment. Physical outputs may be submitted in hardcopy form, in digital or other media on CD, DVD or USB, or as a combination of these.	Online PDF submission or Physical Submission: *Authored book* *Edited book* *Chapter in book* *Scholarly edition* *Journal article* *Conference contribution* *Working paper* *Artefact* *Devices and products* *Exhibition* *Performance* *Patent/ published patent application* *Composition* *Design* *Research report for external body* *Confidential report for external body* *Software* *Website content* *Digital or visual media* *Research datasets and databases*
Research / Impact sub-profile	REF3a/b - approach during the assessment period criteria for assessing impacts are 'reach' and 'significance': In assessing the impact described within a case study, the panel will form an overall view about its 'reach and significance' taken as a whole, rather than assess 'reach and significance' separately. In assessing the impact template (REF3a) the panel will consider the extent to which the unit's approach described in the template is conducive to achieving impacts of 'reach and significance'.	Online PDF submission or Physical Submission Online Templates Case study, impact template (REF3b) Title of case study: 1. Summary of the impact (indicative maximum 100 words) 2. Underpinning research (indicative maximum 500 words) 3. References to the research (indicative maximum of six references) 4. Details of the impact (indicative maximum 750 words) 5. Sources to corroborate the impact (indicative maximum of 10 references)
Research Income & PhDs	REF4a/b/c: Data about research doctoral degrees awarded and research income related to the period 1 August 2008 to 31 July 2013.	Online Templates
Research Environment	REF5: A completed template describing the research environment, related to the period	Online Templates

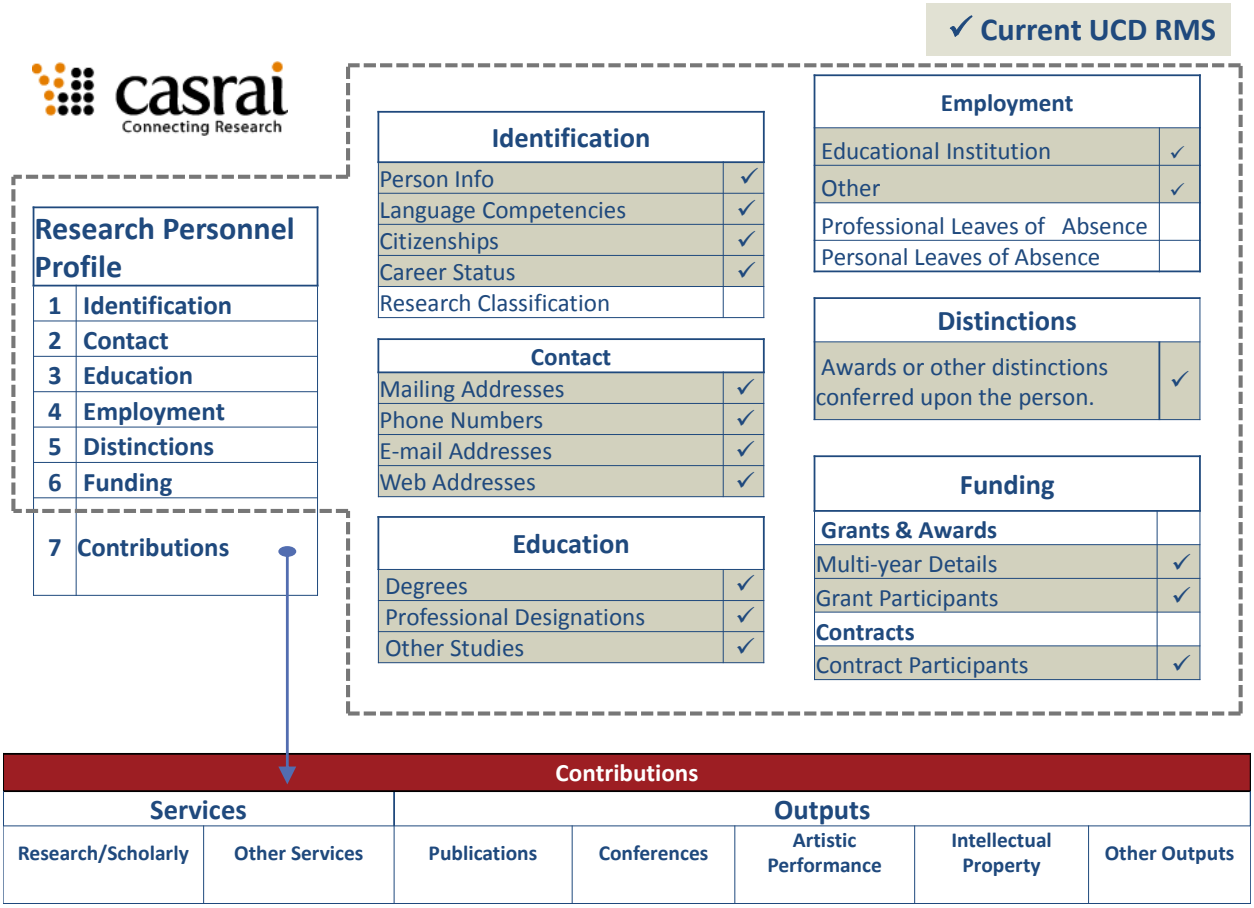
Summary of ERA 2012 Submission Data Collection		
Information	**Overview**	**Collection**
RESEARCHERS	**Eligible Researcher Criteria** basis of determining whether a research output and some applied measures and/or some esteem measures can be included as part of the submission of an institution.	Researcher Data
RESEARCH OUTPUTS	Traditional and Non-Traditional Research Outputs For an institution to submit information on a research output, the research output must meet all of the following criteria: 1. meet the definition of research 2. published or made publicly available within the research outputs reference period 3. have one or more eligible researchers listed as author(s) or creator(s) either within or on that research output; and 4. be an eligible research output type	Online submission or reference to physical site **TRADITIONAL** Books, Authored Research Chapters in Research Book Journal Articles—Refereed, Scholarly Journal Conference Publications Full Paper, Refereed **NON-TRADITIONAL** Research Statement for ERA Peer Review Original Creative Works [Live Performance of Creative Works Recorded/Rendered Creative Works Created or Produced Substantial Public Exhibitions or Events
RESEARCH INCOME	ERA uses research income to produce measures of both research activity and research quality. In order for research income to be submitted, it must: 1. be in an eligible research income category type 2. meet the research income reference period requirements	Australian Competitive Grants Other Public Sector Research Income Industry and Other Research Income Cooperative Research Centre Research Income
APPLIED MEASURES	Institutions must submit information against a range of applied measures. Not all applied measures apply to all disciplines. The ERA 2012 Discipline Matrix specifies which applied measures are applicable.	Plant Breeder's Rights Patents Registered Designs Research Commercialisation Income NHMRC Endorsed Guidelines
ESTEEM MEASURES	ERA includes a number of measures of esteem that constitute recognition of the quality of eligible researchers and indicate that a researcher is held in particularly high regard by peers in their discipline and/or by other well qualified parties.	Editor of a Prestigious Work of Reference Learned Academy Fellowship / AIATSIS Member Nationally Competitive Research Fellowship Membership of a Statutory Committee Australia Council Grant or Fellowship

12 Appendix E – Institutional Review Table

Summary of Institutional Review				
Institution	**World Ranking**	**National System**	**Communication Channels**	**Research & Impact Themes**
Oxford	2	Research Excellence Framework	Impact Case Studies Impact Videos	Business Culture & Public Engagement Environment Health Policy
UCL	17	Research Excellence Framework	Outline examples of impact	Research should have impact beyond academic excellence is explicit in the UCL Research Strategy and embodied in the UCL Grand Challenges. Also Public Policy Strategy UCL Enterprise Public Engagement ,
Cambridge	7	Research Excellence Framework	Thematic Research Case Studies	Strategic Research Initiatives Strategic Research Networks
Liverpool	171	Research Excellence Framework	Impact Case Studies Impact Videos	Changing Cultures Global Health Living with Environmental Change Materials for the Future Personalised Health Security and Conflict Sustainable energy
MIT	5	USA not applicable	Case Studies by sector Case Studies of Public Service Open to All	Industry Public Service
Melbourne	28	Excellence in Research Australia	Research uniquely positioned to respond to major social, economic and environmental challenges. & Public Engagement	The Grand Challenges Understanding our place & purpose Fostering health and well being Supporting sustainability and resilience Arts and culture Business & Industry

				Community Global Engagement
Lund	123	Swedish National Agency for Higher Education Quality evaluation system	Historic achievement case studies Independent review	Innovation and Discoveries
University of Oslo	185	CrisTin Current Research Information System in Norway	Case Studies about Academic Impact does not look at societal or economic impact	Academic Impact - Publications

13 Appendix F– CASRAI Outputs



✓ Current UCD RMS

Contributions						
Services		Outputs				
Research/Scholarly	Other Services	Publications	Conferences	Artistic Performance	Intellectual Property	Other Outputs

Services			
Research/Scholarly		**Other Services**	
Consulting/Advisory	✓	Non-research Presentations	
Expert Witness		Committee Memberships	✓
Journal Reviewing/Refereeing	✓	Offices Held	✓
Conference Reviewing/Refereeing		Event Administration	
Graduate Examinations		Editorial	✓
Grant Application Assessments		Community Service	✓
Promotion/Tenure Assessments		Event Participation	
Mentoring		Membership	✓
Institutional Reviews		Courses Taught	✓
Broadcast Interviews		Courses Developed	
Text Interviews		Programs Developed	
Research-based Degree Supervisions		Course-based Degree Supervisions	✓
		Employee Supervisions	

✓ Current UCD RMS

Contributions						
Services		Outputs				
Research/Scholarly	Other Services	Publications	Conferences	Artistic Performance	Intellectual Property	Other Outputs

Outputs									
Publications		Conferences		Artistic/Performance		Intellectual Property		Other Outputs	
Journal Articles	✓	Conference Papers	✓	Artistic Exhibitions		Patents	✓	Standards and Policies	
Journal Issues		Conference Abstracts	✓	Audio Recording		Licenses	✓	Technical Standards	
Books	✓	Conference Posters	✓	Exhibition Catalogues		Disclosures	✓	Spin Off Companies	
Edited Books	✓			Musical Compositions		Registered Copyrights		Research Techniques	
Book Chapters	✓			Musical Performances		Trademarks		Inventions	
Book Reviews	✓			Radio/TV Programs				Litigation	
Translations	✓			Scripts				Data Sets	
Dissertations	✓			Short Fiction					
Supervised Student Publications				Theatric					
Newspaper Articles	✓			Video Recordings	✓				
Newsletter Articles	✓			Visual Artworks					
Encyclopaedia Entries	✓			Sound Design					
Magazine Articles	✓			Set Design					
Dictionary Entries	✓			Light Design					
Reports	✓			Choreography					
Working Papers	✓			Curatorial/Exhibitions					
Research Tools				Performance Art					
Manuals	✓								
Online Resources									
Tests									
Websites	✓								

14 Appendix G - Impact Case Study Template

	UCD Impact Template
1	**Name:**
2	**Title of case study:**
3	**Images:**
4	**Summary (Indicative Maximum 100 words)** A summary should include a clear concise overview of the case study and avoid too much jargon or scientific language. The reader should be able to clearly see the main 2-5 impacts and get an indication of the significance and reach.
5	**Research Description (Approx. 250 words)** This section can introduce the researchers and provide an outline of the underpinning research. Key contextual information such as timeframe, body of research, research project or programme along with the significance of this research in relation to the impact can be included.
6	**Details of the Impact (Approx. 250 words)** This section provides the narrative explaining clearly the relationship between the research and the impacts mentioned in the summary. It explains the significance and contribution it made to the beneficiaries.
7	**References to the Research** In this section you can include references, web links, grant information, awards, reviews, peer review or other quality assurance processes

15 Appendix H - Sample Impact Case Studies

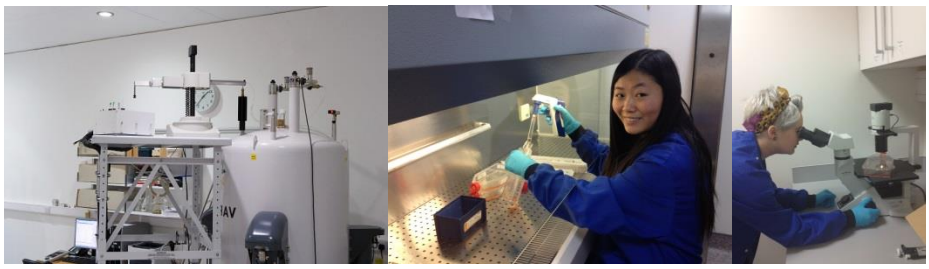
	UCD Impact Template
1	**Name: Professor Jennifer McElwain**
2	**Title of case study:** Flood risk prediction in a high CO_2 world of the future
3	**Images:**
4	**Summary** As carbon dioxide levels in our atmosphere reach their highest concentration ever since the dawn of mankind we look to animals and plants for genetic-signatures of survival that enabled adaptation and evolution in challenging environments. Fossils also offer a unique window into the Earth's past helping us to explore how microorganisms, plants and animals reacted to large-scale climate and atmospheric events and tipping points. This helps us predict how our ecosystems will evolve in response to change and how we can preserve the rich biodiversity of our planet's oceans and terrestrial systems. Jennifer McElwain's SFI and ERC funded research in the School of Biology and Environmental Science has identified the threshold level of greenhouse gas change which resulted in severe ecosystem collapse, species loss and hydrological upheaval in the geological past. This has provided direct insights into when and how natural ecosystems will be negatively impacted by future climate change. Results from the research have been used to raise *public awareness and engagement with major societal issues such as climate change & biodiversity through a TEDx talk, media coverage and* the most importantly through the development of secondary school education material for transition year students http://www.ucd.ie/plantpalaeo/science_for_schools.html. A six-week transition year education course was directly developed from McElwain's ERC funded research on ecosystem response to climate change. Course materials are being downloaded by Irish school and students at a rate of >2000 downloads per month. *This is an example of*

	demonstrated impact of research beyond publications in academic journals.
5	**Research Description (Approx. 250 words)** This section can introduce the researchers and provide an outline of the underpinning research. Key contextual information such as timeframe, body of research, research project or programme along with the significance of this research in relation to the impact can be included. **How will natural ecosystems respond to future global change? Why should we be concerned? These are complex questions which scientists have been grappling with for decades.** Jennifer McElwain in the School of Biology and Environmental Science and UCD Earth Institute Investigator uses plant fossils, historical archives of plants preserved in herbaria and an experimental approach to address how natural ecosystems will respond to future climate change. By tracking the responses of ancient 200 million year old forests to natural global warming events in the geological past, McElwain and her team have established that high concentrations of the greenhouse gas carbon dioxide result in chemical, physical and functional changes in plants in order to survive. Although these apparently simple adaptions were expected, they had unexpected consequences for the cycling of water and for prevalence of fire in these ancient ecosystems. The intensity of fire increased five-fold because leaves adapted to the new hotter climate were more dissected and more dissected leaves burn hotter, faster and release more fire propagating chemicals than less dissected leaves. More water was lost from the land into rivers, lakes and the sea taking valuable nutrients and organic carbon in the run-off. A halving of the number of stomata on leaf surfaces played a direct role in the changes in the hydrological cycle because fewer stomata release less water from plants which ultimately leads to less water be recycled through the vegetation and more being lost from land to sea following a rainfall event. The important implications of this research is that it shows that subtle biological responses to climate change can have a disproportionately large effect on other important processes in the Earth system, such as the hydrological cycle and fire ecology. These unexpected consequences of climate change are elaborated on in a TEDx talk by McElwain http://www.youtube.com/watch?v=E3nn_VSwGoE
6	**Details of the Impact (Approx. 250 words)** This section provides the narrative explaining clearly the relationship between the research and the impacts mentioned in the summary. It explains the significance and contribution it made to

	the beneficiaries. Transition Year six-week course materials: In summer 2013, two teachers, Louise Bailey and Eileen Nertney joined McElwain's research group for a behind the scenes view of plant science research at UCD in order to develop focused teaching materials for Irish Transition Year students. The project was funded as part of McElwain's 1.65 million euro ERC grant OXYEVOL 'Atmospheric Oxygen and Plant Evolution'. Following 4 weeks of intensive exposure and involvement with McElwain's research group at UCD, the teachers developed a six week course aimed at TY students called '*Plants of the Past'*. A dedicated 'Science for Schools' Science for Schools website was launched in October 2013 where all of the materials, data, images and powerpoint presentations needed by teachers to deliver the course was provided. Blogs can also be followed on the websites which highlight the teacher's experience of being embedded in the ERC team at UCD. Website statistics show that the course documents are being visited and/or downloaded on average > 2000 times a month since the website was launched in October 2013. It is hoped that the development of dedicated teaching materials, such as this, will have a significant impact on young people's awareness of major societal issues such as climate change and biodiversity. Academic publications rarely would have such an impact on secondary school students unless covered extensively in the media.
7	**References to the Research** In this section you can include references, web links, grant information, awards, reviews, peer review or other quality assurance processes Science for Schools Transition Year Pack on Climate Change and Plants: https://www.ucd.ie/plantpalaeo/science_for_schools.html McElwain TEDx talk: http://www.youtube.com/watch?v=E3nn_VSwGoE ERC grant website: https://www.ucd.ie/plantpalaeo/oxyevol.html SFI grant website: http://www.ucd.ie/plantpalaeo/flood_risk.html McElwain google scholar page: http://scholar.google.com/citations?user=x1bwH_sAAAAJ&hl=en

	UCD Impact Template
1	**Name:** Professor Aidan Moran
2	**Title of case study: "**Expertise in Sport: An Eye-Tracking Investigation" - see video at http://www.youtube.com/watch?v=1DyHnTk2_to
3	**Images:**
4	**Summary (Indicative Maximum 100 words)** Concentration, or the cognitive ability to focus on the task at hand while ignoring distractions, is vital for expert performance in any field. One way of studying concentration scientifically is through "eye-tracking" or the precise, computerised measurement of certain aspects of people's visual search behaviour (e.g., their "fixation location" - what they look at, and "fixation duration" - how long they gaze at something) as they solve problems in their specialist domain. The purpose of this video is to provide a dynamic illustration of the use of eye-tracking technology to investigate differences in concentration between expert and novice athletes.
5	**Research Description (Approx. 250 words)** Concentration, or the cognitive ability to focus on the task at hand while ignoring distractions, is vital for success in sport (Moran, 2009; 2014a, b, c, d, e, f). One way of studying concentration scientifically is through "eye-tracking" or the precise, computerised measurement of certain aspects of people's visual search behaviour (e.g., their "fixation location" - what they look at, and "fixation duration" - how long they gaze at something) as they solve problems in their specialist domain. Since the 1990s, eye-trackers have been used to explore expert-novice differences in concentration in sport. So far, research shows that expert athletes tend to display more efficient visual search strategies (i.e., they show *fewer* but *longer* visual fixations) than novices. What is not yet clear, however, is how expert athletes in fast-ball sports (e.g., tennis) use early signals ("advance cues") from their opponents' body position and/or limb movements to anticipate the type of delivery, trajectory and likely destination of speeding balls directed at them. Equally, little

	or no research has yet been conducted on the cognitive skill of "green-reading" (i.e., judging the slope of a golf green prior to putting) in expert golfers – despite its vital role for success in elite golf. In an effort to address these gaps in the scientific literature, my research team is investigating expert-novice differences in the visual search strategies of athletes in various sports (e.g., tennis, golf). This research will not only help us to understand how expert athletes achieve their remarkable feats – but will also help to train novice performers in the mental secrets of sporting success.
6	**Details of the Impact (Approx. 250 words)** My video case-study has (a) been viewed over 2,800 times (up to 16 April 2014) since it was uploaded in September 2013; (b) led to numerous invitations to deliver lectures/seminars in Ireland (e.g., Royal Irish Academy's Dublin Talks series: see video at http://www.youtube.com/watch?v=YDFvnaph4_8 and UK and (c) led to offers of collaboration from researchers in the UK and USA – especially since the publication this month (April 2014) of my study on expertise golf-green reading (Campbell & Moran, 2014)
7	**References to the Research** See video at http://www.youtube.com/watch?v=1DyHnTk2_to Campbell, M., & Moran, A. (2014). There's more to green-reading than meets the eye! Exploring the gaze behaviour of expert golfers on a virtual golf putting task. *Cognitive Processing: International Quarterly of Cognitive Science*, doi 10.1007/s10339-014-0608-2 http://link.springer.com/article/10.1007/s10339-014-0608-2 Moran, A. (2009). Cognitive psychology in sport: Progress and prospects. *Psychology of Sport & Exercise*, *10*, 420-426. Moran, A. (2014a). Attention theory. In R. C. Eklund & G. Tenenbaum (Eds.), *Encyclopaedia of sport and exercise psychology* (pp. 39-43). London: SAGE. Moran, A. (2014b). Attention training. In R. C. Eklund & G. Tenenbaum (Eds.), *Encyclopaedia of sport and exercise psychology* (pp. 43-46). London: SAGE. Moran, A. (2014a). Concentration skills. In R. C. Eklund & G. Tenenbaum (Eds.), *Encyclopaedia of sport and exercise psychology* (pp. 161-163). London: SAGE. Moran, A. (2014a). Cue utilization. In R. C. Eklund & G. Tenenbaum (Eds.), *Encyclopaedia of sport and exercise psychology* (pp. 184-185). London: SAGE. Moran, A. (2014a). Situational awareness. In R. C. Eklund & G. Tenenbaum (Eds.), *Encyclopaedia of sport and exercise psychology* (pp. 678-679). London: SAGE.

	UCD Impact Template
1	**Name: Dr Lorraine Brennan**
2	**Title of case study:** Making the link between diet, metabolism and health
3	**Images:** 
4	**Summary (Indicative Maximum 100 words)** What we eat can influence our health. Our current research at UCD is looking into how this happens. Dr Lorraine Brennan is looking at the links between diet and the metabolic pathways that make our bodies work. This work then forms the basis for the delivery of dietary advice that is specific to the individual also known as personalised nutrition. In the long-term such dietary advice tailored to the individual should improve overall health and adherence to dietary recommendations. Additionally this work helps the development of innovative food products that promote health.
5	**Research Description** What we eat can influence our health, but how does that happen at a biochemical level? Dr Lorraine Brennan is investigating this using an approach called metabolomics. Dr Brennan analyses how levels of small molecules called metabolites in the body change under different conditions and with different diets. Using this method, the UCD team have identified patterns of molecules that predict response to dietary interventions and are currently developing a system for delivery of personalised dietary advice. In the long-term such dietary advice tailored to the individual should improve health and adherence to dietary guidelines.

	As part of the EU-funded project Food4me (http://www.food4me.org/) Dr Brennan and colleagues are investigating different approaches to the delivery of personalised nutrition. Separately through the EU-funded project NUTRITECH (http://www.nugo.org/nutritech), Dr Brennan is working with partners in Imperial College London to discover potential biomarkers of dietary intake: identification of new biomarkers of dietary intake can help us study the link between diet and health. As a Principal Investigator with Food for Health Ireland (www.fhi.ie), Dr Brennan is also looking at the potential of functional ingredients from dairy sources to have an impact on metabolic health and in particular how they can be used to help control blood glucose levels.
6	**Details of the Impact** This section provides the narrative explaining clearly the relationship between the research and the impacts mentioned in the summary. It explains the significance and contribution it made to the beneficiaries. Understanding the link between diet and health allows us to develop optimal dietary strategies for individuals. Delivery of dietary advice at the individual level is challenging and the work at UCD has resulted in novel approaches. Using patterns of metabolites we can define the response to dietary interventions or the metabolic health of an individual [1, 2]. Current work is now developing this strategy to deliver dietary advice at the individual level. In the long-term delivery of dietary advice tailored to an individual should promote health. One of the main challenges in assessing the link between diet and health is our poor ability to assess dietary intake. Dr Brennan's team are developing small molecules as markers/biomarkers of dietary intake thereby providing an objective measurement of dietary intake. This work will improve our understanding of the link between diet and health. Further understanding of the link between diet and health will inform the development of disease prevention strategies. Moreover links with the Irish Food Industry through Food for Health Ireland is resulting in the development of innovative food products with health promotion benefits.