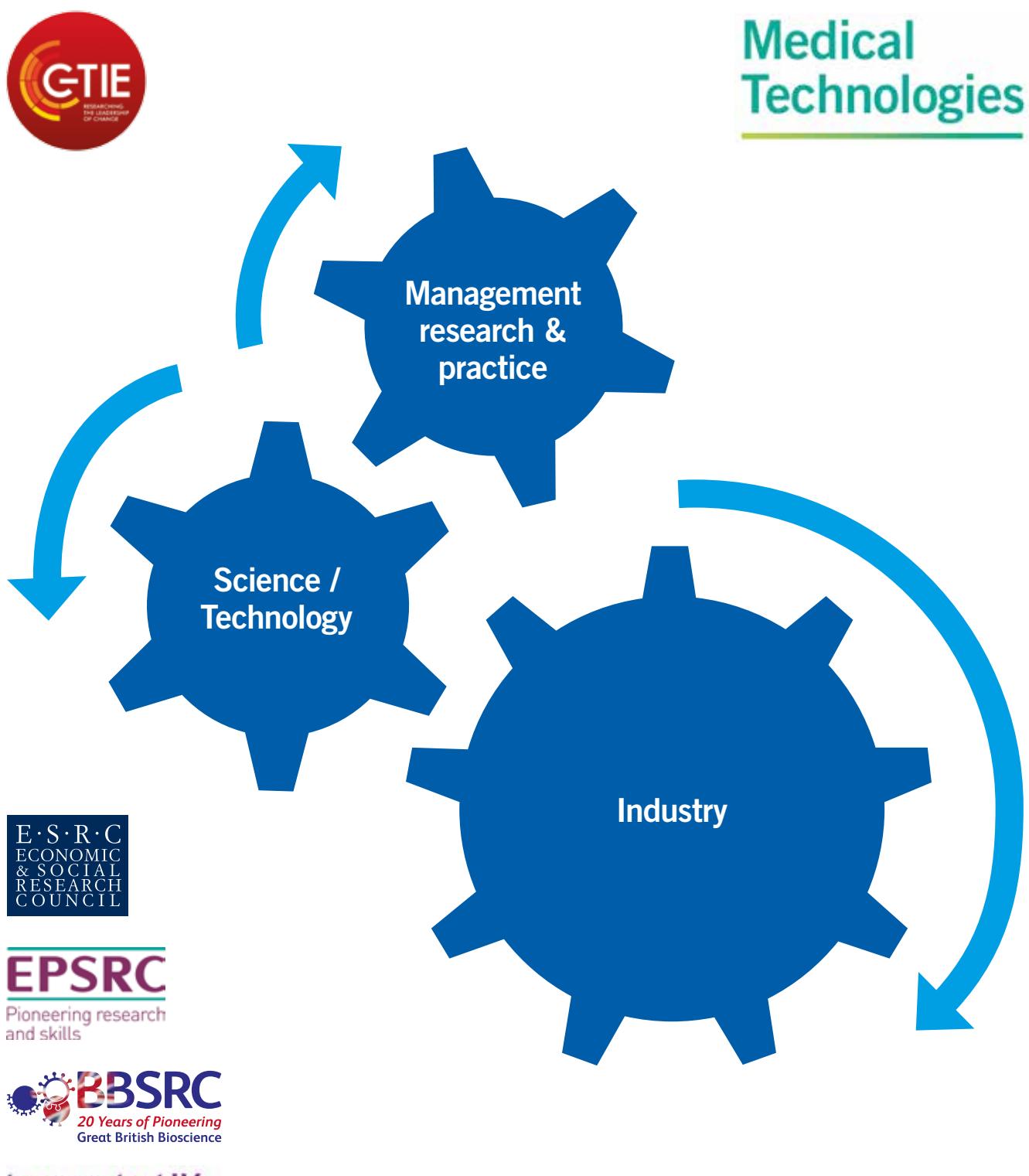

Innovation Engagement: Commercialising science through collaborative research



**Centre for Technology Innovation
and Engagement**

The Centre for Technology Innovation and Engagement's collaborative contribution to the Medical Technologies Innovation and Knowledge Centre



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Making an Impact with Collaborative Research on Innovation

In line with the strategy of the University of Leeds, Leeds University Business School (LUBS) aims to:

- create and advance knowledge through research
- disseminate knowledge through teaching and engagement with users and policy-makers.

Our knowledge-exchange strategy focuses on working directly with individual businesses, organisations, policy-makers and intermediaries, including professional and trade associations, to produce societal benefits and economic value.

We work with our external partners in a number of ways, including through mainstream research projects that have a strong focus on knowledge exchange, and through Knowledge Transfer Partnerships (KTPs), which support UK businesses wanting to improve their competitiveness, productivity and performance by accessing the knowledge and expertise available within UK universities and colleges. These are match-funded by partner organisations and research councils (including Innovate UK) through dissemination and follow-on grants, and most importantly, through collaborative PhD studentships. These are particularly valuable in knowledge translation in the way they act as intermediaries between academics and practitioners.

More generally, LUBS works with companies, the public, third-sector organisations and policy-makers to maximise the impact and social/economic benefits of our research. An example in the area of technology has been the Management of Emerging Technologies for Economic Impact (ManETEI) Initial Training network – funded by the European Commission (EC) through Marie Curie Actions – which brought together LUBS and diverse group of leading European business schools and industrial partners such as Bayer, Intel and GSK, to support industry-led doctoral training.

The University of Leeds is renowned for its capability in technology innovation. Researchers within the Centre for Technology Innovation and Engagement (C-TIE) have embraced the multifaceted nature of technology innovation, and the University possesses considerable expertise for scientific and engineering innovation. We also recognise the importance of industry–university engagement, knowing that technology innovation is determined by many non-technical factors. As a consequence, the University has developed research competence in studying the managerial and social aspects of technology innovation. Advances in these domains have created a number of opportunities to integrate the technological and managerial aspects of innovation research in order to advance collaboration with industry and to leverage research insights into new educational programmes delivered locally, regionally and internationally.

The nucleus of this kind of interdisciplinary and collaborative research into technology innovation processes, with strong elements of training for doctoral students and innovation managers, has been established between the Medical Technologies Innovation and Knowledge Centre (IKC) (a nationally funded centre based in the Institute of Medical and Biological Engineering) and C TIE. This unique collaborative approach has provided the University with distinctive capability.

Centre for Technology Innovation and Engagement

C-TIE, based at LUBS, is dedicated to the co-production of knowledge in the field of technology-innovation management and the creation of impact for businesses and society generally. The centre acts as a platform where close collaborations can be fostered between academic researchers (usually from different disciplines), doctoral students, and innovation managers from profit and non-profit organisations for which innovation is a core capability.

C-TIE members investigate contemporary innovation processes, which are often characterised by their increased social complexity, usually brought about by a requirement to engage with businesses across the industry spectrum as well as policy-makers, universities and members of the public. As a cross-faculty centre, C-TIE aspires to support the University's innovation strategy through developing a rigorous research agenda and evidence-based support for innovation managers.



Professor Richard Thorpe, Pro-Dean for Research and Innovation and a member of both the Centre for Technology Innovation and Engagement and the Innovation Knowledge Centre

C-TIE's activities are based on four pillars:

- **research and innovation intelligence:** producing rigorous and relevant knowledge through collaborative and user-inspired research projects, as well as support for doctoral training
- **engagement:** sustaining close links with companies and academic colleagues from other disciplines across the University of Leeds
- **innovation leadership development:** incorporating the insights of collaboration into our teaching at undergraduate, postgraduate and doctoral levels, as well as for executives
- **methodological development and dissemination strategies:** developing methodologies and dissemination strategies capable of producing multiple outcomes for researchers (including publications in academic journals) and for practitioners, policy-makers and other stakeholders who can use the knowledge produced in practical ways.

'In recent years, there has been a great deal of debate about how the research conducted in business schools has direct relevance to the real world of practice. C TIE's involvement in the Medical Technologies IKC, developing regenerative therapies and devices, is one example where the involvement of LUBS, through its support and evaluation, has led to valuable insights into the commercialisation of science. The collaboration has provided a rich research context for social science researchers to conduct engaged research and generate deeper levels and shared understandings of the tangible and intangible issues associated with innovation.'

'As a member of C TIE and the Executive Management Group of the IKC for the life of the project, and also as Pro Dean for Research and Innovation within LUBS, I am delighted with the outcomes of our involvement – in terms of the collaboration that has taken place and the significance of the outcomes in respect of innovation policy.'



Professor Krsto Pandza, Director of the Centre for Technology Innovation and Engagement

'For those in the management academy community who are interested in innovation studies, it has become accepted that it is organisational, economic, institutional and societal factors that determine the success or failure of the commercialisation of an emergent technology.'

'By engaging closely with the Medical Technologies IKC, C TIE researchers have been able to bridge the double hurdle of rigorously investigating the complex processes of commercialising emergent medical technologies, while at the same time producing knowledge that will help innovation managers strengthen their innovation processes within industry university collaborations of this kind.'

Medical Technologies Innovation and Knowledge Centre (IKC)

Based at the University of Leeds in the UK, the Medical Technologies IKC is funded by the Engineering and Physical Sciences Research Council (EPSRC), Biotechnology and Biological Sciences Research Council (BBSRC) and Innovate UK.

The IKC:

- facilitates collaboration between companies, engineers, scientists and clinicians to develop innovative technologies that help the body repair and restore function

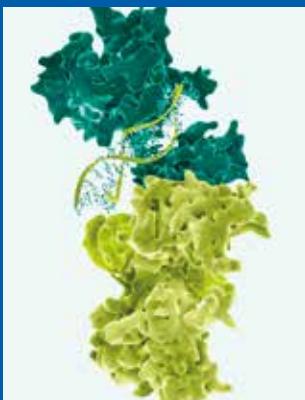
- delivers innovation right across the medical-technology spectrum – from implantable devices through to regenerative therapies that can be enhanced with autologous stem cells
- focuses on technologies that have viable and feasible routes to commercialisation, and supports these through an approach that reduces late failure and cost.

Innovation Areas Covered by the Innovation and Knowledge Centre

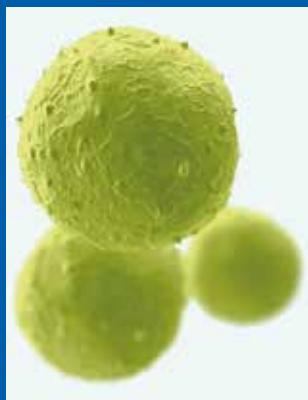
Medical imaging



Biosensors



Stem cells



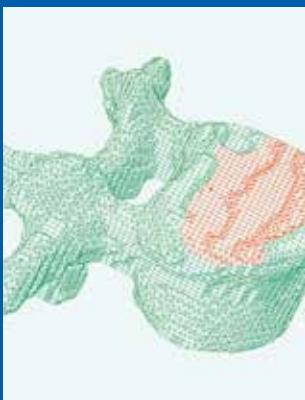
Scaffolds



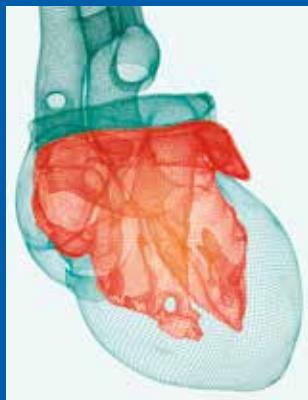
Medical devices



Enabling technology



Cardiovascular



Musculoskeletal





Dr Ceri Williams, Director of Medical Technologies Innovation and Knowledge Centre

'The Medical Technologies IKC is a national multidisciplinary research and innovation platform that aims to reduce the risk and accelerate the successful development of new medical technology products and services. We aim to ensure that companies have the confidence to invest in and progress these technologies all the way to market launch, thus improving health outcomes, and delivering economic and social impact.'

'The IKC has worked in partnership with C TIE to support the development of delivery of our core activities. These include:

- evaluating our innovation management practices
- identifying mechanisms of business engagement
- assessing the effectiveness of the connections across our network
- developing our people from early career researchers up to senior academic leaders
- determining the value we have created through industry inspired projects, and the economic value created through the IKC.

'This partnership has been fundamental to the successful development and impact of the IKC, and has shaped our future development plans.'



Professor John Fisher, Academic Director of Medical Technologies Innovation and Knowledge Centre

'Our main target is to secure investment from the private sector to develop a technology arising from world-leading research in the Medical Technologies IKC – and this sets us apart from other universities and centres in the UK. We believe that if a commercial company is willing to invest, that is a sign of its confidence in the technology, and means a greater likelihood of successful commercial product development.'

'While we continue to support the companies in new product development, through the translation by skilled people of know how, this private sector take up and investment is a strong indicator that the IKC has done its primary job in reducing the risk involved in the translation of emerging technology.'

'We are now looking forward to building on our achievements and the expertise we have acquired, working with partners in C TIE and a wider set of University partners to progress even more technologies through the pipeline and into the private sector.'

Focus of the Interdisciplinary Collaboration between Engineers and Management Researchers

Between 2010 and 2014, members of C-TIE helped to investigate and evaluate the complex innovation processes that surrounded the commercialisation of various medical technologies. The experience was characterised by close collaboration between academic researchers, innovation managers within the Medical Technologies IKC and businesses.

C-TIE assisted innovation managers from the IKC in shaping innovation processes and helping them reflect on their practice, as well as in helping to evaluate innovation performance, and using the project as a site for research on innovation more generally.

This research enhanced C-TIE researchers' understanding of the organisational capabilities required by research centres to balance the requirements of state-of-the art science and engineering research with commercial reality within the fast-moving field of medical technologies. It also enabled academic social scientists to investigate the role of innovation managers who bridge the scientific and business communities.

The IKC's approach to the commercialisation of scientific innovations was to establish a structured stage-gate process for managing the open-innovation processes that occurred within the academic environment, both at the University of Leeds and elsewhere.

The stage-gate process aimed:

- to accelerate the timelines associated with commercialisation
- to reduce the risks and costs associated with developing new technologies through protocols that introduced a process of informed decision-making as the ideas were evaluated.

The stage-gate process itself also provided a framework for learning, collaboration and evaluation. Many of the processes and activities that emerged within the IKC were as a result of the challenges faced in implementing the stage-gate process.

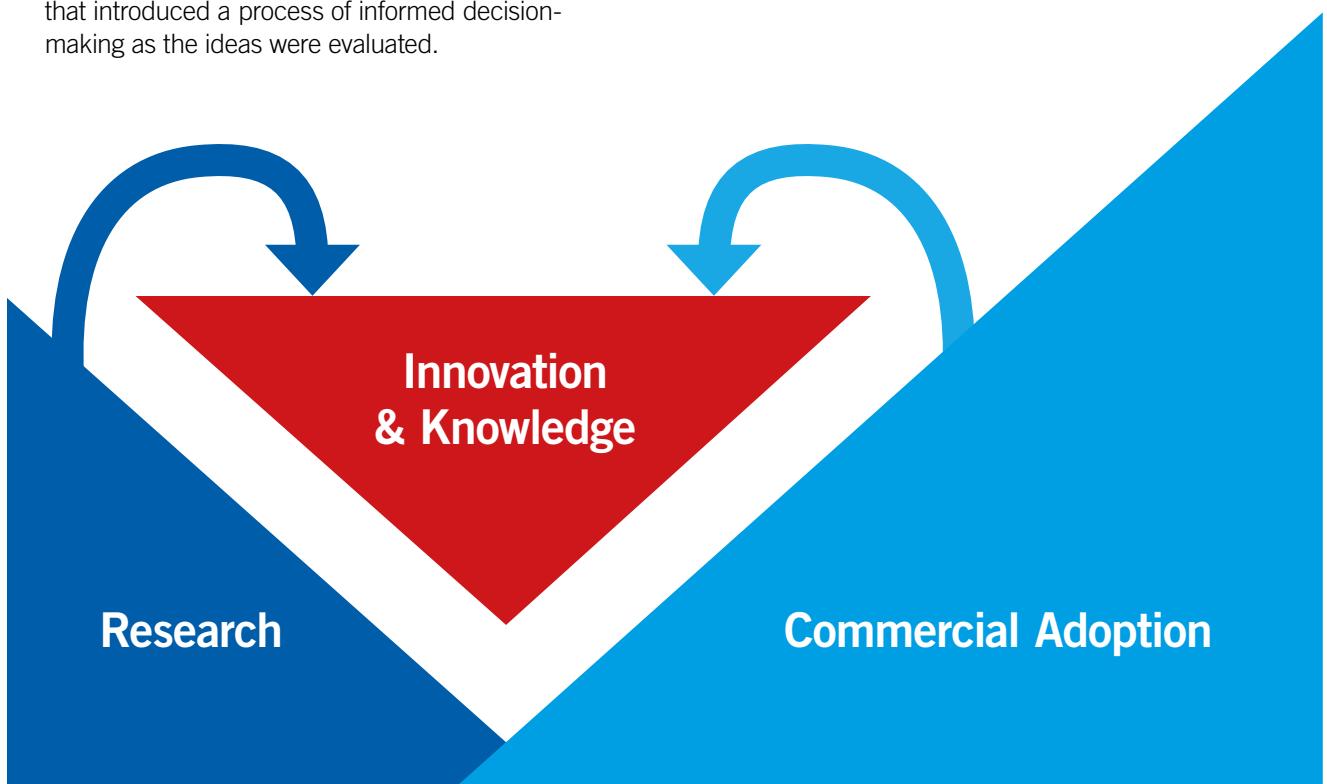


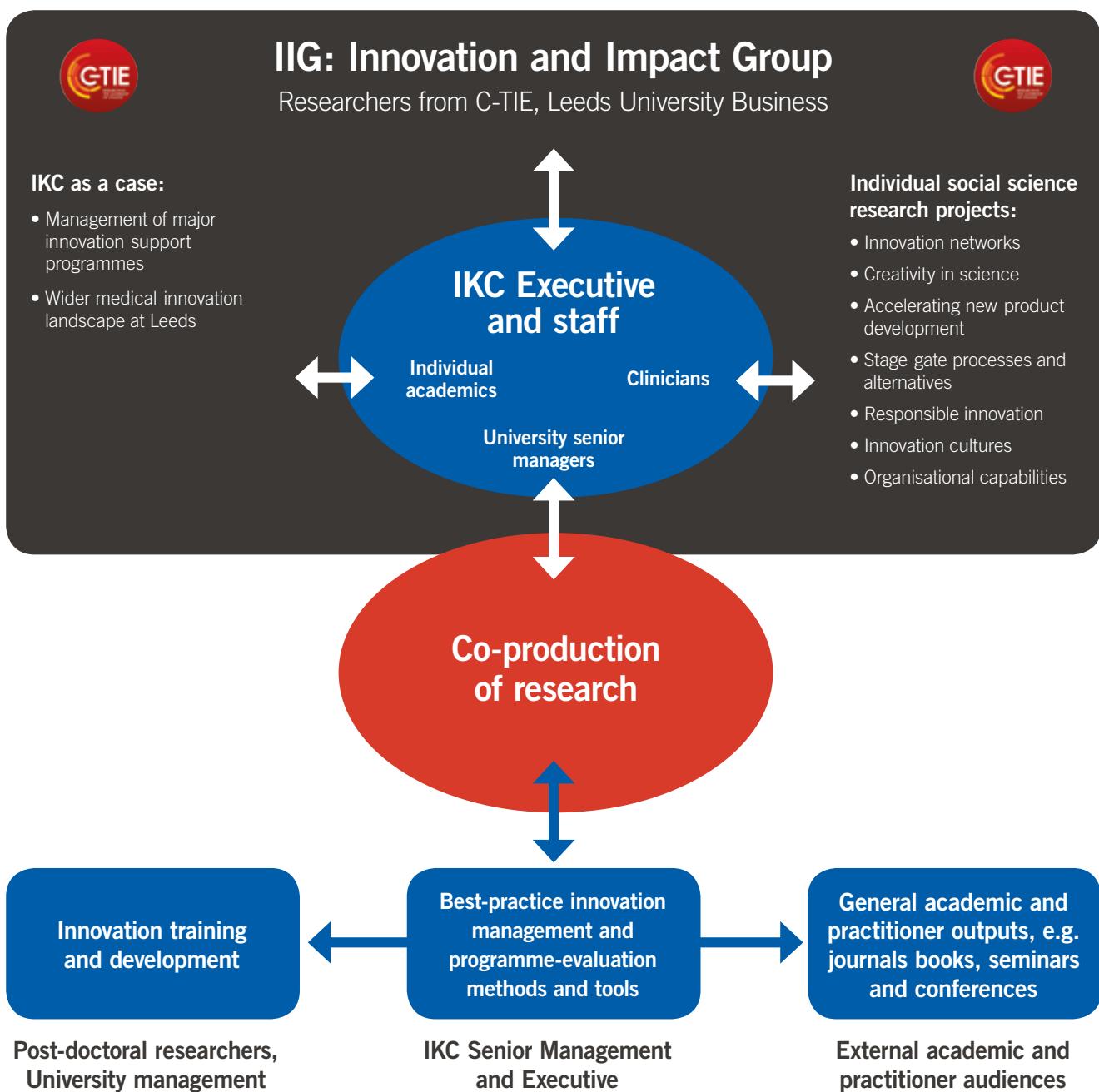
Figure 1: Linking research to its commercial adoption

Areas Where the Collaboration Added Value

How C-TIE worked alongside the Medical Technologies IKC is illustrated in Figure 2. Members of the C-TIE research team engaged on a regular basis with innovation managers within the IKC. A formal Innovation and Impact Group (IIG) was also established to allow intelligence from C-TIE to be fed into the IKC's Executive Management Group, and to shape day-to-day innovation-management systems and capability. C-TIE researchers from all the projects in which they were involved shared their findings, engaged in discussion and, on occasions, acted as critical friends.

Outcomes of this work were changed practices, occasional papers and joint publications. In addition, C-TIE researchers provided an evaluation service for the project, monitoring and supporting the programme; developing projects, human capital within the project, and capacity; and publishing in the area of innovation management.

Figure 2: Supporting innovation in medical technologies: the role of the Innovation and Impact Group



Interdisciplinary Capacity-Building

Fostering a business and science collaboration culture nationally

Involvement in the collaboration has enabled LUBS to produce three PhD students in management, each of whom focused on different elements of the commercialisation process, from networking to the development of creativity within laboratories.

These management scholars have all taken their skills and experiences beyond the University and are now

ambassadors of the cultured development they have observed and experienced in their respective work places: at the BBSRC; in businesses, through the KTP programme; and at the University of Liverpool, where the lessons learnt at the University of Leeds are helping the Management School undertake projects where practising managers are directly involved in engaged research.

Creativity and innovation in multidisciplinary scientific research



Dr Lee Beniston held a University of Leeds Interdisciplinary PhD Scholarship

Dr Lee Beniston currently works across government, industry and academia to drive impact and innovation in the biosciences through supporting academic-industry engagement. Lee is also a Visiting Researcher at Leeds University Business School. Through his PhD and post-doctoral work Lee developed leading expertise on how to foster creativity and innovation in innately multidisciplinary and multicultural scientific research environments. Lee has also been involved in delivering, and evaluating, innovation management training for scientists and engineers.

To date, Lee's research findings and expertise have significantly aided interdisciplinary leaders, practitioners, policy-makers and researchers in a multitude of ways:

- to operate and innovate effectively in multidisciplinary scientific research environments and organisations;
- to rapidly understand how to efficiently and effectively embed and support scientific creativity and innovation in relation to research and training.

Small and medium-sized enterprises and innovation networks



Dr Paul Grimshaw held firstly a White Rose Scholarship and then a Leeds University Business School Post-Doctoral Fellowship

Dr Paul Grimshaw used the Medical Technologies IKC as the site for part of his PhD, researching large-scale programme management and emerging networks, and attempting to understand the way the new programme developed, connected and shared knowledge.

Since then, Paul has extended his interests to connect to the small and medium-sized enterprise (SME) and health communities, primarily in Yorkshire. This work aims to help them understand better the challenges they face in managing innovation.

Paul says: 'Innovation is a big challenge for small companies, and getting an external perspective from experts who understand the challenges they face can be extremely helpful in accelerating that innovation.'

Dr Edward Draper, Innovation Manager, JRI Orthopaedics Ltd, comments: 'JRI Orthopaedics has been a successful UK manufacturer of orthopaedic implants for several decades. Recently, we have invested in innovation in the form of rebranding (we now have the strapline "Innovation in Practice"), creating a new Department of Innovation and Learning and establishing a new post of Innovation Manager. While we have enjoyed major improvements in how we approach innovation, the IKC team has been instrumental in helping us towards the next step. There was a sense of the law of diminishing returns, and of reaching a plateau, part of which arose from trying to marry the innovation and operational worlds. The IKC has been instrumental in helping frame the problem and outlining ways forward. Our work with the IKC will hopefully continue – we see it as being part of a long conversation – and remain as successful as it has been to date.'

Paul's work reinforces that fact that innovation does not happen in isolation; to improve innovation, the IKC was also able to draw on some of the skills and tools that Paul developed. This helped the IKC recognise the importance of organising and managing various events, with the goal of bringing individuals from industry, academia, the clinical world, government, and intermediary and regulatory bodies together under one roof.

Paul has tracked the processes of how this happens very closely, using the tools he has developed; he is able to demonstrate how networks grow over the years, as well as their nature and shape, and how they change.

For example, Figure 3 shows the volume of attendees at events increasing over time, while Figure 4 shows how organisations in the medical field connected as a consequence of their attendance at 12 events. Figure 5 demonstrates how specific industrial partners connected, also through attending 12 events.

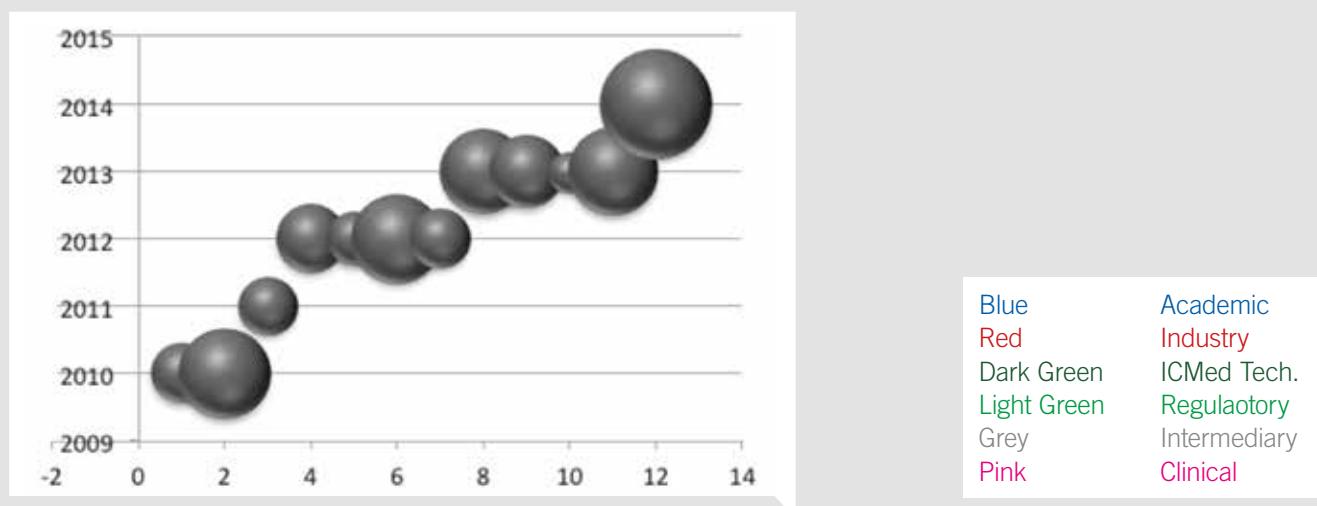


Figure 3: Volume of attendees at events increasing over time

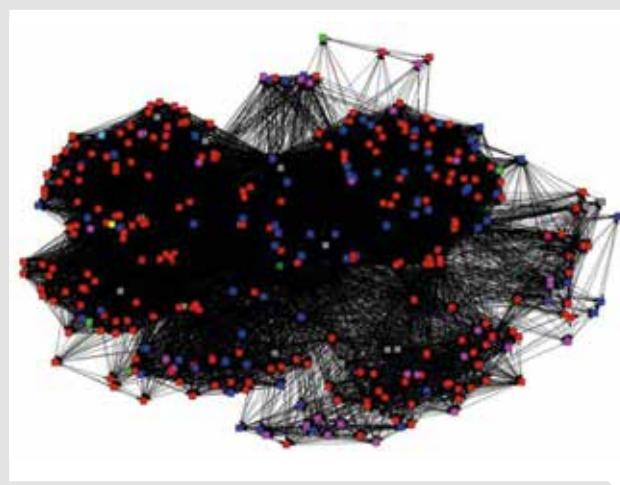


Figure 4: Organisations connected by attending 12 events

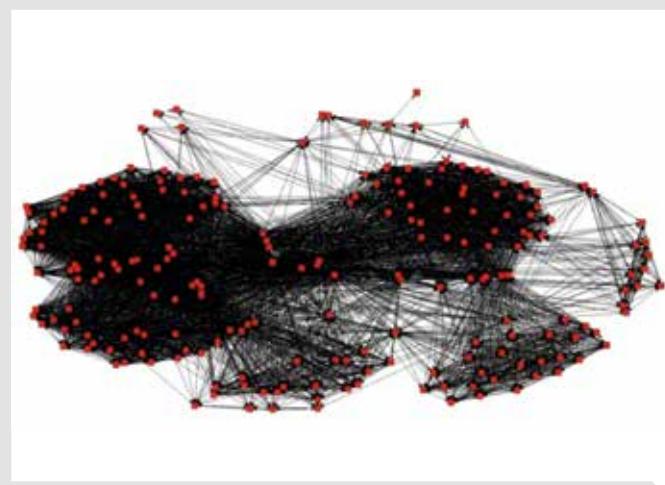


Figure 5: Industrial partners connected by attending 12 events

Responsible innovation



Dr Paul Ellwood was the Innovation Impact Evaluation Manager, Medical Technologies IKC, Leeds University Business School

The aspiration for responsible innovation is built upon the notion that scientists should seek to take into account more than just economic interests as they develop products based upon new technologies. Such interests might reflect standards of ethical acceptability and societal desirability that are not always evident in the established modes of commercialising science. In practical terms, a process of responsible innovation would witness scientists engaging with a new range of stakeholders (e.g. non-governmental organisations, patient groups and civic authorities).

Dr Paul Ellwood conducted his PhD at LUBS, exploring scientists' responses to responsible innovation mandates. This research was extended within the Medical Technologies IKC in collaboration with Professor Anne Kerr and Dr Chris Till from the University's Sociology Department. The project within the IKC involved engagement with a group of bioscience researchers pursuing an innovation agenda. It explored what the principles and discourse of responsible innovation might mean in practical terms for such scientists in their own work with industrialists, regulators and clinicians.

While not originally aware of the debates surrounding responsible innovation, the social-research team encountered a great deal of interest and potential in the idea. Bioscientists' immediate response was to suggest the benefits of having greater transparency in their engagement with patients and other health-innovation stakeholders. They extended familiar notions of personal responsibility towards external stakeholders, to include scientists' responsibilities to support each other with the risks both to their own careers and to the institutions when building a new set of innovation alliances.

The project succeeded in raising the bioscientists' awareness of the innovation networks (both existing and potential) in which they might participate. That such participation might be more than simply 'working in the lab' was an important insight for the bioscience researchers; as a result, responsible innovation now features in LUBS's Postgraduate Certificate in Professional Innovation Management.





LUBS's Approach to Research

The approach taken by LUBS to research embraces a variety of types, from basic/foundational to applied/translational and C-TIE's involvement in the IKC exemplifies these.

As a research-led school, we require our basic foundational research to be published in the highest-quality journals (either academic or mainstream management). Members of LUBS have written about and been involved in debates about the process of knowledge translation, including how it can be both conceived and improved (Thorpe et al, 2011).

In terms of applied/transactional research, LUBS adopts various approaches to ensure that its research is translated into publications in practitioner journals. Among these approaches is co-collaboration with companies and, where possible, the development of directly usable outputs. These

might include developing tools for organisational use, making the research available on website, or even producing textbooks.

LUBS takes the view that research cannot truly be relevant unless, at some stage in the knowledge-production process, it is tested within the context of practice or policy. The way we conceive of this is in terms of a knowledge-translation value-chain.

The types of research supported are depicted in the diagrams below (Figures 6 and 7), in respect of C-TIE's involvement in the Medical Technologies IKC. Figure 6 indicates areas of our intent and the outputs from our research. Figure 7 shows the sources of funding and support.

How we conceive of engagement and impact across the value-chain

Type I: Basic research impacting other researchers

Theory development is depicted by the first two chevrons (KT0/OP1) in Figure 6. This type of research is where the research mainly impacts other researchers through its contribution to knowledge or theory. Very often, this research is the result of grants from research councils.

The measurement of basic research usually takes the form of articles published in journals, research books and monographs, and the impact of this type of research is judged citation counts and so on.

Type II: Theory-to-practice focused research

Theory to practice research or thought experiments, covered by chevrons KT1/OP2 in Figure 6, consider how basic research might lead to improvements in practice, or might influence policy. The focus here is on how the knowledge transfer process could be facilitated. Still conducted within the academic domain by and between academics, this research focuses on the implications for practice. Such considerations might lead to the beginnings of a strategy for engagement with practitioners; also important is how theories can be translated into policy advice.

The measurement of this practitioner oriented research takes the form of outputs in practitioner journals and joint publications.

Type III: Practitioner-located research

Engagement of users, covered by chevrons KT2/OP3

in Figure 6, involves explicit engagement with users. In this, knowledge translation involves the reconfiguration of both practitioner and academic knowledge. This is shown schematically by the different colours on figures 6 and 7. The methods we have adopted involve either knowledge transfer (as in KTPs or Collaborative Awards in Science and Engineering (CASE) studentships) or knowledge translation (where the activities are increasingly interactive in nature). This kind of research is normally undertaken either by individuals (working in this case within the Medical Technologies IKC, e.g. the PhD students) or by groups of researchers working with IKC innovation managers. Here, the design of the research has taken an action research or collaborative research format and was highly interactive, with members of the IKC providing both time and access.

This kind of research has a number of practical outcomes, such as papers in academic journals and the opportunity to influence change.

Type IV: Translating research for practice

Wider dissemination and directly usable outputs, covered by chevrons KT3/OP4 and KT4/OP5, are where our objective is to produce knowledge that can be more widely disseminated with user groups and stakeholders. In the case of the Medical Technologies IKC, this is knowledge that we can disseminate through conferences or build into case studies for students through transfer into the curriculum, and the development of programmes on innovation management, including executive education.

Renewal and extension of research agendas

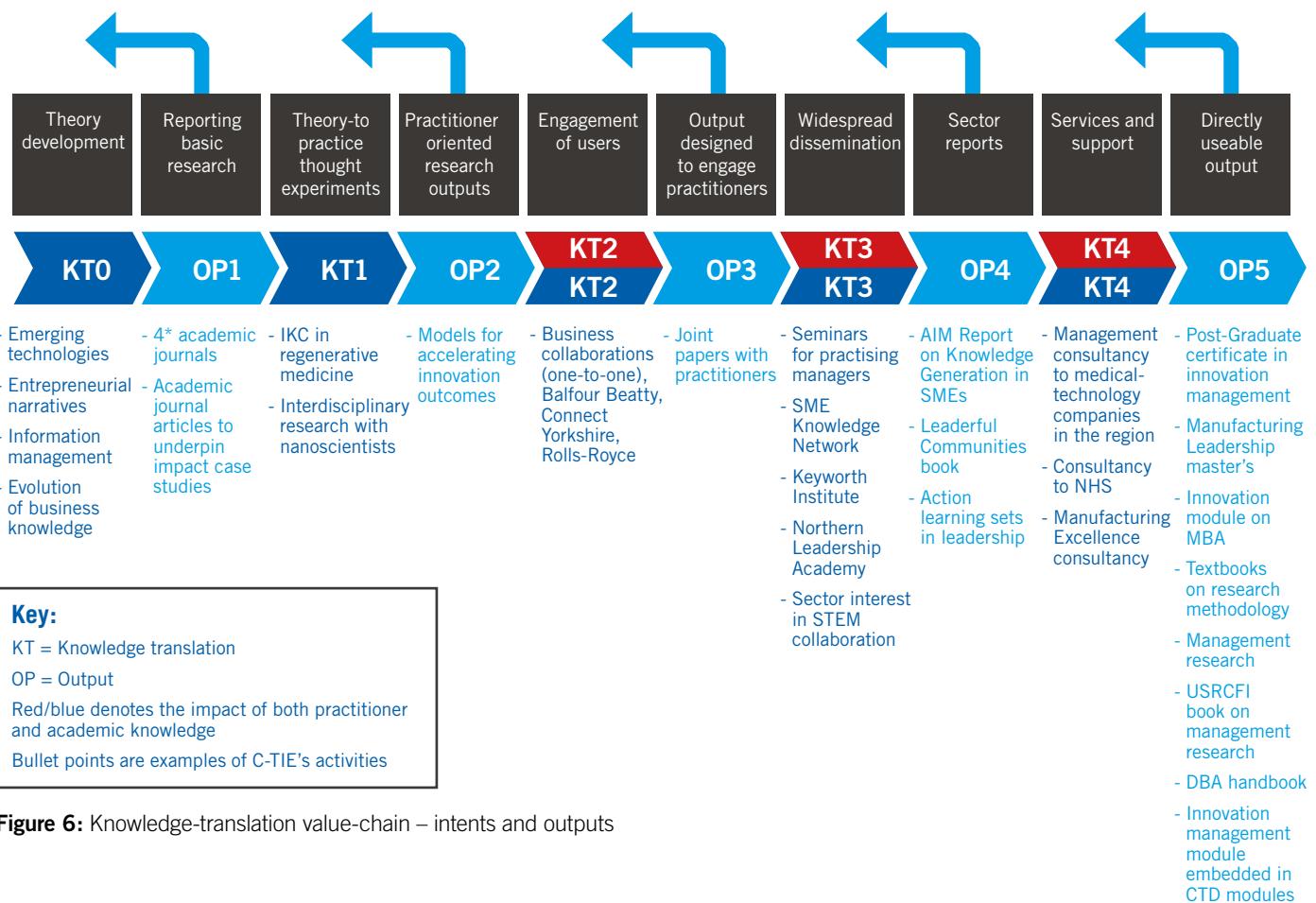


Figure 6: Knowledge-translation value-chain – intents and outputs

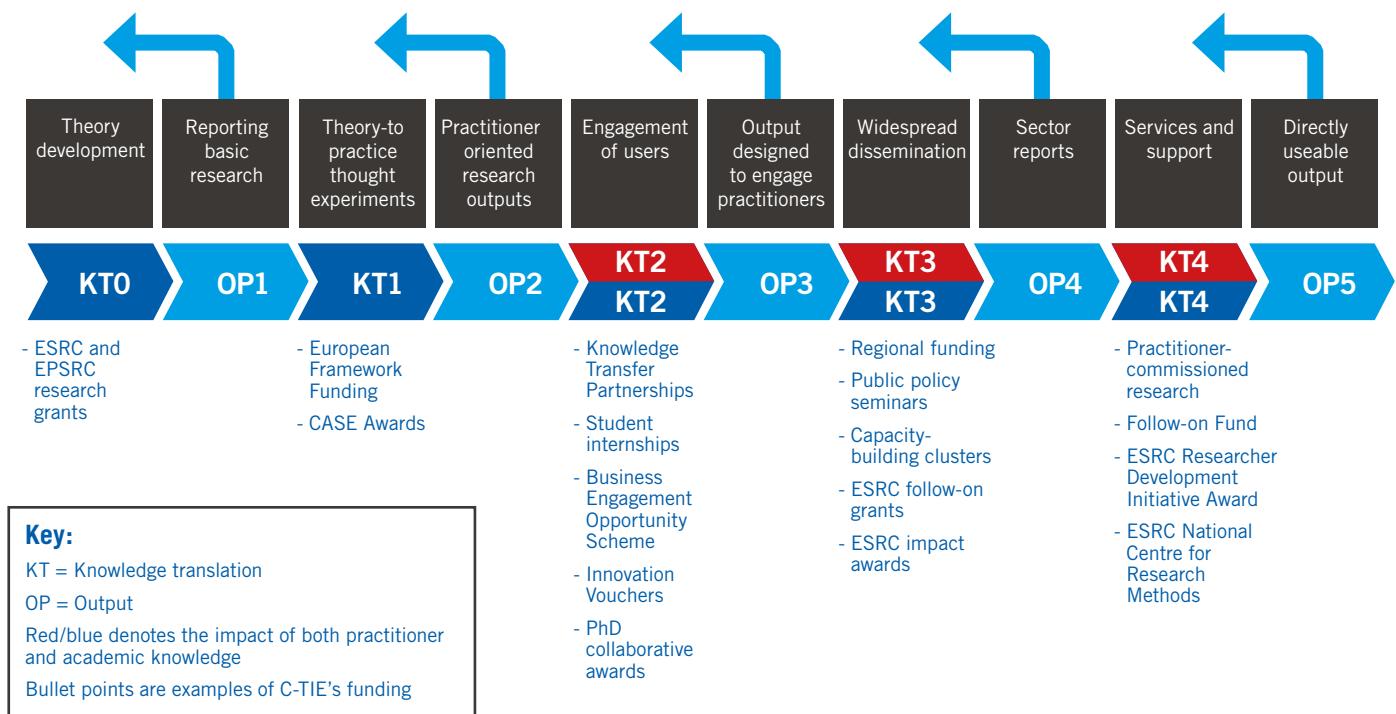


Figure 7: Knowledge-translation value-chain – funding and support

Using the Medical Technologies Innovation and Knowledge Centre to Attract Additional Resources

We have found that research grants to conduct the kind of research we are interested in are limited and highly competitive within the social sciences compared to within sciences. LUBS has managed to leverage the Medical Technologies IKC to gain two additional Fellowship awards – both Management and Business

Development Fellows funded by the Economic and Social Research Council (ESRC) and the Society for the Advancement of Management Studies (SAMS). These have created opportunities for LUBS to embrace interdisciplinary research further, by attaching these research fellows to work on the project.



Dr James Roberts is an ESRC, SAMS Management and Business Development Fellow

Dr James Roberts has used his industry and consultancy experience to offer insights into the management of the project. On joining the project, James explored the ways in which the commercialisation of university research in the field of medical technologies and healthcare would be improved through developing a greater understanding of current barriers.

Universities in the UK are currently undertaking research that has huge implications for the future provision of healthcare, but James found that this research will have a tangible impact on healthcare providers and patients only if it is identified and commercialised (brought to the market) in an efficient and effective way.

There are many barriers that slow the process, including institutional cultures that limit the ability and willingness of researchers to pursue more applied work and its commercialisation actively, as well as a lack of communication between researchers and their potential commercial partners.

James focused on identifying ways in which research cultures and processes within universities could be



Sanaz Sigaroudi is an ESRC, SAMS, UKCES Management and Business Development Fellow

better understood, and modified to ensure a better dynamic and fruitful set of relationships between those undertaking basic research in the field, and those parties (typically healthcare companies and government bodies, such as the NHS) whose role it is to bring new healthcare products to patients.

Since conducting his research, James has gone on to manage LUBS's full-time MBA programme – a role for which his consultancy experience and engaged research interests are particularly well suited.

The other fellow, Sanaz Sigaroudi, has a background in industrial engineering and has helped LUBS enter the European Manufacturing Survey project. The network consists of 14 European countries led by the Fraunhofer Institute in Germany. The project looks at innovation in the manufacturing sector as a whole, encompassing product, processes and management innovations and their interactions. The data is collected every three years and the unified survey enables cross-country comparisons which could lead to better understanding, benchmarking and policy making at national level.

Supporting Innovation by Bringing Academics One Step Closer to Industry

The research insights gained from close involvement with the Medical Technologies IKC have enabled C-TIE and LUBS to develop for the IKC a specialised Postgraduate Certificate (PGCert) in Professional Innovation Management.

The research from our engagement with Medical Technologies IKC and other C-TIE projects (e.g. the EC-funded ManETEI Marie Curie Initial Training Network) has also enabled LUBS to develop a number of new modules on innovation theories and practices and a few interdisciplinary master's programs. We have also developed a new MSc programme in Global Innovation Management, delivered jointly by the Management Division and International Business and an MSc programme in Engineering, Technology and Business Management delivered jointly with the School of Electronic and Electrical Engineering.

Setting researchers on the road to market

Leeds University Business School's PGCert in Innovation Management aims to equip students to steer their research innovations towards a commercial outcome.

This programme uses an action-learning approach, which is a departure from the experience of many of the students. Action-learning offers a problem - and learner-centred approach to development, where knowledge and information are fed into the programme in a flexible way.

It is based around researchers' existing projects, with industrial colleagues and university professionals contributing their perspectives and experience. Students also work on their own innovation project, giving them the opportunity to put their knowledge into practice and take action, thus developing their experience.

As one of the course co-ordinates, Dr Paul Grimshaw, former LUBS Research Associate, explains: 'The work we've done to develop this course, the contacts that we've made, and the relationships we've established among businesses in the Leeds and Sheffield area are already benefitting students on other courses, such as our MBA.'

The course participants are also enthusiastic about the programme.

Dr Maria Katsikogianni, Research Fellow in the University's Faculty of Medicine and Health, is interested in developing novel antimicrobial coatings for medical implants and completed the course in 2014.

'I found the introduction to market analysis very useful, as well as the opportunity to meet surgeons and potential industrial partners,' she says. 'Looking at your research from the perspective of the end user makes a huge difference – it means the technology is being pulled by the market and the clinical need, rather than pushed by research departments.'

Another satisfied course participant was Dr Chris Brown who recently joined the University of Leeds Research and Innovation Service as Intellectual Property and Commercialisation Manager. He had previously been a research scientist on dCELL® technology artificial ligament. 'The course led me to reflective and reflexive thinking; it gave the opportunity to meet people outside my peer group.' He adds 'I learnt how to work effectively with diverse groups of people. It builds capacity, and without the training and hands-on experience offered by the IKC, I couldn't have managed to get where I am now in my new role.'

Another participant was Dr Cait Dennis, who has moved from working on stem cells to a management role - she is currently the Educational Staff Development Manager at the Leeds Institute of Medical Education. She believes the course has enabled her with this transition: 'I've learnt that innovation management is about critical thinking around ideas, open communication and collaboration with others. I'm more confident – I can recognise the potential ideas and their impact and have the skills to develop them to drive progress.'

Training tomorrow's innovation practitioners

Drawing on the experience of delivering the Postgraduate Certificate in Professional Innovation Management, LUBS has taken the opportunity to develop modules that address innovation-management theories and practice for two new Centres of Doctoral Training (CDTs) funded by the EPSRC, for Tissue Engineering and Regenerative Medicine.

The CDT is one of 70 in the UK funded by the EPSRC, designed to equip postgraduate students with the skills needed to address healthcare challenges – a field growing in global importance. Students will obtain a firm grounding in fundamental innovation-management theory, as well as hands-on experience through selecting from a number of specialist topics related to the commercialisation of scientific research. The programme is designed to help them take a lead in industry–university relations, as well as to work effectively on interdisciplinary projects and within innovation groups.

Findings and Products of Our Research

Importance of building industry–university trust

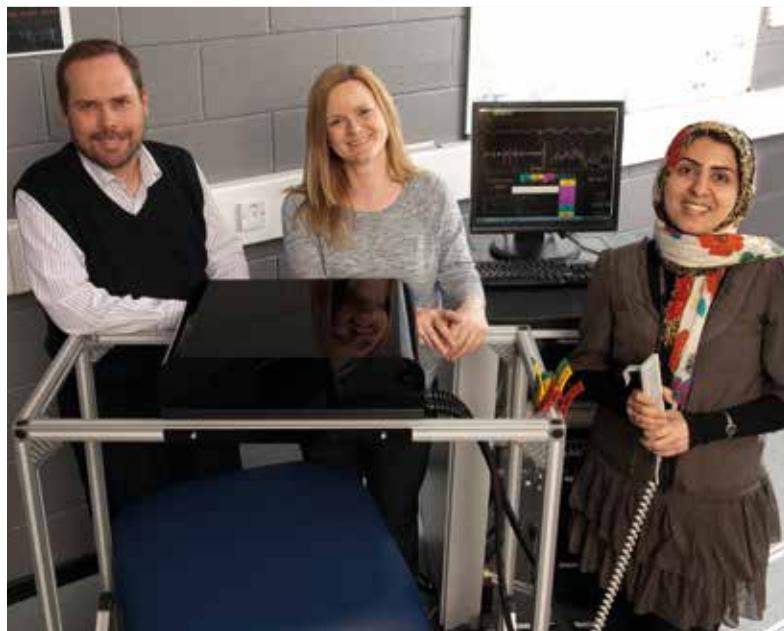
Innovation is far more likely to happen in partnership than in isolation. Working with universities not only helps in the de-risking process, but also allows SMEs to focus on their core competences by leveraging the external expertise in research and development that emanates from universities.

One of the barriers we have identified is the initiation of this link, and the way it is inhibited by both a lack of trust and different cultures manifest in the norms and values of the two communities. The role of innovation managers within the Medical Technologies IKC is to act as a mediator or a friendly interface between the two groups. Speaking a commercial language and yet having an understanding of academics' priorities and values has proved invaluable. Innovation managers are basically scientists who focus not on science but on the management, marketing and feasibility of the innovation. They know the language of both communities and are able to translate effectively the goals and expectations of each, building trust between the two.

An example of this is Pd-m International, which worked with the IKC on developing a surgical device for next-generation laparoscopic surgery. The company specialises in commercialising innovation, primarily for private companies, and has won various innovation awards in medical and healthcare products.

Richard Hall, Managing Director, comments: 'Since being established in 2005, we have worked with several universities, all in the field of medical and healthcare technology. Part of the success of the IKC in my view is the people involved, who have valuable commercial experience yet are able to communicate effectively with the academics in order to positively make an impact. Without the IKC, the project would not have been as successful; of that I am certain. The main gain we have received with the IKC is a renewed faith and trust in working with universities, in terms of increasing the probability of research-based products successfully converting into commercially viable products.'

In another example, Professor Ben Varcoe, of the University's School of Physics and Astronomy, came up with a smart idea for a life-saving device: a portable magnetometer, which will reduce the diagnosis time for suspected cardiac conditions. The time saved by using this device will significantly reduce the costs of unnecessary hospital admissions, as well as saving time and resources for clinical staff.



Professor Ben Varcoe and the project team with the portable magnetometer

I think it was the naivety of thinking that just having the idea puts you on the starting block. Research isn't sufficient; the difficulty is that the work has got to be guided, to make sure that the results that you're generating are on a pathway to become a commercially viable reality. Writing publications on interesting research topics doesn't change anybody's opinion on the marketability of that product. Science and management should go hand in hand.

This has been a team effort and Leanne Burgin, Innovation Manager from the IKC, provided the essential project management to bring the different parties together and aid the transition from laboratory research to a medical product.

Professor Ben Varcoe

Regional and National Innovation Tools

Helping SMEs to innovate

Also key to successful commercialisation are a number of innovation tools that aid and, as a consequence, feed the innovation process. One is a tool kit that codifies the innovation expertise developed at the University of Leeds and is supporting medical-technology business growth in the region. It can be used within organisations to help them think about innovation and improve their processes. The know-how has been created this time within the Medical Technologies IKC by researchers at LUBS, working with companies in the region.

Fripp Design and Research originally approached the University for help with making some key business

decisions around its 3D printing technology. ‘In 2013, we were faced with a dilemma,’ said Tom Fripp, Managing Director. ‘We created a landmark in 3D-print technology that prints silicone – an industry first. It has the potential to be the next generation of kit in additive manufacturing, and it’s generated a lot of interest. We didn’t know if we should take the product to market ourselves – setting up as manufacturers – or whether to sell the company and its intellectual property.’

Tom adds: ‘Sometimes, you cannot see the wood for the trees, operating in your own business, so it was good to get a fresh and challenging approach to why and how we do things.’

Proof-of-concept self-assessment tool

An example of the knowledge input by practitioners was the development of a proof of concept (PoC) self assessment tool. At the heart of the Medical Technologies IKC is the notion that innovations at technology readiness levels 2 and 3 need to be thoroughly evaluated (proved) to ensure they are technically sound and commercially feasible, and address a defined clinical need.

A PoC is a proposal, the purpose of which is to verify that the underlying concept or idea behind the theory has the potential of being used and can be commercialised. Not every novel idea is ready for PoC testing, and the innovation service within the University that works to deal with the intellectual property aspects and help commercialisation is sometimes flooded with ideas that, after more detailed examination, need to be

further researched before they are ready to go forward. To help innovators reflect on whether or not their ideas are ready, a screening tool has been developed to help both the researchers and the innovation service office to spend their resources on those projects that stand a better chance of success.

The PoC Self Assessment Tool developed at the University of Leeds provides rapid evaluation of the readiness of the projects, and can successfully distinguish between projects that should go forward to PoC stage and those that should not.

Through the questions asked, the tool assesses the readiness of the medical technology concept for translation and commercialisation. It then identifies those gaps that a PoC project ought to address. The tool has been adapted for national use at other innovation knowledge centres, such as the N8 Group and University of Nottingham.

Policy Relevance

In 2013, Professor Richard Thorpe was the co-author of a report (Thorpe and Rawlinson, 2013) that examined the role of UK business schools in driving innovation and growth in the domestic economy. The report identified a number of factors that are pertinent here. Perhaps the most significant is the need for business schools to move to more distinctly defined roles for different institutions.

The connection of LUBS to the Medical Technologies IKC is one example of how business schools can help catalyse the commercialisation of university-generated

technology. This kind of specialisation implies developing in specific academic areas of research and particular aspects of business engagement. For C-TIE, this has been in the area of technology innovation and business strategy.

Other themes of the report to which this initiative connects is the way the latter has helped design practice into our courses, and the way we have focused attention on measuring and assessing the impact of our research.

Developing metrics for research engagement

C-TIE's involvement in the Medical Technologies IKC was always with a view to assisting with the evaluation of the project as a whole. However, the close working relationships enjoyed have allowed us to develop a model of how performance and C-TIE's contribution to the whole project might be evaluated.

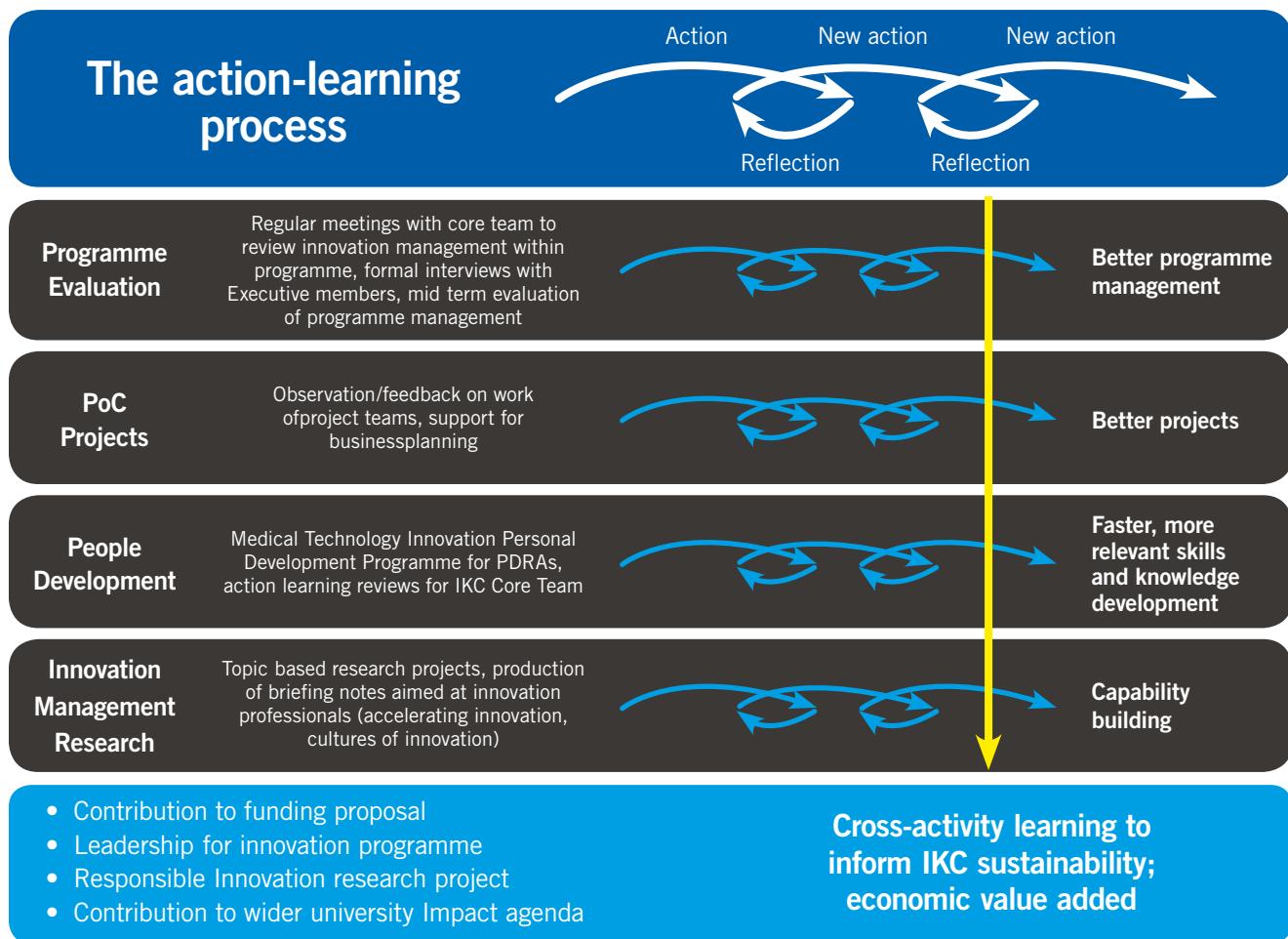
To achieve this, C-TIE has combined with LUBS's Economics division to undertake a detailed examination

of the IKC's and C-TIE's impact on dimensions such as improved processes, the development of human and social capital, and the sustainability of initiatives such as this, through building capacity more widely across the University.

We have also conducted an investigation into the IKC's impact on business within the region, and worked to quantify how the project has added value.

Figure 8 shows these strands in more detail, and illustrates how they are integrated into learning from the innovation and commercialisation processes as a whole.

Figure 8: Innovation and Impact Group action-research programme: our involvement and the measurement of impact



House of Lords evidence

The Medical Technologies IKC and Regener8 (the UK network for translating regenerative technologies) have given evidence to the Science and Technology Committee of the House of Lords. This evidence was on the subject of business models, venture capital and the funding gaps that exist. Of particular concern were aspects of open innovation management practices and the legal framework.

The Committee's report, *Regenerative Medicine*, delivers a stark warning that while the NHS makes

the UK a potentially attractive place for international investment in regenerative medicine, problems in our regulatory arrangements and a lack of co-ordinated leadership are holding back the UK from being able to deliver improvements to the quality of people's lives, notwithstanding the benefits to people's lives as they are. The Committee called for changes to ensure that investor confidence is retained and that a clear pipeline exists from bench to bedside for regenerative therapies.

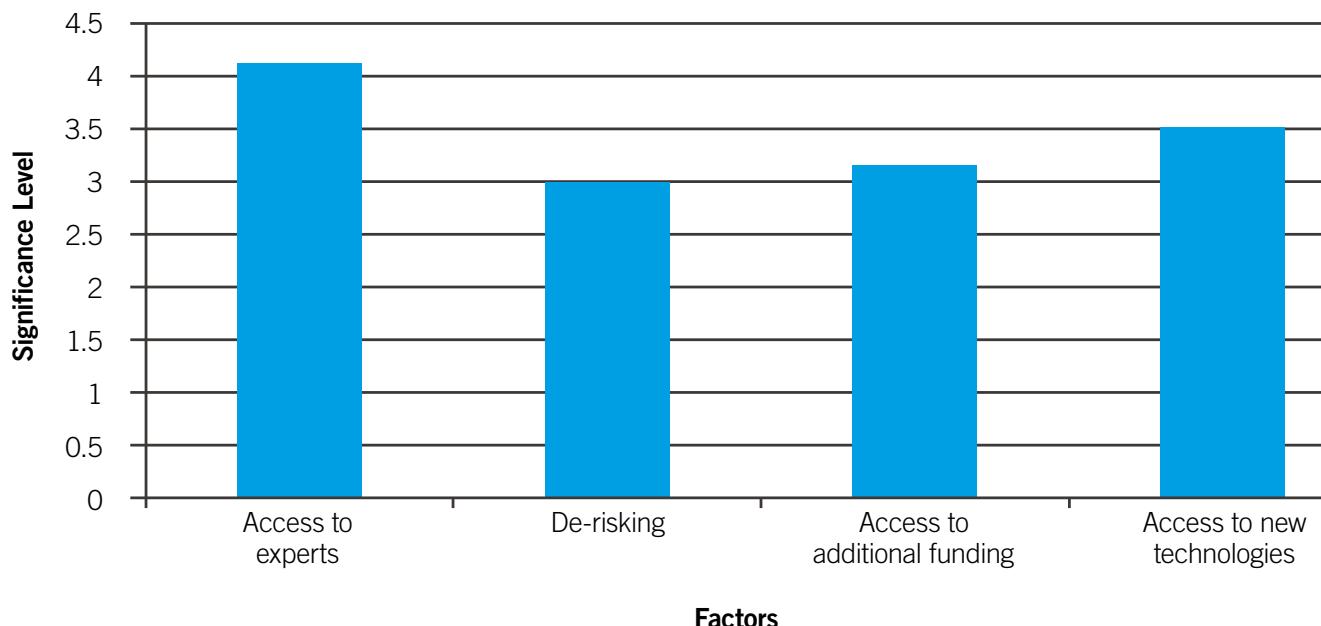
Dedicated investigation of the impact on businesses

Survey data was collected as part of the evaluation of the whole project and used to help shape future engagement with companies. From that data, 'access to expertise' (see Figure 9) seemed to be the most significant aspect of the Medical Technologies IKC

that companies who collaborated with the centre found to be of value. This is probably not a surprising finding, as the IKC had aimed to create a safe, sustainable bridge between industry and academics. Industrial partners have been taken on a journey safely!

The second most significant factor was the access they gained to new technologies, a comment which links well with the notion of a journey and a partnership.

Figure 9: Benefits of the Innovation and Knowledge Centre for industry



Future Opportunities

As we have indicated, this investment in pioneering co production methods in research has become a distinctive feature of LUBS's research generally, and C TIE's research particularly, and has led to the investment in new ways of co producing research through actively engaging external corporate, government and third sector users.

The process within the Medical Technologies IKC has underpinned the University's investment of over £6m in sector hubs, which are themselves represented as a strategic gateway to developing research partnerships within the region and beyond.

Within LUBS, the Business and Professional Services Hub has adopted this approach to kick start a number of important new research projects. The experience has also enabled LUBS to engage in a number of training

and research capacity-building activities nationally. For example, the framework for user engagement/knowledge translation has informed a number of national researcher development programmes. This has included workshops for the Development Programme for Directors of Research (for the British Academy of Management/Association of Business Schools), which exists to help research managers develop impact.

Researchers within C TIE have also designed and delivered training on engaged research in Belfast, Cardiff, Derby, Edinburgh, Leeds, London and Plymouth. These were funded by grants from Vitae, the ESRC and the White Rose Doctoral Training Centre. Material from the researchers' experiences within the IKC was used as case studies for these workshops.

Publications

The following publications show research that has either informed or been produced through C-TIE's engagement with the Medical Technologies IKC.

Theses

- Ellwood, P. (2015) *Where Science Meets Innovation: Organising Technology Research Groups in Response to Mandates for Societal and Economic Impact*. PhD thesis, University of Leeds.
- Beniston, L. (2012) *An Ethnography of Creativity: Studies in Multidisciplinary Scientific Research*. Published PhD thesis, University of Leeds.
- Grimshaw, P. (2012) *The Social Context of Programme Management: the Adoption and Implementation of a Management Innovation Programme*. Published PhD thesis, University of Leeds.

Books

- Anderson, L., Gold, J. Stewart, J. and Thorpe, R. (forthcoming) *Professional Doctorates in Business and Management: A Handbook*, London: Sage
- Thorpe, R., Gold, J., Anderson, L., Burgoyne, J., Malby, R., and Wilkinson, D. (2008) *Towards Leaderful Communities in the North of England: Stories from the Northern Leadership Academy*, Dublin: Oaktree Press

Task-force report

- Thorpe, R. and Rawlinson, R. (2013) *The Role of Business Schools in Driving Innovation and Growth in the Domestic Economy*, Association of Business Schools Task Force Report, London

Chapters in books

- Ellwood, P. (forthcoming), 'Researching and working in and with organisations', In: *Professional Doctorates in Business and Management: A Handbook* (Eds Anderson, L., Gold, J., Stewart, J. and Thorpe, R.)
- Ellwood, P., Thorpe, R. and Coleman, C. (2014) 'A Model for Knowledge Mobilisation and Implications for the Education of Social Researchers' In: *Knowledge Mobilisation and Social Sciences: research impact and engagement*, Jon Bannister (Ed), London: Routledge
- Beniston, L. J., Adams, D. J. and Wakeford, C. (2011) 'Bioenterprise', in: Effective Learning in the Life Sciences: How Students can Achieve their Full Potential (ed D. J. Adams), John Wiley & Sons, Ltd, Chichester, UK.
- Gold, J., Thorpe, R. and Mumford, A. (2010) 'How Leaders and Managers Learn'. In: Gold, J., Thorpe, R. and Mumford, A. (Eds) *Handbook of Leadership and Management Development*, Aldershot: Gower

- Thorpe, R. and Elwood, P. (2010), 'Positioning Current UK Management Research' In: Challenges and Controversies in Management Research, London: Routledge
- Thorpe, R. and Gold, J. (2010) 'Leadership and Management Development'. In: Gold, J., Thorpe, R. and Mumford, A. (Eds) *Handbook of Leadership and Management Development*, Aldershot: Gower

Articles in journals

- Beniston, L., Ellwood, P., Gold, J., Roberts, J., Thorpe, R. (in press), 'Innovation Development – An Action Learning Programme for Medical Scientists and Engineers', *Action Learning Research and Practice*, DOI: 10.1080/14767333.2014.945896
- Thorpe, R. and Rawlinson, (2014) Engaging with Engagement: how UK business schools could meet the innovation challenge, *Journal of Management Development*, 33, 5 pp 470–486
- Ellwood, P., Thorpe, R. and Coleman, C. (2013) 'A Model for Knowledge Mobilisation and Implications for the Education of Social Researchers', *Contemporary Social Science*, 8, 191–206
- Thorpe, R, Eden, C, Bessant, J and Ellwood, P (2011), 'Rigour, relevance and reward: introducing the knowledge translation value-chain', *British Journal of Management*, Vol 22, no. 3, pp. 420–431
- Pandza, K and Thorpe, R. (2010) Management as Design, but What Kind of Design?' *An appraisal of the design science analogy for management*. British Journal of Management, Vol 21, Issue 1, pp171–186.
- Pandza, K and Thorpe, R. (2009) 'Creative search and Strategic Sense-making: Missing Dimensions in the Concept of Dynamic Capabilities', *British Journal of Management, Special Issue: The Practice of Dynamic Capabilities: Theory Development and Research*, Guest Editors: Easterby-Smith, M., Peteraf, M. and Lyles, M. Vol 20, S118–S131
- Jones, O., Macpherson, A and Thorpe, R (2010) 'Learning in owner-managed small firms: Mediating artefacts and strategic space', *Entrepreneurship & Regional Development: An International Journal*, Vol 22, Issue 7, 649 (3)
- Adams, D., Beniston, L.J., and Childs, P.R.N. (2009) 'Promoting creativity and innovation in biotechnology'. *Trends in Biotechnology*. Vol. 27, pp. 445-447
- Gold, J., Anderson, L., Clarke, J. and Thorpe, R. (2009), To act and learn: a Bakhtinian exploration of action learning, *Action Learning: Research and Practice*, Vol 6, No. 2, pp 121–130

Conference papers

- Egan, J., Williams C. and Dixon-Hardy, J. (2013) 'When Science meets Innovation: a new model of research translation', *International Society of Professional Innovation Managers, 6th International Innovation Symposium*, Melbourne
- Garud, R., Pandza, K, Ravasi, D. and Clarke, J. (2011) 'Revealing the Cultural in Entrepreneurship and Innovation', Personal Development Workshop, *Academy of Management Annual Conference 2011*, San Antonio USA
- Gold, J. and Roberts, J. (2012) 'Action Learning Research: Theorising in the Set', *International Action Learning Conference*, Ashridge
- Gold, J., Roberts, J. Thorpe, R. (2013) 'Innovation Development – An Action Learning programme for medical scientists', *International Society of Professional Innovation Managers, Annual Conference*, Helsinki
- Grimshaw, P. and Pandza, K. (2013) 'Innovation Speed – A Systematic Literature Review', *International Society of Professional Innovation Managers, Annual Conference*, Helsinki
- Thorpe, R. (2013) 'Innovation in Business Schools', Professional Development Workshop at *British Academy of Management Annual Conference*, Liverpool
- Thorpe, R., Eden, C. Starkey, K. and Ellwood, P. (2010) 'Framing the Impact Debate', Symposium organised for the *British Academy of Management Conference*, Sheffield Implications of Impact on Researcher Development
- Thorpe, R., Pandza, K. and Ellwood, P. (2008) 'Shaping or (just) observing science driven innovation and enterprise: challenges for management studies'. Workshop in the innovation stream at the *British Academy of Management Conference*, Harrogate
- Thorpe, R., Roberts, J. and Duff, G. (2012) 'Engaged Research', a Professional Development Workshop at *British Academy of Management Annual Conference*, Cardiff
- Thorpe, R., Roberts, J., Williams, C. and Grimshaw, P. (2011) 'Creating innovation practice with practitioners: researching innovation and the commercialisation of academic research in the sciences and engineering', *British Academy of Management Annual Conference*, Aston
- Williams, C., Roberts, J. and Thorpe, R. (2012) 'Critical Friends: working with management researchers for the commercialization of university science', *International Society of Professional Innovation Managers, Annual Conference*, Barcelona

Workshops

- Organised and delivered by Richard Thorpe and Paul Ellwood on The Nature of Engaged Scholarship at the following Business Schools for the ESRC Researcher Development Initiative (RDI) and National Centre for Research Methods:
- 2013 Evidence-based management in practice; Part of the ESRC RDI initiative on engaged research. London. September
 - 2013 Final Conference with the Rt Hon David Willetts, Secretary of State for Science and Universities; Part of the ESRC RDI initiative on engaged research. London. July
 - 2013 Engaged research workshop for doctoral students; Part of the ESRC RDI initiative on engaged research. Belfast. February and June
 - 2012 Evidence-based management workshop; Part of the ESRC RDI initiative on engaged research, London. December
 - 2012 Engaged research workshop for doctoral students; Part of the ESRC RDI initiative on engaged research. Leeds, Edinburgh and Plymouth. November and December
 - 2012 Engaged research workshop; Part of the ESRC RDI initiative on engaged research. Derby. November
 - 2012 'Training the trainers'; Part of the ESRC RDI initiative on engaged research. Cardiff. September
 - 2012 Engaged research-led teaching; Part of the ESRC RDI initiative on engaged research. Leeds. May
 - 2012 Early-career and stakeholder engagement; Part of the ESRC RDI initiative on engaged research. Cardiff. March
 - 2011 Mid-career workshop with Van de Ven; Part of the ESRC RDI initiative on engaged research. Leeds. May
 - 2011 Opening conference; Part of the ESRC RDI initiative on engaged research. London. May
 - 2011 White Rose – With social-science doctoral candidates. Leeds. April
 - 2010 Vitae with social-science doctoral candidates. Leeds. September
 - 2010 Vitae with business-school doctoral candidates. Leeds. April

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