What is impact and why is important

“While curiosity-driven research is at the heart of our culture, **we have the capability**, and indeed the **responsibility**, as scientists **to engage in knowledge exchange which can help to tackle important industrial and societal challenges**. **Impact**, in the broadest sense, **is vital to the future success and prosperity of our School**.

Translating fundamental science into solutions for real world problems is not always straightforward, and often requires dedicated effort, and so the School of Physics & Astronomy is committed to providing you with the support and resources you need to achieve the deepest and broadest possible impact."

Jim Dunlop, as Head of School

Impact is defined as an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia.

HEIs were **required** to submit impact case studies that demonstrate the impacts their research has had beyond academia (~7 for SOPA in REF2029)

It should “saturate opportunity”.
It should have maximum breadth or depth.
(See next slides)

Not everyone has to generate impact, but we don’t want to miss opportunities to increase the Schools prestige and prosperity

It counts for 1/3 of our REF submission and is worth 10M£ per REF cycle.
Each impact case is worth ~1M£ of UNRESTRICTED funds to Schools

Impact is now one of the 3 routes for career development and progression, together with research and teaching.

Types of Impact

Commercialisation

Startups
Spin off/out (Blackford Analysis)
Licensing
Consulting (IBM/Intel)
Collaborations with industries (ECFP)

Needs agreement in place to use statements from company to support ICS

Public Engagement/Outreach

Like Pint of science but bigger and more planned.
E.g. BBC programmes, YouTube channels with ~100k viewers.
Outreach events targeted to deprived/underrepresented groups (ROE Open days)
(Life Beyond prison programme)
Monitor/Quantify impact of engagement!

Policy making/informing

e.g., NHS/Scottish Gov/UK Gov/Vet or Medical Colleges implementing/citing your work in guidelines

Needs tracking of impact through guidelines

SOPA Impact team

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Example ICS

Claim: “We have developed a range of quantitative Magnetic Resonance Imaging (MRI) methods that allow a comprehensive, non-invasive assessment of human physiology in vivo” -> qMRI = quantitative MRI. Non invasive, in vivo

(1) exploited by the medical technology and pharmaceutical sectors to provide information to regulators and licensing agencies which has influenced European Consensus and NICE guidelines POLICY
(2) provided insights for industry and regulators in the assessment of the health benefits of food products COMMERCIAL/POLICY
(3) provided new quantitative imaging biomarkers of disease progression and treatment response COMMERCIAL

Science = “underpinning research” …

Evidence:

1) **Testing pharmaceutics to inform industry and regulators (renal haemodynamics during infusion of fluids after surgery, rate of drug dissolution in the gut, …):**
NICE Guidelines, five European guidelines, ESPEN preoperative fasting guidelines, 2 clinical trials with *Fresenius Medical Care,* change in licensing from added quantitative information on effect of sprays (P&G, Vicks)
2) **Scientific assessment of health benefits for the food industry (Kiwifruit/Zespri, Unilever/areated drinks in the gut/foams/etc)**
Letter of support from Unilever and Zespri
3) **Development of imaging biomarkers (esp useful for Chron’s disease)**
2 Patents on new biomarkers, commercialised via collaborations/licencing to medical devices companies (JEB technologies and Motilent). Downstream clinical trials and improvement of commercial products

Institution: University of Nottingham (UoN)		
Unit of Assessment: 9		
Title of case study: QuantMRI: Quantitative MRI for healthcare, pharmaceuticals and nutrition		
Period when the underpinning research was undertaken: 1st Jan 2000 – 31st Dec 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by the submitting HEI:**
Susan Francis	Professor	2001 – present
Penny Gowland	Professor	1990 – present
Period when the impact occurred: 1st August 2013 – 31st December 2020		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact

We have developed a range of quantitative Magnetic Resonance Imaging (MRI) methods that allow a comprehensive, non-invasive assessment of human physiology *in vivo*. These methods have been applied to a range of dynamic processes including studies of the gastrointestinal (GI) tract, respiratory tract, kidneys and heart. Our MRI innovations in this area have: (1) been exploited by the medical technology and pharmaceutical sectors to provide information to regulators and licensing agencies which has influenced European Consensus and NICE guidelines and led to commercial impact (*Baxter Healthcare and BBraun, Fresenius Kabi and Fresenius Medical Care, Procter & Gamble, Simulations Plus*); (2) provided insights for industry and regulators in the assessment of the health benefits of food products (*Unilever, Zespri International Limited*); (3) provided new quantitative imaging biomarkers of disease progression and treatment response (*JEB technologies, Motilent*).

2. Underpinning research

The Sir Peter Mansfield Imaging Group (SPMIG) in the School of Physics and Astronomy (SoPA) are pioneers in the development of novel quantitative MRI (qMRI) techniques to enable the non-invasive measurement of key biophysical parameters *in vivo*. This approach transcends standard imaging performed in routine clinical radiology, by providing unique spatio-temporal information on the dynamic phenomena that underlie complex physiological processes. The SPMIG has harnessed its considerable expertise in the physics of MRI and its long experience in fast imaging, to develop novel, integrated MR acquisition and analysis protocols for dynamic mapping of NMR relaxation times (T_1 and T_2), viscosity, flow, organ motility and other key measures. Importantly, these unique tools allow a comprehensive assessment of the function of individual organs, and of interactions between organs, all in a single examination, enabling innovative studies of disease processes and responses to therapies. Here we present the underpinning research on the gastrointestinal (GI) tract, upper respiratory tract, kidney and heart which led to this case study.

Since 2000, through longstanding collaborations with Professors Robin Spiller and Luca Marciani (National Institute of Health Research (NIHR) Nottingham Biomedical Research Centre), the SPMIG has developed and optimised qMRI for the measurement of key biophysical parameters to study GI function **[i-v, I-III]**, including: gut motility; the breakdown of model particles to study intraluminal forces; intraluminal emulsification of fat; gastric emptying and intraluminal viscosity of model meals **[1-3];** small bowel water content and colonic volumes **[4];** and water pocket volumes in the bowel and colonic motility **[5]**. Examples of applications include *in vivo* studies of intragastric gelation **[1]**, the fate of aerated drinks in the gastric lumen **[3]**, and gastric emptying of preoperative metabolic preconditioning drinks in healthy volunteers **[6]**. Since 2013 **[7]**, the group have developed novel MR marker capsules, combined with bespoke MRI sequences for detecting them with high sensitivity, to measure whole-gut transit time without ionizing radiation; these markers have recently been used in a first-in-child study **[8]**. These methods have also been re-purposed to study the upper respiratory tract **[9, IV].**

The application of qMRI to understand kidney function forms part of a collaboration with Professor Dileep Lobo (NIHR Nottingham Biomedical Research Centre), and Professors Nicholas Selby and Maarten Taal (Centre for Kidney Research and Innovation, University of Nottingham). The SPMIG has a long history of developing Arterial Spin Labelling (ASL)