

UNIVERSITY OF ABERDEEN
RESEARCH EXCELLENCE FRAMEWORK 2014 (REF2014)

IMPACT WORKSHOP

Tuesday 21 February, IMS, Level 7

To note: this workshop has been designed to look at the assessment of research impact strictly within a REF2014 context. The Workshop is specifically aimed at colleagues who will have direct responsibility for delivering the impact element of each Unit of Assessment's REF2014 submission (including Heads of School, Unit of Assessment leads, deputies, and impact case study authors).

AGENDA

- 1 INTRODUCTION
- 2 IMPACT OVERVIEW - KEY POINTS
- 3 HEFCE IMPACT CASE STUDY TEMPLATE
- 4 IMPACT CASE STUDIES – EXAMPLES OF BEST PRACTICE: Examples of best practice taken from the HEFCE Impact Pilot Exercise for the following Units of Assessment:
 - English Language and Literature (UoA 29)
 - Physics (UoA 9)
 - Public Health, Health Services and Primary Care (UoA 2)
- 5 NEXT STEPS
- 6 Q&A
- 7 For Information: REF2014 Panel Criteria and Working Methods – Examples and Evidence of Impact (by Main Panel)

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01/02/12

REF Impact Workshop

Annex G Impact case study template and guidance¹

1. This annex provides the template for impact case studies, annotated with guidance about the information required in each of its sections. This should be read alongside the definitions and eligibility criteria for impact case studies in Part 3, Section 3 of the main document, and alongside the panel criteria statements. The case study template for use in preparing submissions will be provided in Word, along with templates for REF3a and REF5, on the REF submission system.

2. Each case study should include sufficiently clear and detailed information to enable panels to make judgements based on the information it contains, without making inferences, gathering additional material, following up references or relying on members' prior knowledge. References to other sources of information will be used for verification purposes only, not as a means for panels to gather further information to inform judgements.

3. Each completed case study template will be limited to **four pages** in length (see Annex F). Within the annotated template below, indicative guidance is provided about the expected maximum length limit of each section, but institutions will have flexibility to exceed these so long as the case study as a whole remains no longer than **four pages** and the guidance on formatting at Annex F is adhered to.

Impact case study template (REF3b)

Title of case study:
1. Summary of the impact (indicative maximum 100 words) This section should briefly state what specific impact is being described in the case study.
2. Underpinning research (indicative maximum 500 words) This section should outline the key research insights or findings that underpinned the impact, and provide details of what research was undertaken, when, and by whom. References to specific research outputs that embody the research described in this section, and evidence of its quality, should be provided in the next section. Details of the following should be provided in this section: <ul style="list-style-type: none">• The nature of the research insights or findings which relate to the impact claimed in the case study.

¹ Taken from "Assessment framework and guidance on submissions", REF 02.2011, July 2011
http://www.hefce.ac.uk/research/ref/pubs/2011/02_11/

- An outline of what the underpinning research produced by the submitted unit was (this may relate to one or more research outputs, projects or programmes).
- Dates of when it was carried out.
- Names of the key researchers and what positions they held at the institution at the time of the research (where researchers joined or left the HEI during this time, these dates must also be stated).
- Any relevant key contextual information about this area of research.

3. References to the research (indicative maximum of six references)

This section should provide references to **key** outputs from the research described in the previous section, and evidence about the quality of the research.

Include the following details for each cited output:

- Author(s).
- Title.
- Year of publication.
- Type of output and other relevant details required to identify the output (for example journal title and issue).
- Details to enable the panel to gain access to the output, if required (for example, a DOI or URL), or stating that the output is listed in REF2 or can be supplied by the HEI on request.

All outputs cited in this section must be capable of being made available to panels. If they are not available in the public domain or listed in REF2, the HEI must be able to provide them if requested by the REF team.

Evidence of the quality of the research must also be provided in this section. Guidance on this will be provided in the panel criteria documents. Where panels request details of key research grants or end of grant reports, the following should be provided:

- Who the grant was awarded to.
- The grant title.
- Sponsor.
- Period of the grant (with dates).
- Value of the grant.

4. Details of the impact (indicative maximum 750 words)

This section should provide a narrative, with supporting evidence, to explain:

- how the research underpinned (made a distinct and material contribution to) the impact
- the nature and extent of the impact.

The following should be provided:

- A clear explanation of the process or means through which the research led to, underpinned or made a contribution to the impact (for example, how it was disseminated, how it came to influence users or beneficiaries, or how it came to be exploited, taken up or applied).
- Where the submitted unit's research was part of a wider body of research that contributed to the impact (for example, where there has been research collaboration with other institutions), the case study should specify the particular contribution of the submitted unit's research and acknowledge other key research contributions.
- Details of the beneficiaries – who or what community, constituency or organisation has benefitted, been affected or impacted on.
- Details of the nature of the impact – how they have benefitted, been affected or impacted on.
- Evidence or indicators of the extent of the impact described, as appropriate to the case being made.
- Dates of when these impacts occurred.

5. Sources to corroborate the impact (indicative maximum of 10 references)

This section should list sources external to the submitting HEI that could, if audited, provide corroboration of specific claims made in the case study. Sources provided in this section should not be a substitute for providing clear evidence of impact in section 4; the information in this section will be used for audit purposes only.

This section should list sufficient sources that could, if audited, corroborate key claims made about the impact of the unit's research. These could include, as appropriate to the case study, the following external sources of corroboration (stating which claim each source provides corroboration for):

- Reports, reviews, web links or other documented sources of information in the public domain.
- Confidential reports or documents (if listed, these must be made available by the HEI if audited).
- Individual users/beneficiaries who could be contacted by the REF team to corroborate claims*.
- Factual statements already provided to the HEI by key users/beneficiaries, that corroborate specific claims made in the case study and that could be made available to the REF team by the HEI if audited*.

* Where the sources are individuals who could be contacted or have provided factual statements to the HEI, the submitted case study should state only the organisation (and, if appropriate, the position) of the individuals concerned, and which claim(s) they can corroborate. Their personal details (name, position, contact details) must be entered separately on the REF submission system and not on REF3b. Details of a maximum of five individuals may be entered for each case study; these data will not be published as part of the submission.

REF2014 – IMPACT CASE STUDIES
EXAMPLE OF BEST PRACTICE IN ENGLISH LANGUAGE AND LITERATURE

The following impact case study was released by HEFCE as an example of best practice following the impact case study pilot exercise which took place in 2010.

Public understanding of poetry (Queen Mary, University of London)

1. Short summary of the case study

This case study concerns the public understanding of poetry. Reading and interpreting poetry is one of the core functions of English Studies research. Poetry has very high status in conceptions of literary merit and ambition, and commands large public audiences; and yet it is also recognised as difficult to understand. This is especially noticeable in the public engagement with contemporary poetry. Mediating the complex and rewarding pleasures of poetry to a wide audience is central to QM English's impact on the public understanding of poetry. Research on poetry in the department has developed from scholarly modes of close reading and explication, analysis of poetics, and the print culture of poetry, focusing especially, but not exclusively, on women's poetry. In exploiting this research, the department has encouraged diverse strategies to enhance public understanding of poetry, including broadcast and internet dissemination, publishing ventures, poetry readings, and public archiving of poetry recordings.

2. Underpinning research

The English department at Queen Mary has a well-established reputation for research on poetry in the nineteenth and twentieth centuries, especially on the contexts of literary production, poetics, and women's writing. Researchers in the department have made wide contribution to scholarship in this field, including important monographs, edited collections, scholarly editions and anthologies. The impact-related activities described in the case study use insights from this research, both at the level of analysis and of methodologies for reading, to deepen and extend public engagement with poetry and verse.

Margaret Reynolds has an established international reputation in nineteenth century literature, especially poetry, and the history of women's literature, including her edition of Browning's *Aurora Leigh* (1992), and anthology of *Victorian Women Poets* for Blackwell (1995, with Angela Leighton). Reynolds's more recent research, in her monograph *The Sappho History* (2003) extends this examination of the relationship between women's literary creativity and historical consciousness. Reynolds's research on Victorian women poets was at the forefront of a return to the archive in the 1990s, work that both recovered and evaluated a wide range of women's poetry, broadening scholarly understanding of the contextual print culture and aesthetics of women's poetry in the nineteenth century. Reynolds's research has taken place within the context of further research on Romantic and Victorian women's poetry at Queen Mary by Anne Janowitz (employed at QM from 1999), Paul Hamilton (from 1995), Catherine Maxwell (from 1997).

Brady's research on contemporary poetry examines contemporary experimental poetics in Britain

and America. She has been invited to serve as an expert by the Arts Council, the Poetry Society, and the British Council. Brady's own poetry has been the subject of extensive academic debate and publications. She has performed her poetry in a very wide range of non-academic venues in Britain, Europe and America (for example, the Berlin Poetry Hearings (2007), and a reading tour of the northeast US sponsored by *The Chicago Review*). Brady also supports poetry and poets through the small poetry press Barque (co-founded in 1995), which has published 61 books by 35 poets, 4 CDs, a DVD, and the little magazine *Quid* (554 unique buyers). Brady's work as a practitioner, editor and major critic of contemporary poetry has been mutually informing, both about contemporary poetics and women's writing. The department's contemporary poetry research group has supported further research on modernist and contemporary poetry and poetics by Peter Howarth (since 2008) and Clair Wills (since 1994).

Key researchers:

- (i) Margaret Reynolds: research carried out 1995 to present. 1995-98, Lecturer in English, University of Birmingham; 1998-99: Visiting Fellow, Clare Hall, Cambridge; 1999-2010 Reader in English, QMUL; 2010-present, Professor of English, QMUL.
- (ii) Andrea Brady: research carried out 2002 to present. 2002-2007, Lecturer in English, Brunel University; 2007-present, Lecturer in English, QMUL.

3. References to the research

Key outputs (10)

- Reynolds, Margaret, 'The Child in Poetry', *Proceedings of the British Academy*, 151 (November 2007), pp. 1-52 [peer reviewed].
- Reynolds, Margaret, *The Sappho History* [monograph], (Basingstoke: Palgrave, 2003), 301pp. [peer reviewed].
- Reynolds, Margaret, *Victorian Women Poets: an Anthology*, ed. by Reynolds and Angela Leighton Oxford Blackwell (1995, reprinted 1999). Widely reviewed post publication: see *Review of English Studies*, 48: 190 (1997), 272-273, *Victorian Literature and Culture*, 27 (1999), 601-609.
- Andrea Brady, 'Distraction and Absorption on Second Avenue', in *Frank O'Hara Now: New Essays on the New York Poet*, eds. Will Montgomery and Robert Hampson (Liverpool: Liverpool University Press, 2009).[peer reviewed].
- Andrea Brady, 'The Other Poet: John Wieners, Frank O'Hara, and Charles Olson' in *Don't Ever Get Famous: Essays on New York Writing after the New York School*, ed. Daniel Kane (Illinois State University: Dalkey Archive Press, Dec. 2006) [peer reviewed].
- Andrea Brady, *Vacation of a Lifetime* (Cambridge: Salt, 2001, 130 pp): debated in Tom Jones, 'Andrea Brady's Elections', *Litteraria Pragensia* (December 2007): 139-147; reviewed *Publishers Weekly* (29 Feb 2002).
- Peter Howarth, 'Housman's Dirty Postcards: Poetry, Modernism, and Masochism', *PMLA* 124 (3): (2009), pp. 764-80 [peer reviewed].
- Clair Wills, *Reading Paul Muldoon* (Newcastle-upon-Tyne: Bloodaxe 1999), 222pp. Widely reviewed: *Irish Literary Supplement*, 19:1 (2000), 25; *Contemporary Literature*, 41:2 (2000), 362-4; *Times Literary Supplement* (19 Nov 1999), 20.

Anne Janowitz, *Lyric and Labour in the Romantic Tradition* (Cambridge: Cambridge University Press, 1998) [peer reviewed].

Catherine Maxwell, *The female sublime from Milton to Swinburne: bearing blindness* (Manchester: Manchester University Press, 2001) [peer reviewed].

Justification about the quality of the overall body of research indicated as peer reviewed (pre-publication) or reviewed in academic journals post publication (sample as stated).

Key grants

Archive of the Now: Collaborative Doctoral Award with the Sound Archive at the British Library: for a project on British Poetry in Performance, 1960 to the present. 2008-2011. Value c£50,000.

Archive of the Now: £6500 from the Westfield Trust.

Barque Press: a grant for £12,600 by the Arts Council in June 2005 for the development of its publishing programme as well as to host a series of readings and a poetry festival in Cambridge.

4. The contribution, impact or benefit

Scholars in the English department have exploited their research on poetry and poetics in the Victorian period and twentieth century to enhance the public understanding of poetry, using broadcast media, web-based media, and public events, to disseminate poetry in print and performance, information about poetry, and skills for poetry reading, to a wide public audience.

Reynolds has exploited her research in nineteenth-century poetry as a writer-presenter of 'Adventures in Poetry' on BBC Radio 4 (since 1998). Now in its eleventh series, Reynolds has produced and presented over 44 separate 'Adventures in Poetry' broadcasts, with an audience regularly rated over 750000 listeners (RAJAR). The programmes 'explore the background, effect and lasting appeal' of a poem over 26 minutes, including recitation of the poem, and interpretative commentary by Reynolds and invited guests, exploring moments of insight and difficulty, poetic technique, form and meaning. Reynolds' commentary, derived from insights explored in her research, provides listeners with an interpretative framework for the poem, igniting curiosity through lively and compelling contextual material, and inviting the listener to undertake their own interpretative journey with the poem. The programme is one of BBC Radio 4's flagship programmes in arts programming. Reynolds has also contributed to the *Poet in the City* programme, a charity supported by business (including Lloyd's of London, BT, Pfizer, Pearson and Linklaters), whose aim is to promote 'a love of poetry amongst new audiences by means of live poetry events, and of funding educational work' (Charity No. 1117354). She delivered the British Academy's Warton Lecture in Poetry in 2005, has reviewed contemporary poetry for *The Times* (a daily newspaper), and spoken on poetry at the Ledbury Poetry Festival (2006, 2007).

Brady has an established international reputation for research in contemporary poetry and poetics, and as a poet and poetry publisher (Barque Press). Brady is the founder and director of the 'Archive of the Now' <<http://www.archiveofthenow.org/home.html>>, an on-line repository of recordings of poets performing their own work. Founded in 2006, the Archive presents readings by over 100 British poets, available for download as mp3 files, as well as an extensive collection of printed materials and poets' archives. The archive is distinctive for supporting the experimental

poetic tradition, for being a 'creative commons' site with free access and downloads, and for its commitment to fostering emerging poets. With Howarth (QM), Brady organised a series of public seminars in the City bringing poets and academics into dialogue (2008).

The underpinning scholarly research is fully embedded in the impact-related activities. Reynolds's research on poetry and women writers in the nineteenth century has informed the public outputs of her impact strategy by developing and refining a methodology for the public understanding of poetry. Both public and academic modes of her research employ a consistent approach to poetic practice, examining and exploring questions of form and style, research on context and biography, modes of close reading and explication. It is a practical criticism grounded in excellent and innovative research practice. Brady's research is practice-led, and incorporates both traditional scholarly research and creative inquiry. Her own poems (published in three books of poems, three chapbooks, and over thirty magazines and journals) are based on extensive archival and historical investigations, and make use of late modernist experimental techniques. This practice-led research reflects on contemporary experimental poetics, while her artistic commitment to a radical poetic tradition informs her research. For 'The Archive of the Now' Brady has commissioned and recorded readings (both public and private) by contributing poets.

The institution, as part of its research strategy on the public understanding of the humanities, encouraged the exploitation of the research. QM English has supported Reynolds's research through its sabbatical system and research funding. QM has hosted events in the Poet in the City programme. Reynolds's appointment in 2000 was a 0.5 contract (now 0.75) to support her media and public dissemination interests, and was conceived as a bridge between scholarship and the public domain of culture and literary heritage. Brady's research on poetry has been supported by the institution through its early career research adviser system, through research funding and through its sabbatical leave scheme. The college has hosted, and provided funding, for the QM Poetry Seminar, and hosts the web-site and mp3 archive of the 'Archive of the Now'. The college hosts the Collaborative Doctoral Award (in partnership with the British Library Sound Archive), held by Stephen Willey. More generally, QM English exploits excellent research in the department through the Media Centre and LCACE, a university initiative promoting the exchange of knowledge and expertise with the capital's arts and cultural sectors.

5. References to corroborate the contribution, impact or benefit

Poet in the City: Chief Executive <www.poetinthecity.co.uk/about-us>

Adventures in Poetry: Executive Producer, BBC

'*Archive of the Now*': Curator of Drama and Literature, British Library Sound Archive, London, NW1 2DB;

Creating educational and commercial access to English language resources: the development of corpora for English language teaching and learning (University College London)

1. Short summary of the case study

The Survey of English Usage (SEU) is an English Language research unit based in the English Department at UCL known for its work in the area of corpus linguistics. A linguistic corpus is a collection of written and spoken material, compiled for language research. The SEU houses three corpora: the *Survey of English Usage Corpus*, the *British Component of the International Corpus of English* (ICE-GB), and the *Diachronic Corpus of Present-Day Spoken English* (DCPSE). They contain spoken and written material from a wide variety of sources. ICE-GB and DCPSE are fully *parsed*, which means that every sentence is *grammatically analysed*, and *searchable* with dedicated software.

The research consolidated in the ICE-GB corpus was used to build web resources for grammar teaching and learning, specifically, the *Internet Grammar of English* (IGE; www.ucl.ac.uk/internet-grammar), an introductory web-based grammar designed for learners of English. It contains examples of real English sourced from ICE-GB.

The resource has had an impact in the educational and commercial sectors where it has been used for English language teaching purposes.

2. Underpinning research

The main underpinning research was the work carried out to create the *British Component of the International Corpus of English* (ICE-GB) between 1993 and 1997. (See www.ucl.ac.uk/english-usage/projects/ice-gb) This is a tagged and parsed corpus of contemporary English that is fully searchable with the corpus exploration software ICECUP (*International Corpus of English Corpus Utility Program*) designed and developed at the SEU.

ICE-GB contains 600,000 words of fully parsed (grammatically analysed) spoken English, one of the largest collections currently available globally (see www.ucl.ac.uk/english-usage/projects/ice-gb/compare.htm). For anyone interested in the grammar of the spoken word this corpus is indispensable for data mining.

The research was funded by the ESRC (Grant R000232077), the Leverhulme Trust (F134BG) and the British Sasakawa Foundation. The ESRC also funded the development of the corpus exploration software ICECUP (Grant R000222598). The development of the parser program was funded by the EPSRC (Grant GR/K75033). The Principal Investigators on these projects were Professor Sidney Greenbaum, Dr Mark Huckvale and Sean Wallis.

The research allowed the Survey of English Usage to use the grammatical annotation of spoken and written English to construct the *Internet Grammar of English* and the exercises contained in it.

The *Internet Grammar of English* was developed in a project funded by the Joint Information Systems Committee (JISC; grant reference JTAP 2/247), whose Principal Investigators were

Professor Bas Aarts and Dr Doug Arnold (University of Essex). The researchers working on this project were Dr Gerald Nelson (now Professor of English Linguistics in Hong Kong), and Justin Buckley.

IGE is one of the most recent in a long line of grammars informed by Survey of English Usage corpora, including the *Comprehensive Grammar of the English Language* by Randolph Quirk, Sidney Greenbaum, Geoffrey Leech and Jan Svartvik (1985, based on the Survey Corpus), Sidney Greenbaum's *Oxford English Grammar* (1996, based on ICE-GB), and Bas Aarts's *Oxford Modern English Grammar* (2011; also based on ICE-GB).

3. References to the research

End-of-Award Reports and their assessments for EPSRC project GR/K75033 and ESRC project R000232077.

EPSRC project GR/K75033 (1998) was graded as a 'very significant contribution to the field' with 'good use of resources'.

ESRC project R000232077 was graded by different assessors as 'outstanding' and 'good'.

4. The contribution, impact or benefit

As noted in section 2, the research consolidated in our corpora was used to construct the *Internet Grammar of English*, an online resource for grammar teaching and learning in the shape of an introductory web-based grammar designed for learners of English. It contains examples of real English sourced from ICE-GB. The sections below describe the impact IGE has had outside the academic domain in the educational and commercial sectors.

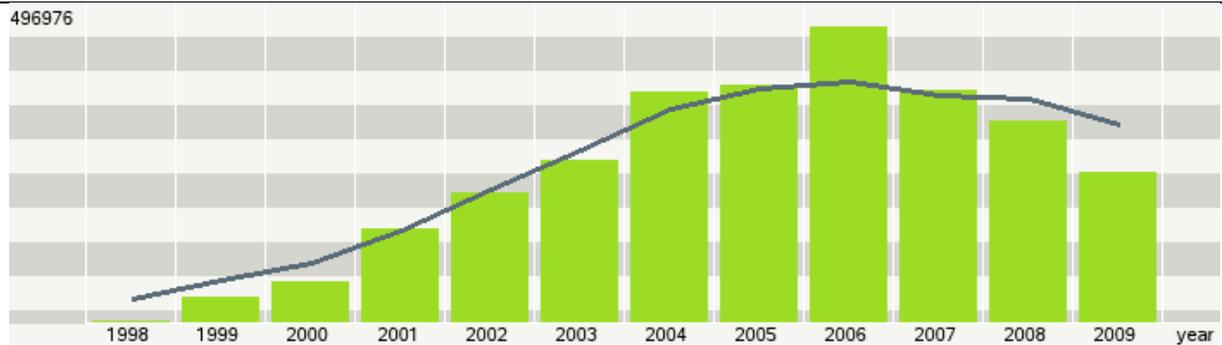
4.1 Non-academic educational impact

There has been a long tradition in language teaching of using artificial, invented examples to illustrate grammatical phenomena to learners (e.g. *The cat sat on the mat/Papa fume une pipe.*). In the past this was a necessity, because no alternative resources were available. However, teachers and learners find the artificiality of these examples a barrier to their ability to get to grips with how grammar applies to real life.

IGE has made an impact on English language teaching and learning by remedying this problem: it makes use of authentic English language examples sourced from the ICE-GB corpus to help learners acquire real English.

We have sold user licences to several Colleges of Education and Sixth Form Colleges in the UK, as well as abroad, e.g. to the *Shaana Religious College* in Israel, the *Institute of Foreign Languages* in Norway, the *Abu Dhabi Men's College*, the *Centre for Educational Technology* in Canada and the *National Institute of Education* in Singapore, as well as to private individuals.

The IGE resource has been used online throughout the world by learners of English, as evidenced by the graph below which tracked access to the website.



The graph clearly shows the greatest impact (measured as the number of page hits) during the years 2005-2007. A peak in impact was measured in 2006 with almost half a million hits. IGE has a global reach and significant user-base, as evidenced by the pie chart shown below.



IGE is recommended on many 'Learning English' websites throughout the world. These include *BBC Skillswise*, *English Teaching in the UK*, *Educyclopedia*, *BUBL English Language Education*, *UsingEnglish.com*, *Intute*, etc.

4.2 Commercial impact

English Language Teaching (ELT) is a huge industry world-wide. Indeed, as Ammon, Dittmar and Klaus (2006) note:

“The English teaching business is now second in importance to the British economy, after North Sea oil.”

It thus represents a huge market internationally, especially in the Far East. Globally, ELT publications and courses sell in their millions and are a major source of income for Britain's commercial publishers. Unlike North Sea oil, the supplies of which are dwindling, the ELT market is continuing to grow.

The Survey of English Usage partakes of this global market by selling commercial licences of IGE to various end users. English Language Schools in the private educational sector are a particularly good example. Several such schools have included IGE in their own web resources. These include a company based in France and another based in the United Arab Emirates. Various companies have also bought the software to teach English to their employees, including the *Commonwealth Academy* (<http://www.commonwealthacademy.org>), the *Institute of Physics Publishing* (<http://www.iop.org>), and the *Afghan eQuality Alliance Teaching and Training Centres* (<http://afghanistan.usaid.gov/en/Activity.74.aspx>).

IGE is also being used as a prototype for a new Knowledge Transfer project funded by the AHRC

at the Survey of English Usage entitled *Creating a Web-Based Platform for English Language Teaching and Learning* (www.ucl.ac.uk/english-usage/projects/grammar-teaching), which started in February 2010.

Sources:

- http://webstats.motigo.com/s?interval=day_peryear&tab=1&link=2&id=275341
- <http://www.bbc.co.uk/skillswise/words/grammar>
- <http://www.english1.org.uk/language.htm>

5. References to corroborate the contribution, impact or benefit

The resources were reviewed in the national and international press.

The *Guardian* wrote: “[T]his excellent site offers a detailed and clear course in English grammar for undergraduates. As well as a glossary and guide to every aspect of grammar, there are simple but effective tests to help reinforce learning, making it of use for TEFL and A-level students as well as teachers”. (<http://education.guardian.co.uk/netclass/tefl/links/0,5607,109745,00.html>)

The *Chicago Tribune* writes: “Brush up on your passive participles and other parts of speech at this cleanly laid out site”. (<http://archives.chicagotribune.com/2007/jan/03/news/chi-0701020248jan03>)

See also:

Latham Skaggs, Bethany (2005) Review of The Internet Grammar of English, *Reference Reviews* 19.8, 32-33. (<http://tiny.cc/Ds033>)

REF2014 – IMPACT CASE STUDIES
EXAMPLE OF BEST PRACTICE IN PHYSICS

The following impact case study was released by HEFCE as an example of best practice following the impact case study pilot exercise which took place in 2010.

Kromek Ltd a spin out company manufacturing large semiconductor crystals for medical and security imaging (Durham University)

1. Short summary of the case study

Research on vapour growth of semiconductor compounds CdTe and (CdZn)Te led to a key breakthrough (now internationally patented) in growing large crystals. This has commercial implications as these form the basis for energy sensitive X-ray detectors and large area substrates for thermal imaging. The process was commercialised by a Departmental spin out company, Kromek Ltd., which now employs over 40 people in a new building opened by Prince Andrew in 2010, and has a current value of just under £50M. The company has incorporated this detector technology into medical imaging products and security systems for screening liquids and gels at airports, providing a route to reduction of current restrictions on carry-on baggage and duty free goods. This application won the \$400,000 prize in the international Global Security Challenge, and the company currently has a \$4M contract to provide large area thermal substrates to the US Defense Threat Reduction Agency.

2. Underpinning research

Professor Brinkman is the leader of a research group in the Durham Physics Department has worked on the growth, characterisation and exploitation of group II-VI compound semiconductors for many years. He has a longstanding interest in CdTe and CdZnTe which form the basis of energy sensitive X-ray detectors, and can also be used as substrates for thermal imaging devices. However, commercial applications of these were limited by problems in growing large crystals. Standard melt growth processes only produce wafers less than 2 inches in diameter, whereas medical imaging applications require larger area detectors. While these can be made by butting several smaller crystals together, this is uneconomic as the cost scales with the number of crystals rather than their size.

Prof Brinkman (in collaboration with Profs Tanner and Durose, also in the Physics Department in Durham) led a BRITE-EURAM grant (1994-1997, with major academic partners including the Universities of Freiburg: Germany, Athens: Greece and Ancona : Italy) to explore and develop methods to improve the growth of CdTe. He realised that vapour growth was not subject to the same size limitations as melt growth processes, but the resulting crystals formed multiple grains rather than a single regular lattice structure. The key breakthrough in growing higher perfection crystals was made by Dr John Mullins, a postdoc working with Prof Brinkman, funded by this grant. He realised that the vapour source and deposition region could be thermally decoupled by using a bent tube rather than a straight one, so that the growing crystal was not heated directly by the source. The first high quality CdTe crystals were grown using this technique in 1997, with results published in a peer reviewed journal in 1999 [1]. A full description of the growth system was

published in 2000 [2]

Research on this technique continued with a further £0.2M grant support from EPSRC (GR/N04287, 2000-2003). The potential of the process became increasingly clear, and development of this into a commercial product was supported by a £0.15M PPARC PIPPS grant (PP/C503470/1, 2005-2006) and £1M from a DTI basic technology award for the HEXITEC consortium via EPSRC (EP/D048737/1 2006-2010). This work [3-9] culminated with the growth by Kromek of the first high perfection and good electrical property wafers of CdZnTe on GaAs in 2007. By 2009 the company had scaled this up the growth of 4 inch diameter crystals.

3. References to the research

All Journals are peer reviewed

[1] **Characterisation of cadmium telluride bulk crystals grown by a novel multi-tube vapour growth technique** *Journal of Crystal Growth* 198/199 (1999) 984, N.M. Aitken, M.D.G. Potter, D.J. Buckley, J.T. Mullins, J. Carles, D.P. Halliday, K. Durose, B.K. Tanner, A.W. Brinkman

[2] **A novel multi-tube vapour growth system and its application to the growth of bulk crystals of cadmium telluride** *Journal of Crystal Growth* 208 (2000) 211, J.T. Mullins, J. Carles, N.M. Aitken, A.W. Brinkman

[3] **Photoluminescence study of a bulk vapour grown CdTe crystal** *Journal of Crystal Growth* 220 (2000) 30, D.P. Halliday, M.D.G. Potter, J.T. Mullins, A.W. Brinkman

[4] **Control of mass transport in the vapour growth of bulk crystals of CdTe and related compounds** *Journal of Crystal Growth, Volume 275, Issues 1-2, 15 February 2005, Pages e543-e547*
B.J. Cantwell, A.W. Brinkman, A. Basu

[5] **Vapor-Phase Growth of Bulk Crystals of Cadmium Telluride and Cadmium Zinc Telluride on Gallium Arsenide Seeds**

J. Electron. Materials 37 (2008) 1460 J.T. Mullins, B.J. Cantwell, A. Basu, Q. Jiang, A. Choubey, A.W. Brinkman, and B.K. Tanner

[6] **Crystal growth of large-diameter bulk CdTe on GaAs wafer seed plates**

Journal of Crystal Growth, Volume 310, Issues 7-9, April 2008, Pages 2058-2061

J.T. Mullins, B.J. Cantwell, A. Basu, Q. Jiang, A. Choubey, A.W. Brinkman

[7] **Close-spaced sublimation growth of homo-and hetero-epitaxial CdTe thick films**

Journal of Crystal Growth, Volume 310, Issues 7-9, April 2008, Pages 1664-1668

Q. Jiang, B.J. Cantwell, J.T. Mullins, A. Basu, A.W. Brinkman

[8] **Hetero-epitaxial crystal growth of CdTe on GaAs substrates**

Journal of Crystal Growth, Volume 310, Issues 7-9, April 2008, Pages 1652-1656

Q. Jiang, J.T. Mullins, J. Toman, T.P. Hase, B.J. Cantwell, G. Lloyd, A. Basu, A.W. Brinkman

[9] **Thick epitaxial CdTe films grown by close space sublimation on Ge substrates**

J. Phys. D: Appl. Phys. 42 No 1 (7 January 2009) 012004 (4pp) Q. Jiang, D. P. Halliday, B. K. Tanner, A. W. Brinkman, B. J. Cantwell, J. T. Mullins and A. Basu

Grants to Prof Brinkman:

EPSRC EP/DO48737/1 £931,012 July 2006 to June 2010. New Materials for High Energy Colour

EPSRC GR/N04287 £177,480 Jan 2000 to Dec 2002. Controlled Vapour Growth of CdTe

PIPPS PP/C503470/1 £152,545 Jan 2005 to Dec 2006. Evaluation of Foreign and Hybrid crystal growth

4. The contribution, impact or benefit

Profs Brinkman and Tanner took the decision to form a spin-out company in order to directly control the exploitation of their new process. They launched this as founder-directors in 2003, with venture capital from Max Robinson, a business angel who was a member of the Durham University technology transfer team, supplemented by a DTI SMART award, for the first commercial crystal growth facility. Their first premises were in the Mountjoy Research Centre, which was then the University business incubator, with two staff, Drs Arnab Basu and Ben Cantwell, both of whom had just completed their PhDs with Prof Brinkman in the Physics Department in Durham.

The company outgrew its original offices and moved to NETPark (North East Technology Park), Sedgefield in 2005. Continued growth necessitated a move to larger premises in NETPark, opened by Prince Andrew in 2010.

The business model was initially focused on the growth of large, high purity CdTe and CdZnTe crystals for sale to other companies which build X-ray & gamma ray detectors or infrared imaging systems. However, the company took a strategic decision to move up the product value chain by fabricating their own X-ray imaging detectors by incorporating ASIC (Application Specific Integrated Circuit) electronics onto the crystals. The potential of these attracted £1M investment in 2005 from Amphion, the UK arm of a US venture capital company interested in high tech start-up companies. Regular calls for venture capital have seen increasing investment, with the most recent round in 2009 raising £12.5M. The company was awarded the ISO2001 manufacturing quality stamp in 2008, and have recently bought Nova R&D, a California based electronics company, in order to directly supply the required ASIC technology.

The three obvious applications for X-ray imaging are medical, space and security. Kromek currently has contracts to develop pixellated detectors for medical applications with a blue-chip company, and with ESA for space based detectors. However, new requirements for security presented a clear opportunity, and with support from the UK Home Office and its investors, the company took a strategic decision to incorporate its materials into X-ray systems for liquid explosive detection. In 2008 they launched a bottle scanner which can deal with individual containers. The system, presently under trial at airports around the world, will have a direct impact on all airline passengers as it will remove, or at least reduce, the restrictions on carriage of liquids through airport security screens. The liquid scanning system, which readily distinguishes *Coca-Cola* from *Pepsi*, also has proven applications for detection of narcotics dissolved in liquids in checked luggage and has been sold to Middle-East airports for alcohol detection. The company went from winning regional awards in 2007 (Business Link North East Business award, Business Innovation Centre), to national competitions in 2008 (IET Innovation award), and European success in 2009 (Western Europe Global Security Challenge for Best Security SME). This series culminated in winning the \$400,000 Global Security Challenge in 2009 for Best Security SME, while the CEO, Dr Arnab Basu won the 2009 Ernst and Young title of Young Entrepreneur of the Year.

An alternative use of the large area crystals is as substrates for thermal imaging, with applications in security, especially night vision equipment, surveillance and smart munitions. The US Defense Threat Reduction Agency has placed a \$4M contract with the company to develop even larger CdZnTe crystals to increase the area of the focal plane in these devices.

Since the original company spun-out, there has been a continuing strong research collaboration between the University with the company. The two founder-directors, Profs A.W. Brinkman and B.K. Tanner, who are members of staff of the Durham Physics Department, continue to sit on the board. Prof. Tanner is the Deputy Chairman of the company. The company has directly supported 2 PhD students, as well as staff time buyout for Prof Brinkman. A former CASE student in the group, Paul Scott, is now employed by Kromek.

5. References to corroborate the contribution, impact or benefit

Global Security Challenge http://www.globalsecuritychallenge.com/page_display.php?p=6&id=55

Ernst and Young UK Young Entrepreneur of the Year 2009 http://www.ey.com/UK/en/About-us/Entrepreneur-Of-The-Year/_EOY---Alumni-videos-2009-Arnab-Basu

Company web site

<http://www.kromek.com/>

Newcastle airport trials

<http://news.bbc.co.uk/1/hi/uk/8244150.stm>

Institution of Engineering and Technology awards 2008

http://www.kromek.com/downloads/news/IETAwards_Pg6-IETAwardsNov08.pdf

Prince Andrew opening Kromek building http://www.kromek.com/news_archive.asp?Year=2010

Daily Telegraph article Sept 2010

http://www.kromek.com/downloads/news/TheTelegraph-X-rayvisionaryfindsthebottletoglobal_2_9_2010.jpg

REF2014 – IMPACT CASE STUDIES
EXAMPLE OF BEST PRACTICE IN CLINICAL MEDICINE

The following impact case study was released by HEFCE as an example of best practice following the impact case study pilot exercise which took place in 2010.

Title of case study: Smoke-free legislation and hospitalisations for Acute Coronary Syndrome (ACS) (University of Glasgow)

1. Short summary of the case study

This University of Glasgow led study provided the most robust evidence that smoke-free legislation has a significant impact on heart disease. Professor Pell's research has raised public awareness of smoke-free legislation and the benefits it brings to smokers and non-smokers.

The research has influenced public policy debate both in the UK and internationally. It provided scientific evidence endorsing Scotland's decision to put the smoking ban in place and it has informed the evaluation of the subsequent English legislation.

2. Underpinning research

Professor Pell's research was a multi-centre study, led by the University of Glasgow and undertaken between 2005 and 2008. It was part of a national evaluation of the impact of Scotland's smoke-free legislation funded by NHS Scotland.

Professor Pell held three positions over the period the study was conducted. Professor Pell started the study as an NHS consultant with an honorary University of Glasgow contract, then continued as Chair in the British Heart Foundation Centre and finished the study and wrote it up as the Henry Mechan Professor of Public Health at the University of Glasgow.

Key academics co-investigators involved in the research include: Professor Stuart Cobbe, University of Glasgow; Professor Dave Newby, University of Edinburgh; and Professor Stuart Pringle, University of Dundee.

Previous studies have suggested a reduction in the total number of hospital admissions for acute coronary syndrome after the enactment of legislation banning smoking in public places. However, it was unknown whether the reduction in admissions involved non-smokers, smokers, or both. This was also the first study to have collected data prospectively using a standardised case definition (see reference 2, section 3).

Since the end of March 2006, smoking has been prohibited by law in all enclosed public places throughout Scotland. Professor Pell's research team collected information prospectively on smoking status and exposure to second-hand smoke based on questionnaires and biochemical findings from all patients admitted with acute coronary syndrome to nine Scottish hospitals during the 10-month period preceding the passage of the legislation and during the same period the next year. These hospitals accounted for 64% of admissions for acute coronary syndrome in Scotland,

which has a population of 5.1 million.

Overall, the number of admissions for acute coronary syndrome decreased from 3235 to 2684--a 17% reduction (95% confidence interval, 16 to 18)--as compared with a 4% reduction in England (which has no such legislation) during the same period and a mean annual decrease of 3% (maximum decrease, 9%) in Scotland during the decade preceding the study. The reduction in the number of admissions was not due to an increase in the number of deaths of patients with acute coronary syndrome who were not admitted to the hospital; this latter number decreased by 6%. There was a 14% reduction in the number of admissions for acute coronary syndrome among smokers, a 19% reduction among former smokers, and a 21% reduction among persons who had never smoked. Persons who had never smoked reported a decrease in the weekly duration of exposure to second-hand smoke ($P < 0.001$ by the chi-square test for trend) that was confirmed by a decrease in their geometric mean concentration of serum cotinine from 0.68 to 0.56ng per millilitre ($P < 0.001$ by the t-test).

The number of admissions for acute coronary syndrome decreased after the implementation of smoke-free legislation. A total of 67% of the decrease involved non-smokers. However, fewer admissions among smokers also contributed to the overall reduction.

The nine hospitals used in the study account for 63% of all Scottish admissions for heart attack.

3. References to the research

Publications/references:

Professor Pell's work was published in the New England Journal of Medicine (impact factor 50.0) and received 31 citations in the first year since publication.

1. Pell JP, Haw S, Cobbe S, et al. [Smoke-free legislation and hospitalizations for acute coronary syndrome](#). New England Journal of Medicine 2008; 359: 482-91 – **Peer-reviewed Voted the top paper of 2008 by the American Heart Association**
2. Pell JP, Haw SJ, Cobbe SM, et al. [Validity of self-reported smoking status: comparison of patients admitted to hospital with acute coronary syndrome and the general population](#). Nicotine and Tobacco Research 2008; 10(5): 861-6 – **Peer-reviewed**
3. Pell JP, Haw S. [The triumph of national smoke-free legislation](#). Heart 2009; 95(17): 1377-9. doi 10.1136/hrt.2009.176230 (Featured Editorial) – **Peer-reviewed**
4. Pell JP, Haw S, Cobbe S, et al. [Secondhand smoke exposure and survival following acute coronary syndrome: prospective cohort study of 1261 consecutive admissions among never-smokers](#). Heart 2009; 95: 1415-1418; doi 10.1136/hrt.2009.171702 – **Peer-reviewed**

Other references:

1. Listed in the Faculty of 1000 most important scientific discoveries
<http://www.f1000medicine.com/article/fc5mj6jdz4wzr8c/id/1119839>
2. Voted by the American Heart Association and American Stroke Association to be the most important research advance of 2008
<http://www.americanheart.org/downloadable/heart/1237914748043Top10ResearchAdvances-08-1page.pdf>

Grant funding:

NHS Health Scotland. Pell JP, Cobbe SM, Fischbacher C, Newby DE, Pell ACH, Dunn F, Murdoch D, MacIntyre P, Oldroyd K, Pringle S, Gilbert T. StOPIT: Study of public place intervention on tobacco exposure. 2005-2008, £545,387

4. The contribution, impact or benefit

This University of Glasgow led study provided the most robust evidence that smoke-free legislation has a significant impact on heart disease. The seminal work by Professor Jill Pell was voted the most important research advance of 2008 by the American Heart Association and is listed in the Faculty of 1000 most important scientific discoveries (ref. 2 and 3).

The pan-Scotland study, led by the University of Glasgow, found a 17% fall in admissions for heart attacks in the first year after the smoking ban came into force in Scotland. This compares with an annual reduction in Scottish admissions for heart attack of 3% per year in the decade before the ban and only a 4% decrease in England, where there was no such legislation. The study was unique in that it was able to demonstrate for the first time that smoke-free legislation was effective in protecting non-smokers specifically from the effects of passive smoking.

One of the primary aims of smoke-free legislation is to protect non-smokers from the effects of passive smoking. This study showed that, amongst non-smokers, there was a 20% reduction in heart attack admissions, confirming that the legislation has been effective in helping non-smokers. The decrease in Scotland was highest in never-smokers, but there was also a smaller decrease in former smokers. Smokers also saw a 14% decline. Of the decrease in hospital admissions, 67% were non-smokers, supporting the argument that protection for these individuals is an important benefit of this legislation, and it should be extended more broadly.

Professor Pell's research has raised public awareness of smoke-free legislation and the benefits it brings to smokers and non-smokers. The results of the research have had extensive International media coverage throughout 2008, appearing in national and international newspapers, radio and the internet. Stand out examples include articles in The Wall Street Journal, Time Magazine and the Today Programme on Radio 4.

The research has influenced public policy debate both in the UK and internationally. It provided scientific evidence endorsing Scotland's decision to put the smoking ban in place. It has informed the evaluation of the subsequent English legislation. Furthermore, Professor Pell has shared her findings with policy makers in numerous countries in which legislation was being considered or had recently been introduced, including India, Sweden, Spain and Greece.

5. References to corroborate the contribution, impact or benefit**Media coverage:**

Professor Pell's research was given extensive international media and press coverage, including [Wall Street Journal](#), Time Magazine, [Today Programme \(10th September\)](#), [BBC News Website](#) and British broadsheets including:

[The Times](#)

[The Guardian](#)

Named contact:

Contact details of the individual who led the study which informed the English legislation were provided for corroboration purposes.

Resulted in numerous invitations to present the results in other countries including:

Stockholm - Europevent - 9 May 2009

Barcelona - European Society of Cardiology - 30 August 2009

Athens - 12th International Symposium on Atherosclerosis and Related Risk Factors - 15 November 2008

Mumbai - 14th World Conference on Tobacco and Health - 12 March 2009

More details about the research can be found at:

<http://www.healthscotland.com/scotlands-health/evidence/smokefreelegislation/publications.aspx#stopit>

The Scottish Government Website:

<http://www.scotland.gov.uk/News/Releases/2007/09/10081400>

UNIVERSITY OF ABERDEEN
REF2014 – IMPACT WORKSHOP

KEY POINTS TO NOTE WHEN PREPARING CASE STUDIES

Suggested questions to help clarify 'impact':

Impact Case Study authors should give careful consideration to the following questions when preparing an impact case study.

- What user groups' outwith academia did you work with?
- What was the purpose of the 'interaction'?
- What has been the effect on the users/audience?
- Did it change something for them?
- How did they benefit from the 'interaction'?
- How did your contribution effect the impact/benefit?

Mistakes to avoid:

Case study authors should take care to avoid making the following mistakes when preparing their impact case studies

- Making generalised, vague claims
- Providing excessive publication lists or web references
- Lack of coherence
- Claiming **potential** impact
- Providing a lack of necessary information

UNIVERSITY OF ABERDEEN

RESEARCH EXCELLENCE FRAMEWORK 2014

EXAMPLES OF IMPACT BY PANEL

REF2014 PANEL CRITERIA AND WORKING METHODS

This paper provides examples of impact and evidence of impact, by each Main Panel, as provided in the final REF2014 Panel Criteria and Working Methods documentation (full document available via the HEFCE website at the following link: (http://www.hefce.ac.uk/research/ref/pubs/2012/01_12/))

MAIN PANEL A: Examples of Impact

<p>Impacts on health and welfare: Impacts where the beneficiaries are individuals and groups (both human and animals) whose quality of life has been enhanced (or potential harm mitigated)</p>	<ul style="list-style-type: none">• Outcomes for patients or related groups have improved.• Public health and well-being has improved.• A new clinical or lifestyle intervention (for example, drug, diet, treatment or therapy) has been developed, trialled with patients, related or other groups (for example, prisoners, community samples), and definitive (positive or negative) outcome demonstrated.• A new diagnostic or clinical technology has been adopted.• Disease prevention or markers of health have been enhanced by research.• Animal health and welfare has been enhanced by research.• Care and educational practices have changed.• Clinical, dietary or healthcare guidelines have changed.• Healthcare training guidelines have changed.• Decisions by a health service or regulatory authority have been informed by research.• Public awareness of a health risk or benefit has been raised.• Public engagement/involvement in research has improved.• Public behaviour has changed.• The user experience has improved.• Animal health and welfare has been enhanced by research.• The control of diseases has changed.
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<p>Impacts on society, culture and creativity: Impacts where the beneficiaries are individuals, groups of individuals, organisations or communities whose knowledge, behaviours or practices have been influenced</p>	<ul style="list-style-type: none"> • Public understanding has improved. • Public debate has been stimulated or informed by research. • Changes to social policy have been informed by research. • Changes to social policy have led to improved social welfare, equality or social inclusion.
<p>Impacts on the economy: Impacts where the beneficiaries are usually the NHS, private health care, or agriculture</p>	<ul style="list-style-type: none"> • Policies have been introduced which have had an impact on economic growth or incentivising productivity. • The costs of treatment or healthcare have changed as a result of research-led changes in practice. • Gains in productivity have been realised as a result of research-led changes in practice. • The roles and/or incentives for health professionals and organisations have changed, resulting in improved service delivery.
<p>Impacts on commerce: Impacts where the beneficiaries are usually companies, either new or established, or other types of organisation which undertake activity that creates wealth</p>	<ul style="list-style-type: none"> • A spin-out or new business has been created and established its viability by generating revenue or profits. • Industry (including overseas industry) has invested in research and development. • The performance of an existing business has been improved. • A business or sector has adopted a new technology or process. • The strategy, operations or management practices of a business have changed. • A new product or service is in production or has been commercialised. • Highly skilled people have taken up specialist roles (including academic consultancy) in companies or other organisations. • Jobs have been created or protected. • Social enterprise initiatives have been created.

<p>Impacts on public policy and services: Impacts where the beneficiaries are usually government, public sector, and charity organisations and societies, either as a whole or groups of individuals in society, through the implementation of policies</p>	<ul style="list-style-type: none"> • Policy debate has been stimulated or moved forward by research evidence. • Policy decisions or changes to legislation, regulations or guidelines have been informed by research evidence. • The implementation of a policy (for example, health, environment or agricultural policy) or the delivery of a public service has changed. • A new technology or process has been adopted. • The quality, accessibility, acceptability or cost-effectiveness of a public service has been improved. • The public has benefitted from public service improvements. • Control measures for infections have improved.
<p>Impacts on production: Impacts where the beneficiaries are individuals (including groups of individuals) whose production has been enhanced</p>	<ul style="list-style-type: none"> • Production, yields or quality have increased or level of waste has been reduced. • Decisions by regulatory authorities have been influenced by research. • Costs of production, including food, have been reduced. • Husbandry methods have changed. • Management practices in production businesses have changed.
<p>Impacts on practitioners and services: Impacts where beneficiaries are organisations or individuals, including service users involved in the development of and delivery of professional services</p>	<ul style="list-style-type: none"> • Professional standards, guidelines or training have been influenced by research. • Practitioners/professionals have used research findings in conducting their work. • The quality or efficiency of a professional service has improved. • Work force planning has been influenced by research. • Forensic methods have been influenced by research. • Educational or pedagogical practices and methods have changed outside of the submitting unit. • Law enforcement and security practices have changed.

<p>Impacts on the environment: Impacts where the key beneficiary is the natural or built environment</p>	<ul style="list-style-type: none"> • Policy debate on climate change or the environment has been influenced by research. • Environmental policy decisions have been influenced by research evidence. • Planning decisions have been informed by research. • The management or conservation of natural resources has changed. • The management of an environmental risk or hazard has changed.
<p>Impacts on international development: Impacts where the beneficiaries are international bodies, countries, governments or communities</p>	<ul style="list-style-type: none"> • International policy development has been influenced by research. • International agencies or institutions have been influenced by research. • Quality of life in a developing country has improved.

MAIN PANEL A: Examples of Evidence and Indicators of Impact

<p>Impacts on health and welfare</p>	<ul style="list-style-type: none"> • Measures of improved clinical outcomes, public behaviour or health services (lives saved, reduced infection rates). • Measures of improved well-being. • Documented changes to clinical and public health guidelines (documented references to research evidence in guidelines). • Evidence from audit, change in guidelines. • Documented changes to animal welfare codes or guidelines. • Evidence of enhanced awareness of health risks and benefits by consumers. • Evidence of enhancement of patient experience.
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Impacts on society, culture and creativity	<ul style="list-style-type: none"> • Documented evidence that public understanding has been enhanced through active collaborative involvement in research. • Critical reviews in the media. • Evidence of public debate. • Documented evidence of changes to social policy. • Measures of improved social equality, welfare or inclusion. • Increased public uptake of scientific training, through public engagement. • Documented shift in public attitude (for example, to sexual behaviour, or social factors in health).
Impacts on the economy	<ul style="list-style-type: none"> • Evidence of improved cost-effectiveness. • Evidence of service change.
Impacts on commerce	<ul style="list-style-type: none"> • Sales of new products/services. • Business performance measures (for example, turnover/profits, trends in key technical performance measures underlying economic performance). • Employment figures. • Licences awarded and brought to market; market authorisation. • Demonstrable collaborations with industry (including knowledge transfer partnerships, and contracts). • Commercial adoption of a new technology, process, knowledge or concept.

Impacts on public policy and services	<ul style="list-style-type: none"> • Documented evidence of policy debate (for example, at a parliamentary Select Committee, material produced by non-governmental organisations). • Documented evidence of changes to public policy/legislation/regulations/guidelines. • Measures of improved public services. • Documented evidence of influence on health policy and/or advisory committees. • Evidence of use of process/technology.
Impacts on production	<ul style="list-style-type: none"> • A new product has been recommended for use or adopted. • Development of a new plant variety or crop protection product which has entered the appropriate national or international regulatory testing system. • Published rights for animals and plants. • Evidence of improved sustainability. • Documented changes to working guidelines. • Documented evidence of improved working practices and/or level of production.
Impacts on practitioners and services	<ul style="list-style-type: none"> • Literature/web information from practitioners and advisers, including the research findings and how they are applied in practice. • Evidence of adoption of best practice (for example, by educators or law enforcement personnel).

<p>Impacts on the environment</p>	<ul style="list-style-type: none"> • Sales of new products, or improvements in existing products, that bring quantifiable environmental benefits. • Verifiable influence on particular projects or processes which bring environmental benefits. • Evidence of generic environmental impact across a sector, confirmed by independent authoritative evidence. • Traceable reference to inclusion of research into government policy papers, legislation and industry guidance. • Traceable reference to the influence of research in planning decision outcomes.
<p>Impacts on international development</p>	<ul style="list-style-type: none"> • Documented evidence of changes to international development policies. • Measures of improved international equality, food security, welfare or inclusion. • Evidence of take-up and use of new or improved products and processes that improve quality of life or animal welfare in developing countries.

MAIN PANEL B: Examples of Impact

<p>Economic impacts Impacts where the beneficiaries may include businesses, either new or established, or other types of organisation which undertake activity that may create wealth</p>	<ul style="list-style-type: none"> • The performance of an existing business has been improved through the introduction of new, or the improvement of existing, products, processes or services; the adoption of new, updated or enhanced technical standards and/or protocols; or the enhancement of strategy, operations or management practices. • A spin-out or new business has been created, established its viability, or generated revenue or profits. • A new business sector or activity has been created. • A business or sector has adopted a new or significantly changed technology or process, including through acquisition and/or joint venture. • Performance has been improved, or new or changed technologies or processes adopted, in companies or other organisations through highly skilled people having taken up specialist roles that draw on their research, or through the provision of consultancy or training that draws on their research. • Potential future losses have been mitigated by improved methods of risk assessment and management in safety or security critical situations.
<p>Impacts on public policy and services Impacts where the beneficiaries may include government, non-governmental organisations (NGOs), charities and public sector organisations and society, either as a whole or groups of individuals in society</p>	<ul style="list-style-type: none"> • A policy has been implemented (including those realised through changes to legislation) or the delivery of a public service has changed. • (Sections of) the public have benefited from public service improvements. • In delivering a public service, a new technology or process has been adopted or an existing technology or process

	<p>improved.</p> <ul style="list-style-type: none"> • Policy debate has been stimulated or informed by research evidence. • Policy decisions or changes to legislation, regulations or guidelines have been informed by research evidence. • Changes to education or the school curriculum have been informed by research. • Risks to the security of nation states have been reduced. • The development of policies and services of benefit to the developing world has been informed by research.
<p>Impacts on society, culture and creativity Impacts where the beneficiaries may include individuals, groups of individuals, organisations or communities whose knowledge, behaviours, creative practices and other activity have been influenced</p>	<ul style="list-style-type: none"> • Public discourse has been stimulated or informed by research. • Public interest and engagement in science and engineering has been stimulated, including through the enhancement of science and engineering-related education in schools. • The awareness, attitudes or understanding of (sections of) the public have been informed, and their ability to make informed decisions on issues improved, by engaging them with research. • The work of an NGO, charitable or other organisation has been influenced by the research. • Research has contributed to community regeneration.
<p>Health impacts Impacts where the beneficiaries may include individuals (including groups of individuals) whose health outcomes have been improved or whose quality of life has been enhanced (or potential harm mitigated) through the</p>	<ul style="list-style-type: none"> • A new drug, treatment or therapy, diagnostic or medical technology has been developed, trialled with patients, or adopted. • Patient health outcomes have improved

<p>application of enhanced healthcare for individuals or public health activities</p>	<p>through, for example, the availability of new drug, treatment or therapy, diagnostic or medical technology, changes to patient care practices, or changes to clinical or healthcare guidelines.</p> <ul style="list-style-type: none"> • Public health and quality of life has been enhanced through, for example, enhanced public awareness of a health risk, enhanced disease prevention or, in developing countries, improved water quality or access to healthcare. • Decisions by a health service or regulatory authority have been informed by research. • The costs of treatment or healthcare have reduced. • Quality of life in a developed or developing country has been improved by new products or processes.
<p>Impacts on practitioners and professional services Impacts where beneficiaries may include organisations or individuals involved in the development of and delivery of professional services</p>	<ul style="list-style-type: none"> • Changes to professional standards, guidelines or training have been informed by research. • Practitioners/professionals/lawyers have used research findings in the conduct of their work. • The quality or efficiency or productivity of a professional service has improved. • Professional bodies and learned societies have used research to define best practice. • Practices have changed, or new or improved processes have been adopted, in companies or other organisations, through the provision of training or consultancy. • Expert and legal work or forensic methods have been informed by research.
<p>Impacts on the environment Impacts where the key beneficiaries are the natural environment and/or the built environment, together with</p>	<ul style="list-style-type: none"> • The environment has been improved through the introduction of new product(s), process(es) or service(s); the improvement

<p>societies, individuals or groups of individuals who benefit as a result</p>	<p>of existing product(s), process(es) or services; or the enhancement of strategy, operations or management practices.</p> <ul style="list-style-type: none"> • New methods, models, monitoring or techniques have been developed that have led to changes or benefits. • Policy debate on the environment, environmental policy decisions or planning decisions have been stimulated or informed by research and research evidence. • The management or conservation of natural resources, including energy, water and food, has been influenced or changed. • The management of an environmental risk or hazard has changed. • The operations of a business or public service have been changed to achieve environmental (green) objectives. • Direct intervention, based on research evidence, has led to reduction in carbon dioxide or other environmentally damaging emissions.
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MAIN PANEL B: Examples of Evidence of Impact and Indicators of Impact

<p>Economic impacts</p>	<ul style="list-style-type: none"> • Business performance measures, for example, sales, turnover, profits or employment associated with new or improved products, processes or services. • Licences awarded and brought to market. • Jobs created or protected. • Investment funding raised from UK and/or non-UK agencies (venture capital/Business Angel, and so on) for start-up businesses and new activities of existing businesses. • Evidence of critical impact on particular projects, products and processes confirmed by independent
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	<p>authoritative evidence, which should be financial where possible.</p> <ul style="list-style-type: none"> • Priority shifts in expenditure profiles or quantifiable reallocation of corporate, non-profit or public budgets.
Impacts on public policy and services	<ul style="list-style-type: none"> • Documented evidence of policy debate (for example, in Parliament, the media, material produced by NGOs). • Documented evidence of changes to public policy/legislation/regulations/guidelines. • Measures of improved public services, including, where appropriate, quantitative information; such information may relate for example to the quality, accessibility or cost-effectiveness of public services. • Documented evidence of changes to international development policies. • Measures of improved international welfare or inclusion.
Impacts on society, culture and creativity	<ul style="list-style-type: none"> • Visitor or audience numbers and feedback. • Critical reviews in the media and/or other professional publications. • Evidence of public debate in the media or other fora. • Evidence of sustained and ongoing engagement with a group. • Measures of increased attainment and/or measures of improved engagement with science in non-HE education.
Health impacts	<ul style="list-style-type: none"> • Evidence from clinical trials. • Measures of improved patient outcomes, public health or health services. • Documented changes to clinical guidelines. • Evidence of take-up and use of new or improved products and processes that improve quality of life

	in developing countries.
Impacts on practitioners and professional services	<ul style="list-style-type: none"> • Traceable reference to inclusion of research in national or international industry standards or authoritative guidance. • Traceable references by practitioners to research papers that describe their use and the impact of the research. • New or modified professional standards and codes of practice. • New or modified technical standards or protocols. • Documented changes in knowledge, capability or behaviours of individuals benefiting from training.
Impacts on the environment	<ul style="list-style-type: none"> • Sales of new products or improvements in existing products that bring quantifiable environmental benefits. • Traceable impacts on particular projects or processes which bring environmental benefits. • Evidence of generic environmental impact across a sector, confirmed by independent authoritative evidence. • Documented case-specific improvements to environment-related issues. • Traceable reference to inclusion of research into government policy papers, legislation and industry guidance. • Traceable reference to impact of research in planning decision outcomes. • Policy documentation.

MAIN PANEL C: Examples of Impact

<p>Impacts on creativity, culture and society: Impacts where the beneficiaries are individuals, groups of individuals, organisations or communities whose knowledge, behaviours, practices, rights or duties have been influenced</p>	<ul style="list-style-type: none"> • Enhancements to heritage preservation, conservation and presentation; the latter including museum and gallery exhibitions. • Production of cultural artefacts, including for example, films, novels and TV programmes. • Public or political debate has been shaped or informed; this may include activity that has challenged established norms, modes of thought or practices. • Improved social welfare, equality, social inclusion; improved access to justice and other opportunities (including employment and education). • Improvements to legal and other frameworks for securing intellectual property rights. • Enhancements to policy and practice for securing poverty alleviation. • Influential contributions to campaigns for social, economic political and/or legal change. • Enhanced cultural understanding of issues and phenomena; shaping or informing public attitudes and values.
<p>Economic, commercial, organisational impacts: Impacts where the beneficiaries may include new or established businesses, or other types of organisation undertaking activities which create wealth</p>	<ul style="list-style-type: none"> • Changed approach to management of resources has resulted in improved service delivery. • Development of new or improved materials, products or processes. • Improved support for the development of 'small scale' technologies. • Improved effectiveness of workplace practices. • Improvements in legal frameworks, regulatory environment or governance of business entities. • Better access to finance opportunities. • Contribution to improved social, cultural and environmental sustainability.

	<ul style="list-style-type: none"> • Enhanced corporate social responsibility policies. • More effective dispute resolution. • Understanding, developing and adopting alternative economic models (such as fair trade).
<p>Impacts on the environment: Impacts where the key beneficiaries are the natural, historic and/or built environment, together with societies, individuals or groups of individuals who benefit as a result</p>	<ul style="list-style-type: none"> • Specific changes in public awareness or behaviours relevant to the environment. • Improved management or conservation of natural resources or environmental risk. • Improved management of an environmental risk or hazard. • Operations or practice of a business or public service have been changed to achieve environmental objectives. • Improved design or implementation of environmental policy or regulation. • Changed conservation policy/practice or resource management practices. • Changes in environmental or architectural design standards or general practice. • Influence on professional practice or codes. • Changes in practices or policies affecting biodiversity.
<p>Health and welfare impacts: Impacts where the beneficiaries are individuals and groups (human or animal) whose quality of life has been enhanced (or harm mitigated) or whose rights or interests have been protected or advocated</p>	<ul style="list-style-type: none"> • Development or adoption of new indicators of health and well-being. • Development of policy and practice with regard to medical ethics, health services or social care provision. • Influence on CPD. • Influence or shaping of relevant legislation. • Influencing policy or practice leading to improved take-up or use of services. • Improved provision or access to services.

	<ul style="list-style-type: none"> • Development of ethical standards. • Improved standards in training. • Improved health and welfare outcomes.
<p>Impacts on practitioners and professional services: Impacts where the beneficiaries may include organisations or individuals involved in the development and/or delivery of professional services and ethics</p>	<ul style="list-style-type: none"> • Changed practice for specific groups (which may include cessation of certain practices shown to be ineffective by research). • Influence on professional standards, guidelines or training. • Development of resources to enhance professional practice. • Use of research findings in the conduct of professional work or practice. • Influence on planning or management of services. • Use of research findings by professional bodies to define best practice, formulate policy, or to lobby government or other stakeholders. • Practitioner debate has been informed or stimulated by research findings. • Research has challenged conventional wisdom, stimulating debate among stakeholders.
<p>Impacts on public policy, law and services: Impacts where the beneficiaries are usually government, public sector and charity organisations and societies, either as a whole or groups of individuals in society through the implementation or non-implementation of policies, systems or reforms</p>	<ul style="list-style-type: none"> • Legislative change, development of legal principle or effect on legal practice. • Forms of regulation, dispute resolution or access to justice have been influenced. • Shaping or influence on policy made by government, quasi-government bodies, NGOs or private organisations. • Changes to the delivery or form of any service for the public. • Policy debate has been stimulated or informed by research evidence, which may have led to confirmation of policy, change in policy direction, implementation or withdrawal of policy.

	<ul style="list-style-type: none"> • Effect on the quality, accessibility, cost-effectiveness or efficiency of services. • Impact on democratic participation. • Influencing the work of NGOs or commercial organisations. • Improved public understanding of social issues. • Enabling a challenge to conventional wisdom.
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MAIN PANEL C: Examples of Evidence or Indicators of Impact

• Citation in a public discussion, consultation document or judgement.
• Citation by journalists, broadcasters or social media.
• Citation by international bodies such as the United Nations, UNESCO, IMF and so on.
• Evidence of citation in policy, regulatory, strategy, practice or other documents.
• Evidence of debate among practitioners, leading to developments in attitudes or behaviours.
• Public debate in the media.
• Parliamentary or other democratic debate.
• Visitor or audience numbers, or number of participants (for example, in the uptake of CPD).
• Media reviews.
• Measures of improved inclusion, welfare or equality.
• Independent documentary evidence of links between research and claimed impact(s).
• Documented evidence of influence on guidelines, legislation, regulation, policy or standards.
• Documented change to professional standards or behaviour.
• Satisfaction measures (for example, with services).
• Use in scrutiny or audit processes, such as Select Committees.
• Incorporation in training or CPD material.
• Outcome measures, including measures of outcomes for beneficiaries.

- Quantitative data relating, for example, to cost-effectiveness or organisational performance.

MAIN PANEL C: Guidance on Impacts arising from public engagement activity

1. Public engagement is an activity that may lead to the impact of research. Sub-panels will welcome case studies that include impact achieved in this way, either as the main impact described or as one facet of a broader range of impacts.
2. Case studies which include impacts that derive from engaging the public with research must:
 - a. At least in part, be based on specific research or a body of research carried out in the submitted unit, and explain clearly which particular aspects of the research underpinned the engagement activity and contributed to the impact claimed.
 - b. Include evidence of the reach of the impact. This should extend beyond simply providing the numbers of people engaged and may also, for example, include:
 - information about the types of audience
 - whether there was secondary reach, for example from follow-up activity or media coverage
 - other quantitative indicators such as evidence of sales, downloads of linked resources, and/or access to web content.
 - c. Include evidence of the significance of the impact. This should include a description of the social, cultural or other significance of the research insights with which the public have engaged. Examples of the evidence that might be provided for this include:
 - evaluation data
 - critical external reviews of the engagement activity
 - evidence of third party involvement, for example how collaborators have modified their practices
 - user feedback or testimony
 - evidence of sustainability through, for example, a sustained or ongoing engagement with a group, a significant increase in participation in events or programmes or use of resources.

MAIN PANEL D: Examples of Impact

Civil society	Informing and influencing the form and content of associations between people or groups to illuminate and challenge cultural values and social assumptions.
Cultural life	Creating and interpreting cultural capital in all of its forms to enrich and expand the lives, imaginations and sensibilities of individuals and groups.
Economic prosperity	Applying and transferring the insights and knowledge gained from research to create wealth in the manufacturing, service, creative and cultural sectors.
Education	Informing and influencing the form or the content of the education of any age group in any part of the world where they extend significantly beyond the submitting HEI.
Policy making	Informing and influencing policy debate and practice through interventions relating to any aspect of human or animal well-being or the environment.
Public discourse	Extending the range and improving the quality of evidence, argument and expression to enhance public understanding of the major issues and challenges faced by individuals and society.
Public services	Contributing to the development and delivery of public services or legislation to support the welfare, education, understanding or empowerment of diverse individuals and groups in society, including the disadvantaged or marginalised.

MAIN PANEL D: Examples of Evidence of Impact

Quantitative indicators	<ul style="list-style-type: none"> • Publication and sales figures both in the UK and overseas, audience or attendance figures (including demographic data where relevant), broadcasting data and other forms of media, download figures, or database and web-site hits over a sustained period. • Funding from public or other charitable bodies. • Evidence of use of education materials arising from the research (where they extend significantly beyond the submitting HEI). • Tourism data, including audience figures and visitor numbers at exhibitions, events, performances. • Growth of small businesses in the creative industries. Generation of new products. Sales figures and income generated. Employment data (for example, evidence of jobs created).
Critiques or citations in users' documents	<ul style="list-style-type: none"> • Citations in reviews outside academic literature. Independent citations in the media, including in online documents. Reviews, blogs and postings. Programme, exhibition or catalogue notes. Prizes. Translations. Recorded feedback. • Inclusion in teaching materials or teaching bibliographies. Replication of

	<p>work in structure of courses.</p> <ul style="list-style-type: none"> • Evidence of uptake of research in documents produced by public or commercial bodies; citations in policy documents and reviews, or other published reports on policy debates.
Public engagement	<ul style="list-style-type: none"> • Information about the number and profile of people engaged and types of audience. Follow-up activities or media coverage. Evidence of sales, downloads of linked resources or access to web content. • Descriptions of the social, cultural or other significance of the research insights with which the public have engaged. Evaluation data. User feedback or testimony. Critical external reviews of the engagement activity. Evidence of third party involvement, for example how collaborators have modified their practices, contributions (financial or in-kind) by third parties to enhance services or support for the public, or evidence of funds from third parties to enhance or extend the engagement activity. Evidence of sustainability, through, for example, a sustained or ongoing engagement with a group, a significant increase in participation in events or programmes, continuing sales, downloads, or use of resources.
Policy engagements	<ul style="list-style-type: none"> • Evidence of influence on a debate in public policy and practice through membership of or distinctive contributions to expert panels and policy committees or advice to government (at local, national or international level). • Formal partnership agreements or research collaboration with major institutions, NGOs and public bodies. Consultancies to public or other bodies that utilise research expertise. • Evidence of engagement with campaign and pressure groups and other civil organisations (including membership and activities of those organisations and campaigns) as a result of research. • Changes to professional standards and behaviour.
Independent testimony	<ul style="list-style-type: none"> • Acknowledgements in annual reports or other publications of NGOs, charities and other civil society organisations. Testimony of experts or users who can attest to the reach and/or significance of impact. Third-party evidence of changed policies, practices, processes, strategies.
Formal evaluations	<ul style="list-style-type: none"> • Professional evaluations of exhibitions, performances or other outputs. Formal peer reviews of funded impact-relevant research. Studies on the social return on investment.