

## Impact template (REF3a)

<b>Institution:</b> Queen's University Belfast
<b>Unit of Assessment:</b> 10 – Mathematical Sciences
<p><b>a. Context</b></p> <p><u>a1. Main Non-Academic Beneficiaries</u> The main non-academic beneficiaries, or users, of research performed within the Mathematical Sciences UoA at Queen's University Belfast (QUB) fall into the following categories:</p> <ol style="list-style-type: none"> <li>1) public services and policy such as the Northern Ireland Assembly, Northern Ireland Ambulance Service, Education and Skills Authority, Police Service for Northern Ireland and UK partners;</li> <li>2) health and the delivery of health services across the globe;</li> <li>3) the general public, primarily in improving the quality of life and the likelihood of saving lives (as demonstrated in one of our case studies), but also schoolchildren through outreach;</li> <li>4) health analytics companies, and finance companies.</li> </ol> <p>The two case studies chosen for inclusion in our submission will illustrate impact in the first three of the above categories.</p> <p><u>a2. Main Types of Impact and How These Relate to Research Centres</u> The types of impact realised in the Mathematical Sciences UoA in the School of Mathematics and Physics vary across two research centres. The Centre for Statistical Science and Operational Research (CenSSOR) interacts strongly with the public services (in particular health services), health analytics companies and in improving the health of the public, while the Pure Mathematics Research Centre (PMRC) engages with the public on outreach. All of our staff engage enthusiastically in outreach and the public understanding of mathematical sciences through a number of events coordinated by the School Outreach Committees. These include organising Summer Schools for Maths students, maths workshops, participating at local popular science clubs and the annual maths competition attended by Stephen Farry, MLA, the Minister for Employment and Learning in the Northern Ireland Executive and a member of the Northern Ireland Assembly.</p> <p><b>b. Approach to impact</b></p> <p><u>b1. Staff Interactions with Non-Academic Beneficiaries</u> Members of staff in the Mathematical Sciences UoA are acutely aware of the benefits of positive interactions with non-academic research users and the increasing importance of impact. In fact, contribution to impact has progressed to being monitored as a distinct element in evaluating staff performance in appraisals and promotions and most recently has also been listed as an important reason to award sabbatical leave. Our approach to impact is to promote our research to those we consider potential beneficiaries, and to establish direct links with resulting interested parties. We achieve this in three ways: through direct participation in multidisciplinary organisations, engagement with companies, potential users, and contact with economic development agencies.</p> <p><b>b1.1 Direct participation in multidisciplinary organisations:</b></p> <p><b>b1.1.1 Strategic Investment Board:</b> The Strategic Investment Board, SIB, (<a href="http://www.sibni.org/">http://www.sibni.org/</a>) is a team of advisors who provide strategic advice to Northern Ireland Ministers on the development and roll-out of the Investment Strategy for Northern Ireland. It also supports the public sector to successfully deliver infrastructure projects. SIB provides expertise on project and programme management, procurement law, corporate finance, regulation, community regeneration and/or strategic planning. It is the strategic planning that is of relevance to CenSSOR whose staff work closely with SIB who currently fund approximately £250K of work, half of which is focused entirely on implementing previous CenSSOR research to have impact on public service areas.</p> <p><b>b1.1.2 Cumberland Initiative:</b> The UK-wide Cumberland Initiative (CI) (<a href="http://www.cumberland-initiative.org/">http://www.cumberland-initiative.org/</a>) was established in 2010 as a channel for promoting healthcare research to industry and government and already has research funded by a healthcare provider in England. The CI has introduced and established links with CenSSOR members, with healthcare providers and the computer industry. The property company SEGRO donated a new 6200 metre<sup>2</sup> building to host the CI's national centre, as a central facility for the UK Academic Health Science Networks (AHSNs).</p> <p><b>b1.1.3 Analytics Institute:</b> The Analytics Institute (AI) was formed on an all-Ireland basis in 2010 to bring together industry, academics, public sector and professionals to change the way organisations interact with the statistics branch of Analytics. One of its founding directors, Marshall, is a member of CenSSOR. The AI provides a place for groups to come together to create public value <a href="http://www.analyticsinstitute.org/">http://www.analyticsinstitute.org/</a>. The collaboration has also led to a CenSSOR member conducting consultancy work for an AI customer, the Irish Revenue Office, to</p>

provide an independent review of the analytics models currently utilised for fraud detection.

**b1.2 Direct Engagement with Companies and potential users:**

**b1.2.1 Engagement with Healthcare Analytics Companies:** Members of staff in the Mathematical Sciences UoA proactively engage with companies that share an enthusiasm for research within mathematics and statistics. The health analytics company Aridhia and cloud technology firm EMC Greenplum have secured funding in collaboration with CenSSOR to establish a Belfast site for their companies to work with CenSSOR members to base a research haven for collaborative work in healthcare modelling. This will fund two postdoctoral research assistants for the CenSSOR team and bring up to 200 graduate posts in statistics and analytics over the next three to five years. CenSSOR has also close links with the Belfast-born Exploristics company who share research interests through project students and who currently employ three CenSSOR PhD graduates to work on state-of-the-art predictive modelling tools for optimising clinical trials.

**b.1.2.2 Engagement with potential users: Staff engage with potential users by:**

- (i) Targeting the presentation of their research uses and applications to relevant specialist groups including the *British Geriatric Society*, *Chest Heart Stroke Association*, the *Novartis Foundation for Sustainable Development*, *Northern Ireland (NI) Statistics Research Agency*.
- (ii) Running workshops at QUB for relevant research groups such as a *Healthcare Modeller's* workshop and the *Cumberland Initiative* meeting in July 2011.
- (iii) Visiting relevant departments and groups where their research could have impact, such as SAS statistical software company, *Ulster Bank* and the *Strategic Investment Board*.
- (iv) Organising special sessions at conferences to promote research in particular fields, for example an *Intelligent Patient Management Track* has been organised at the *IEEE International Symposium on Computer-Based Medical Systems* annually since 2005.
- (v) Organising a one-day instructional workshop, open to industry, public, and academics from other departments (non-mathematicians) on "Capacity of communication", in February 2014.

**b1.3 Engagement through Contact with Economic Development Agencies:**

The School has a strong on-going direct relationship with *Invest Northern Ireland (INI)*, the local regional development agency still seen to be central to the Regional Innovation Strategy by the N. Ireland Assembly Programme for Government. Our academics often accompany INI officials on trade missions, and help attract foreign direct investment by showcasing the university competencies in research and education. Academic staff members have also helped INI to develop infrastructure and graduate training to support local industrial needs and anchor multinational employers to the UK through specific collaborative research programmes. INI has financed the *Connected Health Innovation Centre (CHIC)* who engage with members of CenSSOR and companies wishing to set up premises in Northern Ireland.

b2. Specific Support for Enabling Impact

**b2.1 School's Use of Institutional Resource:** The University offers significant levels of advice and practical help for knowledge exchange through the Research and Enterprise Directorate (R&E) and the QUBIS ([www.qubis.co.uk](http://www.qubis.co.uk)) business support and venture capital unit. Institutional support is developed to the extent that QUB was named the Times Higher Education Entrepreneurial University of the Year (2009), received the European Commission's HR Excellence in Research Award and the only UK University to be awarded a Silver Institutional Athena SWAN Award (2012).

**Research Forum for Statistics & Operational Research at QUB:** Established by the University in 2010 to bring together researchers and users of statistics and OR in Government, Industry and service sectors, the Forum informs users of the latest research in Statistics and Operational Research at QUB thus making it accessible to other fields across the University. It recently hosted Professor Sir David Cox and Professor Jeff Griffiths who gave presentations on impact.

**Connected Health Special Interest Group:** Over the last year 45 academic experts from different schools (eg Mathematics and Physics, Medicine, etc) formed a Special Interest Group to foster new research in the area of connected health. An internal conference in 2013 with international speakers, led to the development of an institutional strategic plan and the development of new collaborations inside and outside the University.

**b2.2 Outreach Committees:** The School runs and financially supports (~£20K) an extensive outreach programme where staff, postdoctoral research assistants and PhD students raise public awareness of the wider technological and cultural importance of both mathematics and physics.

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Outreach programmes are managed and organised by Outreach Committees (one for mathematics and another for physics), composed of academic staff from all of the School's research centres and is credited in the Work Allocation Model. All programmes are focused on sharing the scientific excitement and interest associated with our fields of research. We hold maths Summer Schools, maths workshops, the annual maths competition for 13-17 year olds and give presentations at careers days, for example in 2013, Todorov and Marshall presented to 200 school children the opportunities in Maths through research topics "Encryption" and "Big Data". Another mechanism in engaging with research users and the general public is the University's DNA of Innovation publication that includes case study profiles of many QUB researchers, their work and its impact on society. Volume two of the publication was launched at a research impact showcase in September 2012 at which a CenSSOR member of staff features their research impact in healthcare.

**c. Strategy and plans**

The Mathematical Sciences UoA strategy for promoting its work has been heavily based on communication of our research to potential users through organisations and individually through direct contact. This continues as part of the future strategy for Mathematical Sciences, but will also extend to include other organisations and Industry, relevant to PMRC as well as CenSSOR, such as the Competence Centre managed by the Economic Development Board, INI. The aim of the Competence Centre is to enable research to influence companies directly. Commercial partners in the centre include both small indigenous companies and multinationals. One of the PhD students in CenSSOR has attended courses by the Competence Centre and is partially funded by INI.

**c.1 Impact Facilitation Board (IFB)**

To develop greater coherence in our approach to impact, we have recently established an Impact Facilitation Board (IFB). A Director of Impact (DI) has been appointed from amongst the permanent academic staff who sit on the School Management Board (SMB) and reports directly to the Head of School (HoS). The DI's responsibility is to monitor, develop and support impact with the aid of the IFB, which meets twice per year and is composed of: 3 representatives from our existing industry collaboration base, the Business Alliance Manager (R&E), the Director of Knowledge Transfer Partnerships and Business Networks (R&E), an INI representative and several representatives from relevant Knowledge Transfer Networks (to allow input and generate profile in other UK areas). Directors of Research (DRs), and the Chair of the Outreach and Recruitment Committee attend, as does the HoS on request. The IFB has a steering role and the remit to make recommendations to the HoS for specific actions to help develop and implement the impact agenda.

**c.2 Specific Actions**

While the DI (and HoS) are responsible for actions, we envisage the following specific examples:

- (i) the creation of a centralized database of all current impact-related activity and of the specific pathways to impact plans associated with both current and future RCUK-funded programmes plus other relevant externally-funded grants, as appropriate;
- (ii) the instigation of a monitoring process to assess the extent to which impact plans associated with grants are developing and to suggest specific support actions;
- (iii) an increased engagement with end users, economic development agencies and the media to direct their awareness to the latest work and to demonstrate its benefits to them;
- (iv) an increase in direct investment from industry, sponsored PhDs, consultancy and industry end-user influenced research activity;
- (v) increased recognition of staff effort and success in impact, encouragement / incentives to apply for industry-academic fellowships and the award of sabbaticals specifically to develop spin-out opportunities or similar impact-related activities.

**d. Relationship to case studies**

The two case studies (in our submission) and the relationship to our approach to impact are:

- (i) Efficient Public Access to Defibrillators: This case study impacts primarily on health, and more recently on other public sectors such as policing, the ambulance service, strategic investment and public policy. Impact has been facilitated through the Strategic Investment Board with whom Dr Cairns and Professor Marshall are strongly engaging on a number of projects.
- (ii) Costing Models for Elderly Patients in Hospital: The application of the models to elderly healthcare has impact on patient health, quality of life and associated financial benefits. Research impact has come about through Professor Marshall's international collaborators.