



Universities UK
International

INTERNATIONAL INNOVATION AND UK UNIVERSITIES



By the ERIO-led UCL team*
For Universities UK International

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FOREWORD

There is a growing interest in international collaborations, which is fuelled by a combination of the need to find ways to stimulate economic growth across all nations and the search for solutions to societal challenges that have global implications, such as climate change; antimicrobial resistance; and pressure on resources such as food, water, and raw materials.

Further, the UK Government is increasingly focused on international research and innovation collaboration's potential to deliver a wide range of beneficial outcomes from opening up new markets, attracting foreign investment, and building diplomatic relations and other partnerships with key global locations.

This means that, in many ways, much of our future will be materially affected by how successfully researchers and innovators are able to collaborate internationally.

A great variety of approaches to supporting international collaboration have been adopted reflecting different policy drivers, contexts, and governance structures. These will often focus on particular bilateral collaboration opportunities or the desire to do more with a given country to achieve a range of goals. One UK Government initiative, the Newton Fund programme, which focuses on 15 specific countries, aims to combine UK strengths with the local science and innovation base to address challenges being faced in one of those countries. These challenges are in areas such as urbanisation, healthcare, energy, and innovation capacity and capability.

Universities have a key role to play in this, making a wide variety of contributions that reflect their different research interests and capabilities. They will often be highly intentionally connected with alumni all round the world who can become ambassadors and potential initiators of new collaborations.

When I first spoke to Dan Shah at UUK International about this work I had no idea of the wealth and diversity of the material that would be uncovered by this study.

This report should be inspiring reading for anyone in this area showing as it does what can be achieved and the endless richness of international innovation collaboration potential.

While we did not uncover any simple formula for international innovation collaboration projects, the analysis shows that there are common themes and issues that have to be faced. As such the findings have wide relevance for universities, Governments and funding bodies. I look forward to the debate that will follow and, hopefully, to a clearer understanding of what needs to be put in place for international collaboration projects to succeed in finding solutions to the many challenges we face.

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INTRODUCTION

RATIONALE

UK universities are central to the UK's innovation ecosystem, and world leading in working with business and the community. The UK's higher education sector is high quality and diverse, and its success in internationalisation is one of the reasons for its sustained excellence.

University-business interaction and knowledge exchange more widely are well researched in a domestic setting,¹ but there is less research into the university specific aspects of international innovation. The UK's international comparative performance in research and competitive advantage in attracting students are well documented in Department for Business, Energy and Industrial Strategy (BEIS) and Universities UK International (UUKi) research. There is space to examine the international innovation activities of UK universities, and in doing so provide practical assistance to the sector and potentially to prepare the way for more detailed research and possible policy interventions.

International innovation activities bring considerable direct and indirect benefits to the UK and to international partners, so there is a policy interest in understanding it better, both from overseas governments and higher education sectors who recognise the UK's strength, and from UK policymakers who recognise the benefits to the UK. Policymakers in fast-growing emerging economies are keen to increase collaboration in innovation with UK universities. They are often most familiar with the high profile but relatively small proportion of university innovation activities that relate to classic spin-out and patent activity. As this represents only a part of the UK sector, providing broader examples of the diverse forms innovation takes could serve to enhance and accelerate fruitful sector- and university-level collaborations. UK policymakers recognise the positive spill-overs from universities' innovation activities for productivity and exports, and so

may have an interest in helping them grow. The financial benefit to the university is likely to be relatively small compared to downstream benefit to the UK through attracting foreign direct investment (FDI) and by linking UK companies to and improving the quality and impact from university research.

This study has revealed the range of benefits to UK innovation through our universities' engagement with Europe, making up the largest single geographic grouping of potential case studies offered. The case studies, selected before the referendum had been announced, demonstrate the importance of EU funding programmes in supporting European-scale networks and collaboration, in supporting collaboration with fast growing Asian partners, and as opportunities for UK universities to take a leadership role in continent-wide efforts to address economic and social challenges. As the UK changes its relationship with Europe, and seeks to make a success of its new status in a global knowledge economy, universities' role as institutions anchored in every region of the country with global reach and impact will become more important for UK growth, competitiveness and global profile. In the development of the UK's future research and innovation relationship with Europe, policymakers will need to ensure that the country's universities have the funding and access to networks required in order to continue and strengthen their contribution to the UK economy and society through international innovation.

UK universities themselves have great expertise in innovation and in internationalisation. Often this expertise is found in organisationally distinct but cooperating teams within universities, and available practical guidance is aimed at professionals specialising in knowledge exchange or international partnerships.² Increasingly universities are interested in bringing together international and innovation activities at a strategic level.

² There are some references to the international context in the joint IPO-BIS publication. For example, the Intellectual Property Office *Intellectual Asset Management for Universities* www.ipo.gov.uk/ipasset-management.pdf guide and in Praxis-Unico's practical guides, primarily focussed on intellectual property law and aimed at technology transfer professionals.

There is a wealth of evidence on the impact of research, much involving international innovation, in the case studies submitted to the Research Excellence Framework (REF), though by their nature these are less focussed on how the innovations came about than on describing outcomes. UUKi has produced a series of well-received good practice guides to the sector on aspects of internationalisation, but has not yet created one relating to innovation.³ A better understanding of what effective practice looks like for the UK sector would add value to the UK higher education sector's international activities in research and innovation, as well as build sector capacity to increase this activity, and the case studies presented here are a step towards this.

THIS RESEARCH

Universities UK International, supported by BIS (now BEIS), commissioned the research team under the leadership of University College London's European Research and Innovation Office (ERIO), to present case studies covering the diversity of UK universities, a geographical range of partnerships and a subject-area spread of innovation activities. The case studies are then used collectively in order to extract common messages about the pathway of international innovation from inception to impact.

The case studies crucially capture the perspectives and experiences of the principle agents in establishing the case studies, which compliments insights from existing research and the expertise of senior innovation and internationalisation managers on the steering group. As a short case study exercise, this report should inform universities, policymakers, and those undertaking further research; it does not seek to be a substitute for a more expansive academic review or mapping of the whole

³ For example, on the financial aspects of offshore activities: <http://www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/International/OffshoreFinancingFINALMarch13.pdf> and legal aspects primarily of teaching partnerships <http://www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/International/LegalGuideFINALMarch13.pdf>

sector's activities. This report represents a peer-to-peer learning resource for UK universities, providing clear examples of what has worked and where common barriers to progress are found. Each case study covers the unique story of the innovative team alongside lessons learned, resources used, impacts achieved, limiting factors and advice for others following a similar path.

Common patterns of experience and opportunity are discussed from broader academic and policy perspectives, and much commonality is found concerning drivers of success. However, the focus of the current report is on diverse case studies, and so does not, for example, feature comparison with unsuccessful attempts at innovation. Although innovation is, by its nature, creative and responsive and has no hard-and-fast rules, nevertheless, there are some clear facilitating factors that allow international innovation to flourish. In this guide we have worked hard to present the case studies on their own terms and yet also highlight similarities without attempting to force-fit theories. We hope this report will provide a feel for the real-world situation of internationally innovative teams, whilst also arming universities and policymakers with actionable recommendations.

¹ See, for example, Kitson and Hughes www.ukire.ac.uk/object/rproject/3203/doc/AcademicSurveyReport%20201009.pdf

BACKGROUND

WHAT IS INNOVATION AND INTERNATIONAL INNOVATION?

Innovation typically occurs when new streams of knowledge combine with existing knowledge and capabilities to create ideas, systems or devices which derive greater or different value from resources than is currently being achieved. This innovation is then transformed into economic growth through products and services that bring these improvements to the people that will benefit from them. Innovation may be delivered by a single entity or collaborations of more than one entity. Collaborations often occur when the partnership allows them to:

- innovate closer to relevant markets⁴
- combine diverse or variant knowledge⁵ or
- improve the efficiency of the innovation process⁶

Ideal partners for achieving better market reach, knowledge or innovation capacity may be located within the same country or abroad. Thus ‘international innovation’ is a natural extension of innovation partnerships that play out at a national level. However, the cross-border nature of the partnerships may bring in complicating factors of distance, culture, funding and differing laws or bureaucracies.

UNIVERSITIES’ CONTRIBUTION TO PRODUCTIVITY

Universities are important to the economy at a macro level in providing human capital and research, playing a vital part in the innovation ecosystem. Research suggests that graduate

skills accumulation contributed to roughly 20% of GDP growth in the UK from 1982 to 2005, and that a 1% increase in the share of the workforce with a university degree could raise long-run productivity by between 0.2 and 0.5%.⁷ Many discoveries which transform markets or public services are underpinned by the work of academic researchers from UK universities, and public investment in research and development (R&D) typically has a rate of return of between 20 and 50%.⁸

UNIVERSITY-BUSINESS INTERACTION

Universities’ interactions with business at a micro level also help increase business innovation. Businesses that engage in partnerships with universities are much more likely to invest in R&D themselves and perform significantly better on process and product innovation (+40% and +45% respectively) and to sell novel products (+72%) than similar firms.⁹

The Higher Education Business and Community Interaction Survey (HEBCI) shows that university income from knowledge exchange activities, an indicator of the value placed by business and other partners on the interaction, grew by over 60% in real terms over the last decade (despite the recession) to almost £4.2 billion in 2014–15. The data also demonstrates the range of university-business interactions. Universities commercialise research through spin-offs, with over 1,100 spin-off companies now operating, employing nearly 12,500 people and turning over £1 billion per year. However, income from spin-offs and intellectual property (IP) actually represents a small proportion of the total when the full range of university-business interactions is considered. The largest categories of interaction by total value are for collaborative and contract research, and continuing professional

development (CDP) education is more than five times as large in terms of transaction value as IP.

Surveys of academics show that interactions involving people and solving problems (for example, networks, provision of training, advice and consultancy) were both widespread (with some variations across disciplines and level of seniority) and far more common than direct commercialisation activities.¹⁰ Most interactions began with individual actions and contacts before involving a knowledge transfer office, and were more motivated by research and its application than income. The surveys showed a high proportion of academic staff (29%) had some form of interaction with a non-UK government, European Union or United Nations body, suggesting international involvement in potential innovation in policy and public services in addition to business. International collaborations involving hosting personnel or visiting overseas institutions, as well as joint and consortia research, were far more common than physical equipment sharing and prototyping. Perhaps not surprisingly, many activities were more common nationally and regionally than internationally (especially where this involved providing training) but academics in both large research intensive and small specialist institutions were more likely to have joint research and research consortia internationally than nationally.

INNOVATION BY UNIVERSITIES

Due to their long-term public roles, universities can cast a wide innovation net. Innovation is often regarded as the development of a marketable good that is sold in order to deliver a measurable return on investment. However, innovation can also occur in the form of improved services and systems regarded as a public good. A clear improvement is made to the wider economy and/or quality of life, with the innovator benefiting through more indirect routes. Such public goods may include legal reforms, free educational resources, cultural enrichment and other public resource provision.

In the case of universities, the benefits derived for the innovator often centre on developing expertise. This expertise is then able to leverage further public funds, collaboration with industry and attraction of students through greater reputation, visibility or unique offerings.

The practical innovation dimension of a university is an important complement to teaching and academic knowledge generation. The Dowling Review¹¹ describes the case for collaboration with businesses by citing motivations of academics. These include: ‘experience at the coal-face of industry’, ‘a chance to see research make a difference’, ‘increase employability’, ‘connect theory with practice’, ‘access to real-world problems’, ‘it gives our work meaning and purpose’.

The benefits of collaboration are not just for the academics, however. Innovate UK found that the gross value added per pound spent was twice as high for businesses with multiple academic partners than those with no academic partners.¹² Repeated evidence shows that public investment in research and innovation strongly leverages private investment, with business-financed R&D greater in places where the publicly-financed R&D is greater.¹³

As such, universities have an underpinning role in a nation’s innovation infrastructure. Not only does the higher education sector train our workforce for highly innovative jobs, it also actively engages in innovation activities itself - from the generation of new resources and services to the interaction with businesses and communities, as well as the attraction of investment into the national innovation ecosystem. The active symbiosis between innovation capacity and our higher education sector is vital both for the nation’s productivity and the relevance of higher education.

⁴ Schmiele A (2012) ‘Drivers for international innovation activities in developed and emerging countries’ *The Journal of Technology Transfer* vol 37/1: 98-123

⁵ Carlsson, B (2006) ‘Internationalization of innovation systems: A survey of the literature’ *Research policy* vol 35/1: 56-67

⁶ Granstrand O, Håkanson L., Sjölander S (1993) ‘Internationalization of R&D – a survey of some recent research’ *Research Policy* vol 22/5: 413-430

⁷ BIS (2013) *The relationship between graduates and economic growth across countries* report by NIESR

⁸ BIS (2014) *Insights from international benchmarking of the UK science and innovation system* report by Tera Allas

⁹ BIS (2014) *Estimating the effect of UK direct public support for innovation*

¹⁰ Kitson and Hughes (2012) *Knowledge Exchange between academics and the business, public and third sectors*

¹¹ (2015) *The Dowling Review of Business-University Research Collaborations*

¹² Innovate UK (2013) *Evaluation of the Collaborative Research and Development Programmes*

¹³ BIS (2014) *Insights from international benchmarking of the UK science and innovation system* Annex D

UNIVERSITIES' INTERNATIONAL REACH

The national innovation ecosystem is not an isolated entity; it is part of a networked world. Partnerships increasingly reach across borders, revenues can be derived from international sources, and talented students and workforces flow between countries. Particularly in an environment where financially fragile small businesses or even large R&D companies can suddenly leave a country or go bust, universities provide a robust stabilising framework for the nation within the global dynamic innovation ecosystem. This key role of universities in innovation was acknowledged in BIS's Innovation Report of March 2014: 'Our universities are a key source of knowledge and expertise for UK businesses. The UK has world-class universities that provide us with the highly skilled workforce necessary to drive innovation and are second only to the USA in attracting students from around the world' (from the foreword by David Willetts).

Internationally mobile staff tend to be associated with higher productivity and publication rates, and internationally collaborative research is associated with higher field-weighted citation impact (a proxy for research quality) than domestic co-authorship.¹⁴ International collaboration also enables the pooling of resources and talent and can enable universities and businesses to access different or larger markets and resources. The UK ranks second in the world for innovation in the Global Innovation Index and university/industry research collaboration (based on survey responses) is rated as a particular strength. International engagement and collaboration strengthens the success of UK research and is vital to address global challenges.¹⁵

'It is likely that recent increases in UK research productivity have, at least to some extent, been driven by the increase in UK international research collaboration.'

International Comparative Performance of the UK Research Base, 2013

Almost half of UK academic publications are internationally co-authored, two-thirds of researchers have an international affiliation and one-quarter of academic staff are from overseas. The USA, by comparison, is still on around 35% with regards to co-authored publications.¹⁶ A striking feature of internationally co-authored papers is their tendency to be more impactful in terms of citations,¹⁷ with citation impact increasing with the geographical distance between the collaborating countries.¹⁸ Working internationally allows researchers to pool their expertise and resources to achieve more together – solving challenges from climate change to international development requires global teams and infrastructure that no one country can assemble alone.

The power of the international dimension to core research was also flagged in a report by Elsevier for BIS in 2013: 'It is likely that recent increases in UK research productivity have, at least to some extent, been driven by the increase in UK international research collaboration.'¹⁹ The report also noted:

¹⁶ Adams, *ibid.*

¹⁷ Frenken K, Hardeman S, Hoekman J (2009) 'Spatial scientometrics: Towards a cumulative research program' *Journal of Informetrics* vol 3: 222–232

¹⁸ Nomaler O, Frenken K, Heimeriks G (2013) 'Do more distant collaborations have more citation impact?' *Journal of Informetrics* vol 7/4: 966–971

¹⁹ International Comparative Performance of the UK Research Base, 2013. A report prepared by Elsevier for the UK's Department of Business, Innovation and Skills (BIS)

'While the UK represents just 0.9% of the global population ... it accounts for ... 15.9% of the world's most highly-cited articles. Amongst its comparator countries, the UK has overtaken the US to rank 1st by field-weighted citation impact ... Moreover, with just 2.4% of global patent applications, the UK's share of citations from patents (both applications and granted) to journal articles is 10.9%.'

The reputational advantage of UK universities globally also facilitates UK innovation capacity on two other levels: 1) It draws in the best students and workforce internationally,²⁰ which boosts the UK's innovation workforce whilst also forging soft links abroad; 2) It allows the UK better to draw funds from non-UK parties, whether they be foreign governments fully funding or co-funding work, international businesses, NGOs commissioning research, or philanthropists. A clear example of the UK doing well in international fund competitiveness is the European Union research and innovation funding programme, where the UK wins over 16% of all funds despite a budget contribution of 11.5%²¹ and a population comprising just 12% of the EU. Overall, 23% of UK universities' research grants and contract income come from overseas.²²

The excellence of the UK's university system itself depends to a large degree on its international success. International higher education is one of the UK's leading exports, with earnings estimated at £10.7 billion in 2011. Non-EU students alone supported 137,000 full-time education jobs in 2011-12 spread across the UK. Furthermore, international higher education has significant trade and diplomatic impact; many international alumni retain professional links with the UK.²³ International students account for 12.7% of university income and sustain courses in science and technology subjects where domestic demand alone is insufficient. Employers want culturally

²⁰ Subject to opportunities for international students to stay and work in the UK post-graduation

²¹ Russell Group response to the *Government Review of the Balance of Competences between the UK and EU: Research and Development*

²² £1.17 billion in 2013-14, HESA finance

²³ House of Lords report (2013) *Persuasion and Power in the Modern World*. BIS (2013) *The Wider Benefits of International Higher Education in the UK*. The British Council report one in ten current world leaders have studied in the UK.

aware and well-rounded graduates, something reflected in the fact that a lower proportion of internationally mobile graduates are unemployed. UK students recognise this – record numbers of them are gaining overseas experience – but the UK still lags behind EU peers in this regard.

Overall, the UK enjoys the second largest share of international students in what is predicted to be a growth market.²⁴ However, key competitors are investing heavily in promoting their higher education systems internationally.

BARRIERS TO INNOVATION BY UNIVERSITIES

The Dowling Review explores the barriers to interaction between universities and businesses within the UK. The analysis provides insight concerning difficulties academics might face with innovation more generally. The report identifies common barriers on both sides, though businesses were more likely to comment on the difficulty of finding an academic partner and academics more likely to mention universities' internal metrics (related to a competitive academic culture that rewards publication of papers); both commented on the lack of time or funding for engagement and that negotiation processes could become complicated. Much of this is consistent with previous surveys, with academics noting a lack of time, excessive bureaucracy, and lack of resources (internal and external partners) and rewards.²⁵ Businesses share many of the same constraints, with slightly different ordering, lack of internal resources and the challenge of finding the right partner were greater for businesses. Neither side was particularly exercised by IP or cultural differences. Encouraging academics and business people to spend more time together has been a priority since the Lambert Review.²⁶

²⁴ OECD *Education at a Glance*

²⁵ Kitson and Hughes, *ibid.*

²⁶ (2013) *Lambert Review of Business-University Collaboration* published by Her Majesty's Treasury

¹⁴ Elsevier, for BIS (2013) *International Comparative Performance of the UK Research Base*. Adams, J (2013) 'Collaborations: The fourth age of research' *Nature* vol 497: 557–560 doi:10.1038/497557a

¹⁵ E-Cordis data on Framework Programme 7

The Dowling Report makes recommendations concerning the effective brokerage between business – particularly small-medium enterprises (SMEs) – and academic activities, including that ‘pump-prime funding’ must be made available to incentivise collaborative work. The importance of funding streams in bringing universities to businesses or communities to address commercial opportunities or grand social challenges has already been recognised by the European Commission with its Horizon 2020 funding programme. The availability of money for business-academia responses to grand challenges appears to help such relationships grow organically.

Already some academia-SME networks have self-organised in order to form clusters that can target the Horizon 2020 funds collaboratively.²⁷

THE NEED FOR CASE STUDIES

As innovation is a dynamic entity, perhaps one of the best facilitators of increased innovation is the sharing of good practice and experiences. Such peer-to-peer exchange allows collective learning at pace. Any drive to increase an entity as varied as ‘international innovation’ must be thoroughly informed with up-to-date on-the-ground examples of what actually works in the current climate. Therefore, we hope that this report will shed light on what real international innovation activity by UK universities looks like, in all its diversity. We believe we have identified inspiring examples relevant to the breadth of UK universities and their interests. The case studies are therefore not the most long-standing high-impact projects we could find, but rather a deliberate spread across the landscape. The case studies herein also highlight some of the struggles faced. In this report, we both show the examples as they are and extract common patterns of success, identifying the key resources and barriers. This allows us to describe a loose guide for facilitating international innovation from inception to strong impact.

We aim to provide actionable directions both for UK universities’ strategy teams and for relevant national and international policymakers.

FINDINGS AND CONCLUSIONS

MAIN CONCLUSIONS

The case studies involved a wide range of impacts, UK universities and international partners. It is clear that international innovation activity is not limited to only certain types of institution, discipline or partner country. Looking across the case studies and the experiences of those involved in a diverse range of innovation activity, some overlapping messages relevant to understanding the progress of international innovation appeared. These cross-cutting themes are:

1. Relationships between people. The interviewees repeatedly stressed that the fundamental success of projects began with excellent personal relationships between people. This was not only true between academics looking to form consortia, but also concerned friendship and common vision between academics, university leadership and business partners. The relationship with university leadership appeared to be of particular importance in forming new projects or new institutions for which there was not readily available grant money. University leaders needed to understand the vision of the academics and champion it. Where this involved international relationships between more than one academic institution, nurturing the personal relationships between the university’s leadership (vice-chancellors (VCs) or pro-vice-chancellors (PVCs)) and their foreign counterparts was repeatedly stated as a key aspect in forging the necessary frameworks for action and progress.

2. Importance of people circulation. An extension of the above involves the resources and mechanisms needed to bring like-minded people into continual contact. The Lambert Report (2003) noted the important role in innovation of regular close contact between academics and business, with transfer of talent between the two domains. With the current international innovation case studies, the meeting of minds across international borders and active exchange of people between entities appears to be key to forging long-term teamwork between institutes. As mentioned above, this is often vital at the senior/strategy level, where the deep engagement of pro-vice-chancellors and vice-chancellors in other countries with their counterparts in the UK is a key factor in successfully building partnerships. Several recommended that senior leadership travel abroad with the academics in order to forge the necessary links on both administrative and vision levels. Many of the academics interviewed cited the establishment of exchanges and summer schools as an important success of their programme. A large proportion of the international innovation case studies reported here were seeded by foreign researchers working in the UK seeking to involve institutions from their home countries. Others were built from UK organisations with contacts overseas bringing in UK universities to forge a programme. Either way, the circulation of people across international borders is key to developing such personal contacts. This needs to be facilitated by travel funds, time allowance and active encouragement.

3. Support for long-term stability. A clear concern of academics engaging in international innovation was the long-term stability of their endeavour. Some academics had already acquired per annum support (whether small or large) from their universities. Other case study interviewees were seeking it. Those that had established some degree of permanence (for example, via a new centre or institute) appeared to have more ambitious growth plans. Those that were looking to the next round of funding expressed less vision beyond the stage of acquiring new funds. Without some safeguarding of the core team and mission, it is hard for entities to be bold in their long-term planning. It was expressed many times over that university financial or bricks-and-mortar support

for a new institute alongside an allowance of independent governance was a powerful facilitator of innovation capacity.

4. Diversity of funds available. A surprise to the research team was the wide diversity of funds drawn upon by the academics interviewed. Although some projects lived mainly from a single government or international public grant, others often complemented those funds with additional streams or simply built up their funding from an eclectic mix. These ranged from business contributions to co-funding from other governments to individual philanthropic sources. Some international innovation projects were very impressive in the wide range of funds that they drew on, both from the UK and also across the globe. The philanthropic, charitable and business funds were often found through personal contacts. This very entrepreneurial angle of fundraising, especially with the opportunity of tapping vibrant donor cultures internationally, is less discussed in past UK-focussed reviews. This raises the question of what resources might exist or be developed to harness the opportunity more systematically, for example, enhanced support to match international innovation projects with potential donors, investors and sponsors around the world.

5. Barriers are usually bureaucratic, not cultural. Although a couple of projects (see the Lancaster University and School of Oriental and African Studies examples) employed mechanisms in order to overcome some barriers in the form of business culture and language, for the majority of cases these were not seen to be limiting factors in international collaboration. Particularly between academic institutions, national culture or sensitivities had little bearing on capacity to engage productively. Repeatedly, however, the major barriers to international innovation appeared to lie in navigating the differing bureaucracies involved. It was often case that time had to be dedicated to understanding differences in financial, administrative and other functional aspects of the international partners. Dedicated offices in the partner countries were often seen as a good way to maintain the vital personal links and keep abreast with the

²⁷ Vision2020: The Horizon Network <http://2020visionnetwork.eu/>

administrative peculiarities and hurdles required in order to make agreements or access funds. A similar rule applies to the collaboration between academia and businesses, where any large entity's bureaucratic processes can slow progress.

6. Experienced management teams are vital for business interactions. It was stressed by various sources engaging with large business partners that clear competence in project management or relevant business experience went a long way to reassuring industry collaborators that academic teams can deliver. Capacity in forming IP packages, forming Memoranda of Understanding and writing appropriate contracts are vital skills in this area. Particularly with contracts, it was stated many times that these form a good way to marry the long-term vision of academics with the shorter timescales of what businesses expect. A robust answer appears to lie in the shaping of a contract to declare a clear incremental series of deliverables. These milestones then provide tangible results for the business partner whilst also mapping out a pathway to the more ambitious new territories that the academics are interested in exploring.

DISTANCE AND RESOURCES

The case studies revealed an interesting relationship, not always stated explicitly by the lead academics, between the costs and benefits of distance in collaborative innovation. Discussions seemed to reveal distance as an issue but principally because of the importance of personal contacts, senior visits, professional management that understands both sides and the time taken to coordinate across different bureaucracies, all of which would seem to increase the cost of collaboration at a geographic distance. Interestingly, administrative distance features more heavily than cultural.

There are known benefits of clustering (geographic agglomerations) for businesses, where the positive spill-overs exceed the increased competition or cost of locating very close to other similar businesses. Entrepreneurs

may make location decisions for the whole company, and since academics are unlikely to move their university, businesses often cluster around universities. Within the UK, a survey of businesses conducted by the UK Innovation Research Centre to capture their perspectives on university-business collaboration²⁸ found proximity to be very important with respect to businesses accessing skilled labour, but less important for business access to universities, as well as venture capital and specialist services (perhaps because they can act at a greater distance). It also found that large firms were more likely than average to recruit internationally, as were those that were innovative and growing. In many instances of collaboration there will be clear cases where physical components need to be brought together (though this is more likely the closer research is to application) and when proximity to the target market matters. These factors would suggest additional disadvantages to conducting innovation collaboration internationally.

However, the case studies of international innovation are necessarily those where collaborating internationally brought advantages. The market and/or capital that enables the innovation to have a commercial application may be international (for example, the University of Ulster's collaboration with partners in the USA to access a large market for medical technology, or the development of a new therapy at the University of Aberdeen supported by venture capital from Singapore that enabled them to pursue a different business model than they would have with only UK collaborators). The innovation itself may arise from the multinational nature of business partners (the University of Southampton, for example, worked with both multinational businesses and international academic partners to enable a trial across three countries). Some research problems can only be addressed internationally (for example, Cardiff University's work on a European-scale energy grid) while others could in principle be addressed in one place but are best addressed by assembling teams of talent from more than one

country (for example, the University of Warwick's collaboration with both EU and Korean partners on laser welding). However, it would require more research to fully assess the balance between the additional costs and overall benefits of distance and international partners.

The participants stressed a number of factors common to collaborating for innovation in the UK: the importance of relationships, the need for institutional support structures, long-term stability (and the patience) to have an impact, and (often) the need to formalise initiatives. Even where the international dimension from their perspective did not introduce entirely new challenges, it seems likely to have increased the cost (in time and money) in meeting those needs. For example, telecommunication and virtual meetings were not complete substitutes for face-to-face interaction, especially at the start of projects, and for international projects this is likely to require more resources to be found up front. Institutional coordination at greater distances (experienced as needing to invest professional time in understanding and bridging institutional processes) involving senior university leaders to establish trust and vision also adds to the cost and time of collaborating at a distance (organising diaries for senior staff to meet can be as much a barrier as the cost of travel). Management support might require additional skills or experience to operate internationally, which would again impose higher costs on institutions even if the need for project management is not unique to working internationally. Although some partnerships were formed directly in response to international innovation funding calls (for example, from the EU) many made use of multiple funding streams, from different sources and at different points in their development, which introduced an additional challenge of coordinating internationally (while increasing the range of resources available).

Discussions in the steering group also raised the challenge for universities (which might be more visible to university management than to the academic leads) of strategically harnessing what are principally bottom-up initiatives taken by

research-active academics. While academic staff are motivated by networking and the desire to confront challenges and access resources beyond the boundaries of the institution, the university's ability to support them, in both management time and cost, is finite and requires some coordination and prioritisation.

ACADEMIA, BIG BUSINESS, SMALL BUSINESS

It was agreed by the academics interviewed that engagement with industry is vital for the relevance of their research. However, the challenges and benefits for academics of working with big businesses compared to SMEs were distinct. Large businesses have better-developed capacity and can bring in their own funds, but appear to be slower adopters of the innovations developed. Smaller businesses are more financially unstable and more reliant on financial, managerial and workforce assistance, but were more open to innovation.

The research team gave interviewees the opportunity to make anonymous contributions which could help improve practice but which would not be attached to their case study. The most common discussion involved partnerships with big business. In cases where big business offered sponsorship of programmes, respondents agreed that the finances, engagement and name-recognition were all extremely helpful. In cases where a major company was sharing public funds as part of an academia-industry team, there could be cases of lesser engagement with bringing innovations to market, as a large business partner's continued existence does not depend on the success of the project to the same degree as that of a small business' or academic team's might. Incentive structures for big businesses engaging in public-private partnerships (PPPs) under public or joint funding may well be a topic worthy of future research.

²⁸ Hughes, A and Kitson, M (2013) *Connecting with the Ivory Tower: Business Perspectives on Knowledge Exchange in the UK*, UK-IRC

Within the culture of academia, we noted a range of attitudes towards the core purposes of innovation activities. Some respondents appeared uninterested in the monetary return-on-investment for their universities, instead stressing the public good delivered and the capacity-building benefits of their activity in terms of enhancing expertise and resources. Others actively criticised what they perceived as a business-shy attitude among UK academics, noting the lack of interest by other academics in delivering value or making deals and the lack of support from university administration for academics seeking to take time and resources to pursue entrepreneurial routes.

THE PATHWAY FROM INCEPTION TO INNOVATION IMPACT

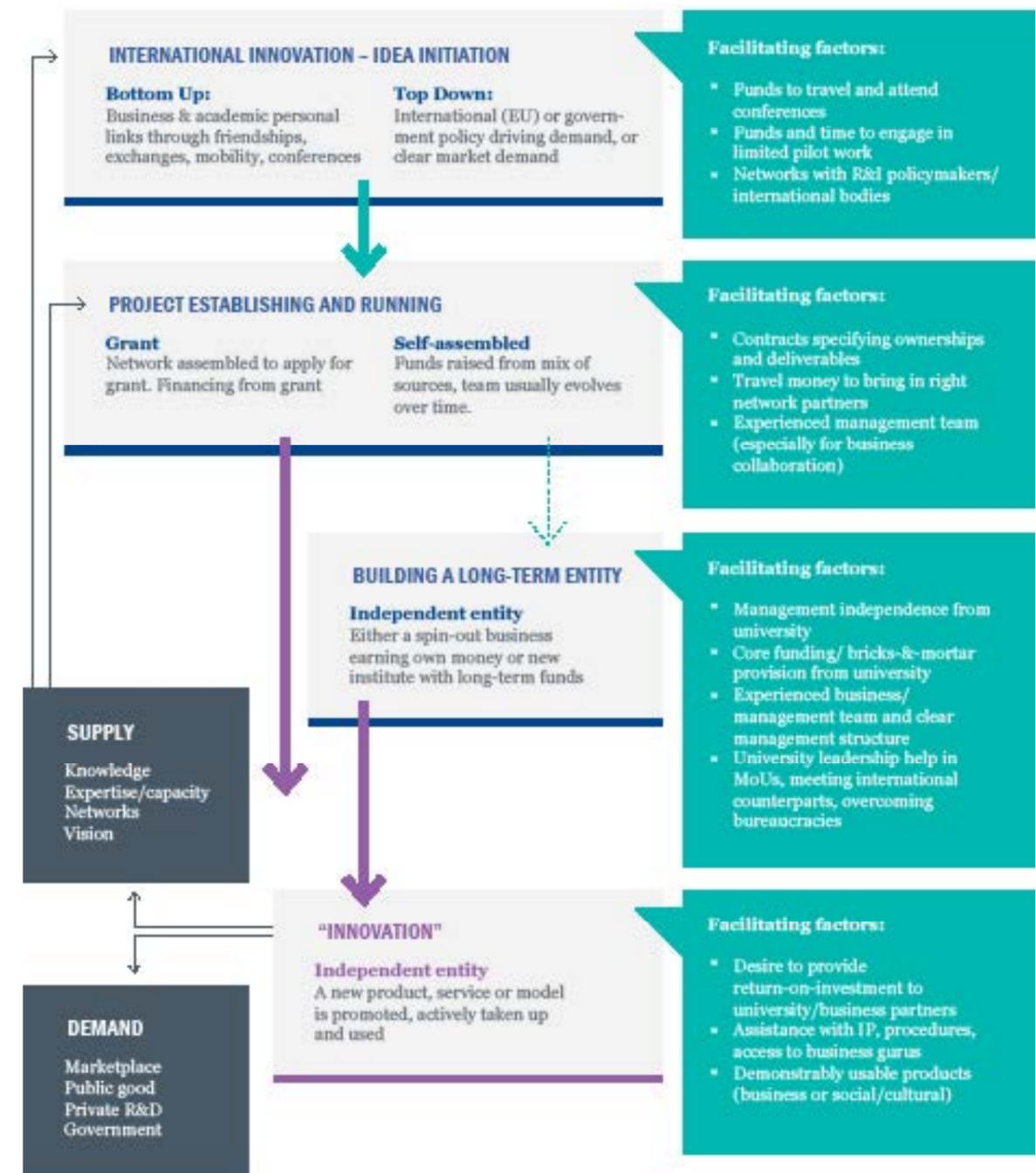
The case studies in this report detail international innovation initiatives by teams in UK universities. Each case study describes a chronology, identifying the factors that initiate and drive the growth of the activities, deliverables achieved or intended, and barriers or limitations encountered. Taken together, these diverse chronologies of development can help draw a common pathway. This then helps place future projects on that pathway, whilst identifying upcoming challenges they may face, such as creating stability of funds and core functions, or producing valuable impact that allows them to grow and stay relevant.

The range of vehicles and collaborations covered in the case studies varied considerably. Some of the activity, if not the impact, is captured by existing quantitative data. For example, Aston University’s work in Vietnam would be covered by the Higher Education Statistic Agency (HESA) Offshore Student Record data for transnational education (TNE) students, while Sheffield Hallam and Cardiff Universities’ activity would appear under the aggregate heading ‘research grants and contracts from overseas’. In many interactions the international dimension would not normally be captured, but the examples explored here would leave a trace in the HEBCI survey responses by category aggregated with

domestic activity: Ulster’s spin-outs, Cambridge’s consultancy income, Continuing Professional Development income from SOAS and Harper Adams, transactions with SMEs in the Lancaster case study, and those with large companies in the Southampton case study. Future quantitative research would be needed to map the extent of these different dimensions.

That path diagram is shown below:

International innovation diagram: From ideas to impact



The basic steps of the diagram are described in more detail below.

The drivers initiating international innovation activity: Inception usually begins with personal relationships forged around common interests. With the international dimension, these relationships may arise from exchange programmes, individual researcher mobility between countries or meetings at conferences. The individuals then seek to gather resources to pursue that line of work in partnership. It is at this stage that any availability of funds to travel, network or engage in pilot work is of particular use. Another stimulating factor at this stage is a ‘call’ or higher-level policy declaration that attracts the attention of the researchers or provides them with a channel to act upon the ideas they have been developing. Therefore, the ‘demand’ is either the market as seen by the partnership of colleagues or a body looking for a solution. The ‘supply’ is the unique expertise, or fusion of expertise, of the partners – capable of forming a new solution. Specific to the international context, it may be part of the innovation itself to help articulate demand across different national contexts (for example, the Lancaster University case study) and the demand itself may be inherently international (for example, a need for outside support from Harper Adams University for capacity building in the partner country).

Building a team and gathering funds:

In terms of project establishment, there were two main distinctive routes. One is in response to a specific source of funding, where there are reasonably clear demands that must be met to access the resources. While the call may precipitate new relationships, it is of huge advantage if the team have already experienced working together and thus share mutual knowledge. Such a team might then seek out (via contacts or literature searches) new players in order to meet the demands of the call.

The other is for teams to self-assemble funds in order to facilitate the work, which requires considerable time and work dedicated to finding an initial financial backer. The pathway is more

entrepreneurial as the lead innovator or team must approach a range of potential funding sources and sell their vision. This requires time, travel, work in hand, and often some degree of business experience or knowledge of the market. Often longstanding personal contacts with university leadership, business, funding bodies or philanthropists will be called upon. With initial funding secured, part of the ongoing mission is then to raise further funds from a variety of sources.

Bringing industry partners on board at this stage poses its own challenges for academics. The industry partners must be convinced that the academic partners can produce useable deliverables within a relatively short period of time. They will be reassured by the presence of strong management teams and contracts with a clear timeframe. At this stage, it is also necessary to lay down any non-disclosure agreements. Expertise in the university is a facilitating factor.

During the project the team needs to ensure that external demand will be satisfied and to focus on developing their capacity to supply. Team expansion, exchange programmes, development of external resources and representation at conferences all help develop the team’s capacity to claim greater expertise, which will help them go on to attract more funds, students (who bring funds), private investment, or collaboration partners (who may also bring resources).

Building a long-term entity: A transition of great importance in many of the case studies is from a project or series of projects to an established entity which allows the preservation of the core team and mission. Projects which were funded from a time-limited project grant were found to be preoccupied with meeting those specified deliverables and then planning to apply for another grant. With academic grant success rates being generally low, this is a rather precarious existence. For the established entity, however, the long-term stability allows for a broader and bolder vision, with more capacity to attract new long-term partners and handle multiple projects and sources of funding. The role of university management is key here, as senior

university figures must champion the drive to establish a permanent entity. Funding, whether seed funding or ongoing core financing, is usually critical, as is bricks-and-mortar provision. Allowing independence of governance is also important, as it allows the core team to bring in relevant external parties as major stakeholders in the endeavour. In terms of the international dimension, it is vital that any new centre or institute has the full backing of university and industry management at all locations. A hugely facilitating factor at this stage is face-to-face meetings and personal relationship-building between the senior management figures in both locations. Repeated meetings in person between the pairings of academics and senior management develops the interpersonal relationships that will drive the vision and the practical development.

Making impact: Delivery of any innovation requires strong business nous. In most cases, this will involve understanding the marketplace where the innovation is to be taken up. In some cases, it will involve ensuring adequate capacity to package and manage IP, making it an attractive proposition for businesses or developing it in-house. Where the core university team does not have such expertise, it must be hired in. This can be in the form of university-wide capacity, a role within the team, or consultancy. Interviewees thought that innovation would be increased if the academic environment offered more reward mechanisms; currently, the drive to rank academics primarily by their academic research outputs leaves less time or motivation for exploring more entrepreneurial angles in many cases. Showcasing of innovation, resource provision for academics (training, IP help, new contacts, specific pilot/travel funds) could all stimulate greater engagement by academics. To target the international aspect, there must be funds and resources available in order to ensure that travel to meet potential innovation partners is not a barrier. This needs to be complemented by flexibility in employment rules for a higher proportion of academics to engage in their own entrepreneurial activities, and a clear vision within university management, communicated to the researchers, of what the career paths of their best innovators should look like.

RECOMMENDATIONS

Conclusions drawn from the case studies were discussed with the Steering Group (Appendix II) and developed into a series of recommendations. It was decided that these would be most useful if targeted at the various stakeholders involved. Therefore our recommendations are divided into four sections: for university researchers, for university leadership, for businesses seeking to engage with universities, and for government/funding bodies.

For researchers. Many challenges can beset those who establish projects with the intention of generating innovations in an international context. However, academic excellence is not sacrificed by engaging in practical innovation; often it helps maintain research excellence by keeping it highly relevant and opening up new areas to explore. Furthermore, there is likely to be stronger recognition by universities of innovation success by academics in the future. Recommendations are:

- Seek to travel and engage with international counterparts in all sectors. Innovation often emerges from the unexpected sharing of ideas. Team leaders should actively encourage exchanges, conferences, summer schools and other foreign trips amongst students and staff.
- Ensure that your team is connected to relevant employment opportunities outside academia. A low proportion of PhD graduates remain in academia, so it is important that all departments have bridges to potential careers outside.
- Reassure industry partners that their concerns will be understood by ensuring you have team members with experience in deals between academia and industry, or by involving knowledge exchange staff. It is often advisable to convert your plans into a contract that sets out a series of incremental deliverables to reassure businesses that what they get is tangible and not on too long a timescale.

- Communicate and collaborate with university professional staff, including the knowledge exchange and international offices, as well as departmental colleagues, to ensure that the university can join up its activities and capture the full range of benefits; this can also increase likelihood of institutional-level support. Be prepared to be persistent with administration and seek to restructure resources to meet the changing demands of innovation if necessary.
- When engaging with foreign universities, especially with a view to establishing long-term collaboration, it is advisable to bring leadership figures from the two universities together. Such personal relationships often allow for more rapid and coherent backing of new ventures.
- Provide information to entrepreneurial academics that could assist them to draw on the full range of potential funding sources, including international businesses, charities, government schemes and philanthropists. This may involve greater connections between international and research and innovation strategies, and the professional teams that lead these functions (along with others such as advancement and alumni).
- Support the conversion of short-term initiatives for innovative projects into longstanding programmes by a) providing funding support from the university itself and b) giving the project leader the independence to bring outside stakeholders into the governance structure, increasing their incentive to be long-standing partners.

For university leadership. Universities face the challenge of both accelerating the formation of bottom up innovative ideas and strategically managing risk and the portfolio of activity for the university. A number of activities can increase the likelihood of international innovation attempts succeeding and progressing rapidly. Leading recommendations are:

- Encourage the circulation of talent internationally and with potential innovation partners. This may include developing some form of official recognition for exchanges and sourcing funds for travel, as although modern telecommunications are often sufficient to maintain a relationship, face-to-face meetings are vital to their establishment.
- Senior leadership figures (VCs, PVCs) should be prepared to travel with academics and meet counterparts in overseas institutions in order to establish personal relationships which help cement long-term collaboration.
- Communicate to academics a clear career path for the highly successful innovator, including the possible rewards from more entrepreneurial career routes and flagship examples. Allow more work time and flexibility for university researchers to run their own businesses or engage in entrepreneurial activities.
- Senior managers should encourage, and possibly incentivise, relevant staff to develop networks with universities.
- Ensure there is a clear internal implementation path within the business for innovations, as often academics find that industry partners use of innovations is slowed due to siloes within the company.
- Engage with academics at conferences and meetings. This is where they are presenting their capacity and looking for collaborations. Inviting academics to give talks to business groups and teams also helps forge new links.
- Sponsor exchange or joint training schemes. These help bring back knowledge, ideas and contacts.

For businesses. Businesses should be aware that engagement with academics has been shown to improve business productivity markedly. Therefore, there is every incentive to engage with university teams. Such partnerships also allow businesses to work with university staff which they may later want to hire. Recommendations include:

- Senior managers should encourage, and possibly incentivise, relevant staff to develop networks with universities.
- Ensure there is a clear internal implementation path within the business for innovations, as often academics find that industry partners use of innovations is slowed due to siloes within the company.
- Engage with academics at conferences and meetings. This is where they are presenting their capacity and looking for collaborations. Inviting academics to give talks to business groups and teams also helps forge new links.
- Sponsor exchange or joint training schemes. These help bring back knowledge, ideas and contacts.

For government and funders. It can be seen from many examples within this set of case studies that high level government initiatives and declared challenges can initiate new partnerships. Furthermore, funding can be overtly structured to link universities with businesses large and small internationally, as has been done in the pan-European Horizon 2020 research and innovation funding programme. Recommendations are:

- Promote awareness amongst businesses of the added value gained by working with universities.
- Ensure that major international innovation funding opportunities are effectively promoted to UK businesses. UK universities are well placed to work with small businesses in particular, to help them access international markets or collaboration opportunities through such funding programmes once the business is aware of the benefits and approaches the university.
- In the short term, it is crucial that current and prospective EU-funded research projects are not disrupted or annulled as a result of the UK's exit from the EU, and to communicate this guarantee to UK researchers and EU partners, working with the European Commission.
- In the medium term of the UK's changing relationship with the EU, it will be vital to ensure that UK universities can access funding and networks in order to collaborate with European partners and participate in Europe-wide and European-based global endeavours. The UK should seek to maintain access to and influence over future EU research programmes, in recognition of the scale of collaboration between the UK and European partners, the UK's disproportionate past success in this area, and the opportunities which exist to engage globally using European funding.
- Longer term, the case for coherent and sustained investment in international research and innovation only grows stronger. The UK should invest in expanding and promoting opportunities for international collaboration through new bilateral and multilateral research

schemes. It must ensure that international researchers, whether from Europe or beyond, can come to work in the UK without undue administrative burden, in recognition of their enormous contribution to the UK research base and wider society.

- Strengthen and increase the coordination of information flowing from the various overseas UK government representatives that engage with local universities and businesses, to assist the entire UK university sector to access opportunities arising from local demand in those countries.
- Policy makers should consider the benefits of increasing incentives and support to universities. As the case studies demonstrate, the significant spill-over benefits from international innovation activities come at the price of higher costs to universities in establishing such collaborations. Factors found to increase the success of international innovation projects depend on universities themselves either being able to access sustainable unhypothecated resources to invest or funds targeted at increasing international collaboration at both an early networking stage and when transforming projects into sustainable entities.

Finally, there is a need for future research including quantitative investigation into the development and growth of international innovation projects. In this study, we could only take forward a few case studies from the 100 offered. A more comprehensive study might take the form of a survey which looks to systematically record partnerships, funding amounts, fund types, employment generated, sales made, and so on. Although attempting to map international innovation by UK universities more deeply would require substantial effort, the value of the endeavour could be significant. UK universities are world-leading and greater clarity on how they can effectively drive innovation throughout the world will bring further dividends to the nation.

CASE STUDY SELECTION

METHODOLOGY OVERVIEW

We acquired case studies in three phases. In the pilot phase, a few initial case studies were obtained via UCL ERIO's own contact network. This was then followed by a call-out phase where an email invitation was sent from Universities UK International to the whole university sector through various channels and networks. From the replies received, many were followed up to obtain more information and some were approached for inclusion in this report. As the number of case studies was necessarily limited, from a very large range of excellent offerings, cases were chosen on the basis of representation in order to ensure the spread over geographies, development levels, subject areas and outputs.

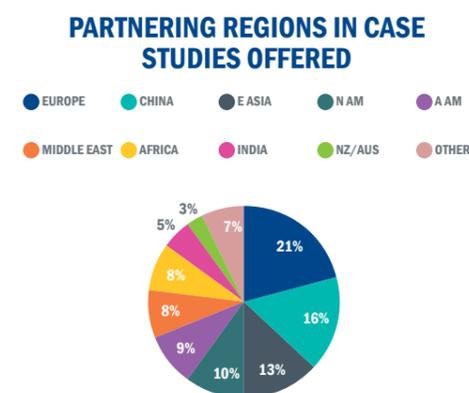
On obtaining sufficient information (via phone or email) to decide to include the nominated project, an interview was arranged. This interview was usually conducted via Skype, but face-to-face and telephone interviews were also conducted as appropriate. Example questions (Appendix I) were emailed to the interviewees beforehand. In almost all cases, the interviewees took it upon themselves to send the interviewer relevant materials before the interview. In practice, the interviews lasted between 40 minutes and an hour and a half. All interviewees were informed that the case study would be written up and sent back to them for fact checking, input and approval before publication.

As some of the discussions covered more sensitive or political territory, interviewees were assured that any viewpoints they did not want to appear in the texts of their case studies would not be included, but insights that were of clear value would be taken into the collective findings anonymously and could then be discussed elsewhere in the report in more general terms.

RESPONSES TO THE UNIVERSITIES UK INTERNATIONAL CALL FOR CONTRIBUTIONS

In response to the call for international innovation case studies, 88 distinct responses were recorded from 68 different institutions; 65 UK universities (49 from England, 8 from Scotland, 6 from Wales, 1 from Northern Ireland, and the Open University) plus 3 higher education sector bodies, offering exactly 100 case studies. Those that made it through initial lines of enquiry and were not rejected on the basis of duplication were sorted according to the region or country of any international partners cited, divided into Europe, China, East Asia (for example Japan, Korea, Malaysia, Vietnam, but not Central or South, which fall into the 'Other' category), North America, South America, the Middle East, Africa, India, New Zealand/Australia and Other. The breakdown is shown in the figure below.

Regions of foreign collaborating partners cited in international innovation case studies offered by 65 UK universities



Notes: 100 case studies were offered, so percentages are also real numbers. Other: Turkey x2, Uzbekistan, Bangladesh, Pakistan, Sri Lanka, Russia.

Although these figures do not come from a representative survey and so must be treated with caution, they serve to open interesting lines of enquiry. The dominance of Asian countries in the cases that UK universities offer as their best examples of innovation is very intriguing. There were several extremely impressive large programmes with China, but only one could be taken for the report due to our necessary emphasis on variety. However, in future, it would certainly be of interest to specifically analyse the collection of UK-China programmes. Europe's domination was expected, as EU programmes mean that there are strong pan-EU collaborative networks that feature even for programmes where the focus is beyond Europe. Slightly surprising was the comparatively low North American representation, given America's leading position in science and innovation and its cultural links with the UK. Also surprising was the very low number of innovation programmes in collaboration with Indian partners. Otherwise, there was excellent global choice from which we selected a more even spread.

CRITERIA FOR SELECTION

In order to ensure that the case studies had maximum relevance to all primary stakeholders (especially to the diverse range of UK universities themselves), it was decided that they must collectively cover a spread along the following dimensions, where possible:

- The size of the UK institution and department/team involved
- The geographical location of the university in the UK
- The geographical location(s) of the international partner(s) (representing cultural spread)
- The subject area of the innovation (science, arts, engineering, business)
- The nature of partners engaged with (big business, small business, charity, individuals, governments)

- The maturity level of the international collaboration (recent, long-standing)
- The key outputs of the innovation (academic impact, services, patents/products, training, resources)

The motivations for international innovation are as diverse as their forms:

Examples of drivers of international collaboration:

- The relationship between international innovation activities and domestic policy
- The role and impact of existing bilateral or multilateral initiatives
- The benefits of international innovation to the UK
- Strategies for the effective management and coordination of international innovation
- Supporting the development of a university's profile overseas
- Perceived barriers to the continued growth of international innovation activity
- The benefits to the partner organisations with which UK higher education institutions have cooperated

Examples of international activities which can support innovation:

- Collaborative research
- Consultancy
- Contract research
- Technology licensing
- Continuing professional development and training
- Knowledge transfer programmes
- Student placement/recruitment
- Access to university laboratories and equipment
- Networking opportunities
- Creating spin-out companies based on university-owned IP

The age of institutions chosen for interviews ranged from one of the oldest universities in Europe to an institution granted full university status in 2012. Regarding subject areas, we aimed to pull a core set from science, technology, engineering and mathematics (STEM) subjects but also complement this with innovation in more unexpected areas. We therefore interviewed participants in cases from life sciences, physical sciences/engineering and business, but also education, law and music. Partners in the

innovation activity ranged from academics and university administration to large and small businesses, NGOs, church bodies and governments, while types of interaction involved not only research collaboration but also physical overseas presence and distance learning. The clustering of the subject areas and partners is shown in the diagram below:

Clustering diagram of the case studies according to geography, type and subject area



* Projects can have more than one partner/domain.

** Number of projects with at least one representation from the partner type.

LANCASTER UNIVERSITY

Pairing UK and China SMEs through university research programmes

Lancaster University runs an MSc in International Innovation. Central to this course is the Lancaster China Catalyst Programme, which pairs British small and medium-sized enterprises (SMEs) and Chinese organisations, helping them develop innovations in new products and services. The programme provides leaders of these businesses with relevant training, along with a team of selected students to complete the work. These innovation projects double as hands-on experience for the Lancaster MSc students who then write their dissertations based on their experiences in the UK and China. Thus, Lancaster provides a thorough development pathway for the small-business partnerships, from initial matching to tailored human capital support provision, appropriate business/cultural training and access to funding in China. The programme acts as a natural laboratory for Lancaster researchers seeking to identify the critical factors in small-business innovation and international partnerships.

Summary details

UK University:	Lancaster
Project/Dept.:	Lancaster China Catalyst Programme
Partnering with:	Guandong Department of Science & Technology (GDST)
Period:	2014-present
Funding:	HEFCE, Lancashire County Council, Participating Companies, Lancaster University and GDST
Interviewee:	Dr Nick Burd, Director, China Catalyst Programme

AN SME PROGRAMME AND A CHINA PROGRAMME

The Lancaster China Catalyst Programme fuses two strands: the University's developing relationships with SMEs and its interest in China.

Lancaster hosts collaborating (for example, via shared grants) companies on its campus. The university decided to provide office space within its buildings for both start-ups and established companies to facilitate close collaborative working. The developing research and innovation ecosystem has grown briskly since 2000. This model is now in use by several departments across the university and as these activities expand, bricks-and-mortar space is allocated to relevant companies.

Collaborations between Lancaster and China began in 1975 via personal relationships between academics. Since then, there have been two foci of the work: one centred around Lancaster University Management School (LUMS) and the other around the Lancaster Environment Centre (LEC).

The successful award of a China-Bridge grant to the LEC allowed strong research partnerships with a number of Chinese institutions. Similarly, since the early 2000s the Lancaster China Management Centre (LCMC, which is part of the Management School) has been bringing Chinese managers to the UK on practical courses to experience and learn about UK management practices. The facilitated learning programme was complemented in 2011 by the establishment of a Confucius Institute. There are around 30 Confucius Institutes in UK universities. They are funded via Hanban (part of the Chinese Government) and provide training in Chinese language and culture.

A COMPLETE PROGRAMME TO PAIR UP UK AND CHINESE BUSINESSES

The Lancaster China Catalyst Programme pulls together these two strong strands of experience: working in China and working with UK businesses. The bulk of the funding comes from a competitively awarded HEFCE 'catalyst fund' grant of £3.5 million for the years 2014-2017. There is also a contribution of £0.5 million from Lancashire County Council. The university makes a contribution too, while companies are asked to pay £10,000 for the training, travel, services and resources (students) they receive over the two years of their engagement with the programme.

Lancaster University identifies interested technology companies in the UK, predominantly SMEs. Its team in China, working with key partner the Guandong Department of Science & Technology (GDST) and other public and private partners, does the same via a network of companies which it fosters. From these two pools of interest, a negotiated pairing takes place. The process is then to establish a Memorandum of Understanding (MoU) and a research and innovation contract between the UK-China partnerships. This must specify the new product or service, the research and development to be undertaken, or the product to be refined.



An advertisement for the programme.

Students studying for Lancaster's Masters in International Innovation (designed specifically to meet the needs of the Catalyst Programme) then join the China-UK business partnerships and provide a dedicated workforce for the new project. These students spend the first part of their work with the partnerships in the UK and the second part in China, giving them two separate academic projects to write up. These reports also serve as excellent feedback for the companies involved and their strategies and operations in China. Students with backgrounds in computing, telecommunications, engineering, environmental sciences, entrepreneurship or design are selected to give the team a broad range of skills. They are given Chinese language and cultural training through Lancaster's Confucius Institute.

The course also provides learning opportunities for the SMEs involved, particularly in the area of company sustainability, via an executive course enriched with satellite seminars. The course addresses the company's capacity to implement a project, how to build up its own learning in order to keep growing, how to navigate the market and legal issues in China such as IP. During the programme, GDST provides the partnerships with an opportunity to competitively bid for additional funds (up to ¥1 million – approximately £115,000 – per project) to develop their new products or services within China.

DEALING WITH SMES

Small businesses are exciting entities to deal with. Lancaster is already seeing within its first two cohorts networking and cross-linking beyond the core pairings. However, there are also barriers to progress which are particular to SMEs. Firstly, recruiting onto a programme such as this demands sizable administrative and marketing input from the university. Lancaster has already increased its UK team to six people and has a team of three based in Guangzhou. The combination of financial and time commitments makes the programme a significant decision for smaller businesses, although the return on investment is substantial. Many start-ups are too financially fragile to make this kind of long-term plan. Companies may also need to change direction or prioritise their efforts in other areas during the programme. For this reason, companies that fall out of the scheme are only charged for resources already consumed.

Language is also an issue, as some of the Chinese organisations (businesses or research organisations) will have little or no English skills. The Catalyst Programme has a team in China comprised of Chinese natives that helps to facilitate communication and has access to a pool of interpreters used during meetings between UK and Chinese companies. Lancaster actively tries to recruit Chinese students onto the Masters in International Innovation course so that student teams involved with the company partnerships will have some native Chinese capability. Having a local desk in China also allows development of relationships with GDST and other important organisations and institutions, providing key insight into their working processes and how best to engage with them.

A NATURAL LABORATORY

The programme is a huge boon to Lancaster, giving the university the opportunity to lead in both teaching and understanding the processes surrounding international innovation. The UK-Chinese company pairings are all focussed on innovative products and services, giving

Lancaster the opportunity to study multiple examples and distil key lessons from each. This knowledge is fed back into the university's research and teaching, as it attracts further students to the International Innovation Masters course. It also adds value to Lancaster's business collaboration offer.

TAKE HOME MESSAGE

Universities are natural matchmakers for small innovative businesses. They can offer a pathway of resources to help SMEs grow. In return, the university benefits from embedding its students in real-world innovation development and business management projects, giving them valuable work experience. Finally, ongoing opportunities to study the innovation process give the university a critical mass of high-value knowledge and expertise.

IMPACT:

- The project aims to create 240 jobs, help up to 400 UK businesses and boost the economy by £40 million, helping to revitalise UK position in global export markets
- The project contributes to the Lancashire economy
- Project has received support worth over £70,000 to develop international collaborative R&D and commercialisation with Chinese partners
- UK SMEs are internationally networked and grown by addition of tailored student workforce
- Training provided for managers of SMEs
- Chinese grants opened to UK-China partnerships
- UK students gain unique hands-on international experience working on innovative projects
- International Innovation MSc students are supported via a tax-free bursary of £16,000 over their course of study

UNIVERSITY OF ULSTER

Spinning out medical technology

Ulster's Nanotechnology and Integrated BioEngineering Centre (NIBEC) has generated 35 patents and three high value spin-out companies in medical sensors and electro-stimulation devices. Together these companies are currently valued at almost £100 million with over 200 skilled employees. They produce medical innovations which make a global impact on health costs and individual patients' lives. On 17 March 2012, when Bolton footballer Fabrice Muamba collapsed on the pitch in front of millions watching on TV, it was one of HeartSine's products that was central to his miraculous survival. HeartSine's automated external defibrillators (AEDs) can also be found in the White House and on Air Force One. They are favoured by many international airlines, sports bodies and emergency services, from Shell Oil super-tankers to the Singapore emergency medical service.

Summary details

UK University:	University of Ulster
Department:	Engineering Research Institute (ERI)
Centre/Project:	Nanotechnology and Integrated BioEngineering Centre (NIBEC)
Spin-outs:	HeartSine Inc. Intelesens Ltd Heartscape Inc. (sold to Verathon, USA)
Partnering with:	Partners Healthcare (Massachusetts General, USA) CIMIT (Boston) and many other international hospitals.
Website:	www.nibec.ulster.ac.uk
Interviewee:	Professor James McLaughlin, ERI Director

FROM MINIATURISATION TO IRELAND'S FIRST STANDALONE RESEARCH CENTRE

In 1966, John Anderson (d. 2012), head of the School of Electrical and Mechanical Engineering at the University of Ulster, harnessed miniaturisation technology to develop a portable defibrillator. Medical technology has come a long way since then but Northern Ireland has remained at the forefront. In 1985, John Anderson and James McLaughlin founded the Northern Ireland BioEngineering Centre (NIBEC). That centre has since been renamed the Nanotechnology and Integrated BioEngineering Centre; the acronym 'NIBEC' remaining intact.

Initial funding of £200,000 for NIBEC's 'microfabrication' in 1985 came from an American company, Chesebrough-Ponds (since acquired by Unilever). To date, funding of £45 million from sources around the world has enabled NIBEC to maintain its position as a hub of international innovation in medical devices. Significantly, a European Regional Development Fund (ERDF) investment of £1.6 million in 1996 (leading to grants of £6 million in total) was deployed to create a new building for NIBEC and to buy high-tech equipment. That regional development fund, aimed at stimulating less competitive regions in the EU, combined with Irish investment, allowed NIBEC to become the first standalone research centre in Ireland, a model soon copied by other Irish universities.

MAKING SPIN-OUTS THAT GO GLOBAL

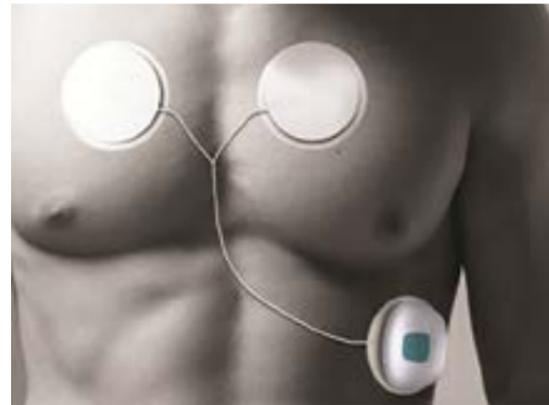
NIBEC is one centre within the University of Ulster's Engineering Research Institute (ERI), of which Professor James McLaughlin is the director. Over the years, ERI and NIBEC have become proficient in developing spin-out companies and taking their innovations to international markets.

Their three spin-out companies are HeartSine Inc. (founded 1998 and sold to Physio Control-Stryker in 2016), Intelesens Ltd (founded 2001, partially owned by GE Healthcare) and Heartscape Inc. (started 1993/1994, founded in the USA in 2005, sold to Verathon-Roper in 2010). HeartSine's top product is a leading low-cost miniaturised defibrillator (providing electrical bursts following heart attacks). Intelesens makes a patch-based wearable system for monitoring vital signs. Heartscape produced the world's first 3D mapping of the heart. The collective product portfolio includes the world's best-selling disposable ECG electrode, sold by Tyco, HP, Ludlow and Space Labs among others, with 70 million in sales to date.

The companies have enjoyed high profile success. In 2011, Intelesens won the 'Most Promising Technology Award' at the 4th Annual Silicon

Valley Technology Leaders Awards. After raising over £6.5 million of investment and entering strategic partnerships with Mondo in 2005 and Intel in 2008, GE Healthcare decided to take a 22% stake in the company in 2011.

HeartSine's development of the world's most compact AED was based on NIBEC's chest impedance and arrhythmia algorithms. The company employs 80 people in Belfast and Pennsylvania and is currently exporting to over 40 countries. How has NIBEC, this academic-business hybrid in an 'under-competitive' region, had such repeated success?



Zensor is a wearable monitoring device that detects heart arrhythmias.

'DOING A DEAL' SHOULD NOT BE FEARED

Professor McLaughlin believes that while academics in the USA and Asia have no problem talking about business and money, in the UK there still resides a feeling that 'doing a deal' is something ugly. Many academics do not feel it is their role to deliver financial impact for their universities. If the academic team which wants to bring a product to market does not have business experience they should bring in someone with expertise and previous success in this area. This will also reassure potential investors who will look for business acumen in the team as an indicator of capacity to deliver.

Universities must allow their researchers freedom to be more independent and take time to pursue entrepreneurial interests. Business intelligence cannot be undertaken by internet search; there must be the financial support for teams to network with potential investors and partners to assess opportunities for collaboration. University teams need to make the first move towards potential investors, presenting a clear case for investment in their product or service.

Looking at available support mechanisms, Professor McLaughlin's assessment is that in the USA, academics spend 20% of their time looking for funds and 80% working. In the UK and EU, academics spend 70% of their time looking for funds and 30% working. However, he believes that both Innovate UK and the EU's Horizon 2020 funding programme are developing well, inspired by America's SIBR funds, and providing the quick support many start-ups need. Despite NIBEC's many patents, the market now moves so fast that the experts must engage with businesses quickly, establishing MoUs and cornering market niches, rather than worrying about protecting inventions that will soon be obsolete.

THE IMPACT OF INNOVATION

There have been over 200 jobs created across the three NIBEC spin-out companies, over £37 million of investment, and in excess of £30 million sales per year. The technology is estimated to save hundreds of lives annually, cutting costs and improving quality of life, especially for the elderly.

The new technologies have been utilised by various companies via joint ventures, buy-outs and specific translational investment and mentoring by the Wellcome Trust, the UK government, CIMIT (Boston) and Invest Northern Ireland. New funding, best-practice examples, approval platforms and business models are being established which involve strategic partnering with multinational companies (for example, GE Healthcare, Intel). Finally, the experiences of ERI and NIBEC have moulded the shape of the Northern Irish

government's strategies through the MATRIX (the Northern Ireland Science Industry Panel) and NI Innovation Strategy panels.

TAKE HOME MESSAGE

'Doing a deal' is not something ugly. Academics should be encouraged to deliver portfolio/financial impact for their universities. Business skills are critical and must either be cultivated or hired in if not already present within the university team. This will also reassure potential investors that there is capacity to deliver.

IMPACT:

- Three spin-out companies valued at nearly £100 million together
- 35 patents
- Sales of >£30 million per annum
- Employment of >200 people
- Exports to over 40 countries
- Partnership with several multinational companies
- Products that reduce health costs and save lives

CARDIFF UNIVERSITY

Designing a pan-European renewable energy ‘super-grid’

Cardiff University is heading a €3.9 million international academic-industry partnership, pioneering the research and knowledge exchange needed for the development of super-grids for offshore wind: ‘Multi-terminal DC grid for Offshore Wind’ (MEDOW). These super-grids are planned to span the European continent and beyond, linking sources of renewable power generation to ensure constant provision to millions of homes.

The consortium consists of five academic and six industrial partners from the UK, Spain, Belgium, Portugal, Denmark and China.

Summary details

UK University:	Cardiff
Department:	School of Engineering
Partnering with:	Universitat Politècnica de Catalunya (UPC) Control Intelligent de l’energia (CINERGIA) Alstom Renovables España (ALSTOM) Universidade do Porto (UPORTO) Efacec Energia – Máquinas e Equipamentos Eléctricos (EFACEC) Katholieke Universiteit Leuven KULEUVEN (or KUL) Elia System Operator (ELIA) Danmarks Tekniske Universitet (DTU WIND) China Electric Power Research Institute (CEPRI) National Grid (NGRID) (Associated Partner)
Project:	Multi-terminal DC grid for Offshore Wind (MEDOW)
Website:	www.medow.engineering.cf.ac.uk
Interviewee:	Dr Jun Liang, Scientist-in-charge

AN ENERGY STRUCTURE FOR EUROPE’S FUTURE

This DC grid, based on multi-terminal voltage-source converters, is a newly emerging technology suitable for the connection of offshore wind farms. Increased national targets for sustainable energy are driving research in this area and the MEDOW project aims to make significant contributions to the development not only of a North Sea offshore wind super-grid, but also of a pan-European super-grid which can draw in and distribute energy from other renewable sources (for example, the huge solar power potential of North Africa, which could connect with the European wind and solar grid).

The shortage of skills and experience in the field provided the context for a collaborative project which not only carries out research but also trains and develops early career researchers so as to build capacity and human resources in the EU.

EVERYONE NEEDS TO BRING IN AN INDUSTRY PARTNER FROM THEIR COUNTRY

Dr Jun Liang of the School of Engineering at Cardiff University decided to apply for EU Framework Programme 7 ‘Marie Curie Actions’ funding for an ambitious project. There were existing collaborations with the Technical University of Catalonia in Barcelona and the University of Porto in Portugal but the team of three universities wanted to expand the academic network in order to include experts in the North Sea power grid. Initial contact with the Danish team about developing the proposal was via a cold call. Dr Liang brought the Belgian partners to the developing consortium through existing links with Leuven (KUL).

The academic teams agreed to bring on board an industry partner from each of their countries. Cardiff University brought in the UK National Grid and Dr Liang was also able to bring in the China Electric Power Research Institute (CEPRI), where he had previously worked.



The changing face of energy. Denmark has set a new world record for wind production by getting 39.1% of its overall electricity from wind in 2014. Picture from an article about MEDOW: <http://renews.biz/80439/super-grid-project-takes-off>

PARTICULAR CHALLENGES OF WORKING WITH BIG COMPANIES ON MULTI-PARTNER PROJECTS

Industrial partners are crucial for a successful project aimed at real-world change, providing insightful inputs and guidance regarding the direction of research. However, the business culture is much more protective of knowledge than the traditional academic environment, in which knowledge is disseminated as soon and as widely as possible. This meant that time had to be dedicated to drafting and signing confidentiality agreements – not just for the research and IP development, but also for researcher exchanges and visits.

Challenges of working with such a large group have included the difficulty of coordinating 11 partners, and varying levels of engagement from industry partners at some points in the project. A company may join a large project in order to network and keep abreast of helpful or disruptive technologies, but as the operation is unlikely to affect the company’s bottom line, it is not a high priority. For the academic partners, however, continuing papers, exchanges and other outputs are critical to their reputation and survival. The

academic partners also feel pressure to show that their findings and models are being actively taken up and applied by industry.

As long-term change to Europe's energy landscape has significant policy and economic implications, MEDOW has sought to promote its findings and support the non-technical progress needed to make the super-grid a reality through engagement with Friends of the Supergrid, a Brussels-based association of international companies which promotes the policy agenda for a European super-grid.

BUILDING A STRONGER ENERGY RESEARCH NETWORK

Although the MEDOW project runs until 2017, plans are currently being made to capitalise on the current project and Cardiff University's central position in this collaborative network. The project has taken on 12 PhD students and five postdoctoral researchers since beginning in 2013. It has involved local training and researcher exchange programmes, run biannual network meetings and invited external researchers of international standing to provide input. The project leads at Cardiff University are considering applying for funding to continue the project - MEDOW-2. They have also joined the Vision2020 Network, a pan-European research network for SMEs and universities, where they now head the Energy cluster. This should help them engage with an even greater number of relevant academics, companies and institutions as they seek to address the big issues around changing Europe's energy management.

KEY FINDINGS

Academics in applied technology areas are usually well connected with relevant institutions in their own countries. When they network on an international level, they can also bring those industry players together, to develop common long-term frameworks with a wide geographical reach. The academics have to be tenacious however, to make sure the technologies and methods developed are seized by industry.

IMPACT:

- Hired 12 new PhD students and five post-docs to be part of the international team
- Linking industries across borders, providing opportunities for future collaborations
- Contributing to an international framework for the development of a pan-EU power grid
- MEDOW has received funding from the Seventh Framework Programme of the European Union under grant agreement number 317221

ASTON UNIVERSITY

Aston leads the establishment of a new university in Vietnam

The Vietnamese government had engaged in many conversations with UK representatives about establishing a new local university based on UK research practice and accreditation, but no real action had been taken until the Pro-Vice-Chancellor's Office at Aston University saw the opportunity and immediately took the lead, drawing diverse funds from UK grants, industry sponsorship and Da Nang University in Vietnam, as well as committing the university's own funds. Aston was therefore able to discuss Vietnam's higher education needs with the Vietnamese government and begin to shape a programme and develop a faculty. The increasingly integrated nature of the ASEAN group of countries means that Aston can use this as a strong channel to pursue similar models in the broader geographical region.

Summary details

UK University:	Aston University
Department:	Pro-Vice-Chancellor's Office
Partnering with:	University of Da Nang (Vietnam) British Council in Vietnam Sterling Group The Ministry of Education and Training (MOET) in Vietnam Rolls Royce Prudential HSBC Standard Life My Duc Ceramics (SME partner in Vietnam)
Project:	VN-UK Institute for Research & Executive Education
Website:	www.aston.ac.uk/vnuk/about/
Interviewee:	Professor Alison Halstead, Pro-Vice-Chancellor for Strategic Academic Developments (to 2015)

TAKING THE INITIATIVE TO LEAD ON A PLAN

The Sterling Group is a collection of leading UK engineering universities based at Durham, but actively developing international connections. When visiting the University of Da Nang, it engaged in discussions about building a consortium to support the Vietnamese government to make a new university based on British standards. Until then, the Vietnamese Government had largely supported its research capacity by annually sponsoring some 200 PhD

candidates to train internationally. It now wanted to build internationally-recognised research capacity at home so that its university staff could diversify from just teaching undergraduate courses. The Sterling Group formed a three-way conversation about the opportunity between themselves, the UK Government Department for Business, Industry and Skills and the British Council in Vietnam (BC Vietnam). The concept was discussed at length from 2007-12. However, the idea was not pursued actively until Julia King, the Chair of the Sterling Group and also the Vice-Chancellor of Aston University, brought it to the attention of Professor Alison Halstead, who then joined their annual tour of Vietnam in June 2012. Professor Halstead spent three months a year over two years in Vietnam and gained funding to enable staff from Aston and other universities to travel and give research seminars and meet potential students.

Professor Halstead won a Higher Education Partnership Fund award which she used as seed funding to attract other contributions from BC Vietnam, Aston, Rolls Royce and Da Nang University (raising £80,000 of funding for employer engagement, October 2012-September 2013). Professor Halstead then reached out through Aston's alumni in industry in order to find further sponsors. Further funding was provided by Tate & Lyle, Vietnam and BC Vietnam for leadership development. This was followed by £600,000 from BC Vietnam/FCO UK, Aston and Da Nang Universities to create a UK-ASEAN Research Hub in Da Nang. This hub is currently chaired by Professor Helen Griffiths, Aston's Pro-Vice-Chancellor International, and is managed through a steering committee that includes partners from industry and academia. The latter are supported by further funding to build an entrepreneurship hub which is considered to be an important vehicle for economic growth. Professor Griffiths has also been successful in obtaining a further Higher Education Partnership Fund award to develop a doctoral training hub centred in Da Nang. This aims to create a sustainable route for excellent research skills development and international collaboration.

DISCUSSING VIETNAM'S HIGHER EDUCATIONAL NEEDS AND CHANGING THE EMPLOYER-EDUCATION MODEL

The research hub is centred around engineering and business, which is where the Vietnamese government, specifically the Ministry of Education and Training, felt the country had its greatest needs. The engineering aspect largely involves telecoms and software engineering, with the business aspect focussed on finance, accounting and leadership training. Recently, the hub has been complemented by a biotechnology department with around 10 staff led by Professor Griffiths. The broader purpose is the establishment of research partnerships to enable access to fully funded PhDs from the Vietnamese International Education Department (VIED) and to open up alternative research funding.

One area of difficulty has been convincing the Vietnamese government that it is important to have employer sponsorship and vocational integration. Traditionally, employers have only picked up students when they come out of education, rather than sponsoring their progress. Also, although the government understands the importance of business integration, there are concerns that the citizenry want more academic rather than vocational qualifications, as these are seen as being more prestigious. Their initial idea had been more focussed on the British certification rather than business integration, as Vietnamese parents tend to be more interested in giving their children a classic British education.

FROM A CORE TEAM TO A FULL UNIVERSITY

Founded in October 2014, the VN-UK Institute currently has a director and 12 permanent staff, including a senior management team across three floors in part of the University of Da Nang. However, they have a five-year plan to become a full university, the equivalent of a large faculty in the UK. Building locations have

been earmarked, course structures are being developed and individuals are being sent to Aston for training with a view to their becoming faculty staff. Officially, the VN-UK Institute is currently a spin-out, looking to fund itself through all appropriate routes. From September 2015, VNUK established high quality undergraduate education programmes in business and computer science, and will open for bioscience in September 2016. All programmes are delivered in English and the curricula have been mapped to Aston University's for articulation purposes. It is planned that the first master's courses will run in January 2017.

Aston has been successful in bidding for the Newton Fund in a collaborative project that partners VN-UK with Hanoi National University to explore improved uses for rice straw waste. Business engagement is increasing and partners who have expressed interest include Prudential, Rolls Royce, GSK, Harvey Nash, HSBC and Standard Life. Working closely with these partners offers the VN-UK Institute the opportunity to understand the needs of business and link closely for internship opportunities.

ENTHUSIASM, CULTURE AND BUREAUCRATIC BARRIERS

The Aston team had excellent success in establishing trust and contacts. This was a major advantage in gaining funding. They found the Vietnamese students and staff to be hardworking, highly motivated and fun. The major barrier was the time taken by the Vietnamese in releasing the funding, the bureaucracy being more challenging than in the UK. On the other hand, although as a six-tone language Vietnamese is a challenge for foreigners, there was no problem with cross-cultural communication as most of the Vietnamese collaborators speak excellent English.

Professor Halstead stated that if she could do it again, she would involve the international office and international teams earlier to get their support. At the time, she thought it was a short-term project which once delivered could be expanded. In practice, it turned out to take much longer. She also noted that there could have

been more of a shared vision from the university given that it was a task the Vice-Chancellor had personally set. She suggested that others going down a similar route should realise that it will be a slow process and take care to manage everyone's expectations, whilst ensuring all interested parties are kept up-to-date all of the time.

TAKE HOME MESSAGE

Building new international entities can be a very long process, often involving much awkward bureaucracy that needs to be understood. Expectations must be managed and all interested parties should be kept up-to-date all of the time. Shared vision and real support for the university is key, as are resources to travel and meet face-to-face.

IMPACT:

- £740,000 of funding raised from business and governments
- Institute formed with a director and 12 staff
- New study courses developed
- Plans for a separate university in progress

UNIVERSITY OF ABERDEEN

Commercialisation of an entirely new Alzheimer's drug in collaboration with a Singaporean university spin-out

Led by an academic with past commercial experience of collaborations with the pharmaceutical sector, a team of biochemists at the University of Aberdeen pursued a non-traditional route to developing a new Alzheimer's disease therapy. The team assembled a group of investors in Singapore, who in 2002 formed a new spin-out company, TauRx, to fund Phase 2 and Phase 3 trials and development of manufacturing capability. Over \$335 million was raised in an initial period of 12 years from investors in TauRx and, following strong success in mitigating the progress of Alzheimer's disease at Phase 2, confirmatory Phase 3 trials have now been completed with results to be announced shortly.

Summary details

UK University:	University of Aberdeen
Partnering with:	TauRx Therapeutics
Period:	2002-present
Interviewee:	Charlie Harrington, Chief Scientific Officer, TauRx

A NEW THERAPY

In the mid-1990s at the University of Cambridge, Professor Claude Wischik and his team uncovered and patented new compounds that dissolved filaments that are believed to cause the symptoms of Alzheimer's disease.

Collaborations with large pharmaceutical companies – first ICI (now part of AstraZeneca) and then Roche – to develop a drug based on the compounds were successful but limited. In 1998, Professor Wischik and his collaborator, Charlie Harrington, joined the University of Aberdeen and began the search for a new partner to exploit the discovery. A propitious meeting in Singapore with an investor led to the development of a university spin-out company, TauRx, in 2002 and an initial investment of \$2 million.

In 2002 a new head chemist, John Storey, joined the team, bringing synthetic and manufacturing expertise, and the new company taught themselves how to conduct a Phase 2 trial – an enormously complicated undertaking for testing a drug aimed at a chronic, rather than acute, condition. Seventeen investigation sites were set up in the UK, with one in Singapore for the Phase 2 trials. Remarkably positive results were achieved in 2008: the product, rember®, appears to slow the progress of the disorder by 81% over a year, and could offer hope to millions worldwide.

One intention to sell the product back to a major pharmaceutical company did not progress, in part because of the combined impact of the credit crunch and the pharmaceutical industry's favour for an alternative 'amyloid theory' of Alzheimer's disease. With approval from the University of Aberdeen, TauRx itself raised a further \$200 million of private investment, largely from South East Asia, to fund confirmatory Phase 3 trials.

DEVELOPING CAPACITY FROM SCRATCH REQUIRES NEW HR PRACTICES

A team of 70 was assembled, primarily in University of Aberdeen buildings, to tackle challenges such as the development of a stable version of the drug with fewer side effects, and the ability to bulk manufacture in 100kg batches. Over time, HR practices at the university were adjusted so that TauRx managers and staff with clinical trial expertise could be recruited to the institution without being beholden to the university's usual pay scale and terms and conditions.

TauRx has now raised a further \$135 million in investment and the lengthy Phase 3 trials are now complete. The drug has potential to make a major impact on the lives of those that suffer with the disorder.

Dr Harrington reported that the significant freedom given by the 'single project model' – the TauRx spin-out – was important to the overall success of the project. The willingness of the University of Aberdeen to adjust its policies has been a significant factor in the success of this innovation.

Two notable outcomes of the long collaboration between the University of Aberdeen and TauRx are 1) a gradual change in Aberdeen's Technology Transfer policies regarding the employment of staff with required skills at 'market rates', and 2) a 'single project model' where, in contrast with the normal pharmaceutical company practice of managing a portfolio of therapies, a single approach is being backed by the firm, allowing for greater persistence in the face of developmental obstacles.



A Lab scene from the TauRx team.

TAKE HOME MESSAGE

Collaborative innovative partnerships may require substantial flexibility in terms of HR practice, for example, such that highly specialised staff can be recruited to the institution without being beholden to standard university pay scales or terms and conditions. A 'single project model', as opposed to the typical large business model where a portfolio of developments are concurrently supported, can provide focus that is a significant driver of success and allow for greater persistence in the face of developmental obstacles.

IMPACT:

- Spin-out company formed
- \$335 million raised for product development
- Team of 70 employees drawn together
- New drug taken through Phase 2 and Phase 3 trials
- New HR and project management models designed

UNIVERSITY OF SOUTHAMPTON

Globally partnering with big nutrition to understand epigenetics

Epigenetics, the natural modification of DNA by the environment, is a very new area of scientific study with impacts not yet fully understood. However, it appears to play an important role in development and – unlike other aspects of genetics – it is potentially changed by factors such as diet. New understanding of the impacts of diet and health are of huge interest to the industry players that specialise in early nutrition. This is what brought an international academic collaboration between the University of Southampton and counterparts in Singapore and New Zealand together with household names such as Nutricia Research, Abbott Nutrition and Nestec SA. The industry-sponsored research contracts generated as a result have provided in the region of £28 million in funding to enable the EpiGen Global Research Consortium to advance the fields of applied epigenetics and maternal and infant nutrition.

Summary details

UK University:	University of Southampton
Department:	Faculty of Medicine
Partnering with:	National University of Singapore
Interviewee:	National University of Singapore MRC Lifecourse Epidemiology Unit, University of Southampton Auckland UniServices Ltd., Liggins Institute, University of Auckland, New Zealand Singapore Institute of Clinical Sciences, Agency for Science, Technology and Research, National University of Singapore Nutricia Research Abbott Nutrition Nestec S.A.
Project:	EpiGen Global Research Consortium
Website:	www.epigengrc.com
Interviewee:	Dr Jo Slater-Jefferies, General Manager, EpiGen Consortium

A CONSORTIUM GATHERING AROUND EPIGENETICS

The EpiGen Global Research Consortium is an international academic research network with five partner institutions in three countries. It began in 2006 when strategic investment by the University of Southampton, Auckland UniServices Ltd and AgResearch Ltd allowed researchers at the institutions to dedicate

more time to epigenetics and form EpiGen. In 2009, the two Singaporean institutes joined to develop the academic consortium further. The collaborators agreed a scientific strategy focusing on understanding gene-environment interactions throughout the life cycle in relation to health and wellbeing. It is believed that environmental factors, such as the diet of the mother, can adjust epigenetic processes in utero with lasting consequences, including affecting early child development. The EpiGen partners provided initial funding for the pilot work to ‘pump prime’ investment in the research.

FROM CONFERENCE MEETINGS WITH INDUSTRY TO SPONSORED RESEARCH

Singapore-based Abbott Nutrition became interested in this area of research through the work of EpiGen. Any dietary components which are scientifically proven to have positive health impacts provide a strong development and marketing angle for food product companies.

EpiGen collaborated with the Medical Research Council Lifecourse Epidemiology Unit to study participants in the Southampton Women’s Survey, which explored mothers’ nutrition during pregnancy and DNA methylation (an epigenetic marker) in umbilical cord tissue collected at birth. The concept was now to follow the children growing up to see whether the diet and prenatal environment correlated with epigenetic marks at birth that had been linked with later cognitive performance. In collaboration with Abbott Nutrition, research was undertaken that found a correlation between the methylation status of a gene called HES-1 and the later cognitive performance of the child.

In 2010, collaboration began with Nutricia Research, a relationship initiated via conferences focusing on prenatal health research.

A year later, a partnership was formed with Nestec SA, a scientific research and technological development company that operates as a

subsidiary of Nestlé SA. This ongoing research is aimed at understanding the relationship between the mother’s nutrition, epigenetic mechanisms and offspring body composition, with a particular focus in adiposity levels. The study also examined the babies’ gut microbiome, leading to findings linking specific characteristics of this with the children’s weight and level of obesity later in life. A large contract renewal was signed in October 2014 and the company announced it would contribute CHF 22 million (£15 million) to a six-year research collaboration with the EpiGen Consortium. The NiPPeR clinical trial is now recruiting in all three countries.

For more on the research, see: www.epigengrc.com/news/impact-of-nutrients-before-and-during-pregnancy

MAKING THE CONSORTIUM WORK

Dr Jo Slater-Jefferies acts as general manager across all sites. Despite being five organisations across three jurisdictions, EpiGen provides a joined-up and streamlined approach. Discussions and negotiations are coordinated so there is a single voice on each aspect of the project – project planning, finances, contracts, publication and IP. EpiGen collaborates internally within the consortium at all levels, including research, legal, finance and project management. Collectively, the EpiGen IP management group has filed four families of patents, two of which are now accepted for grant. The University of Southampton also has its own patent panels with dedicated funding.

STRUCTURES ARE NEEDED TO DEAL WITH BIG BUSINESSES

The business partnerships have allowed EpiGen to strengthen its team across its three university-based sites. It has also been able to draw in grant money to match the investment.

Dr Slater-Jefferies believes that a key ingredient

to working with big business is to have experienced managers and a clear management structure. This gives business partners confidence in the relationship. There also need to be funds for travel to network, and also for IP expertise where appropriate. Businesses and academics will always have different expectations from a project and so contracts must be clearly written to ensure the incremental deliverables that businesses are looking for are included. This allows the academics their long-term vision, whilst providing the business with the clear short-term progression which reassures them they are receiving a strong return-on-investment. Having a clear programme of work with deliverables, bound together by a contract, is important to ensure the success of public-private partnerships.

TAKE HOME MESSAGE

An international research consortium can provide opportunities for collaboration with global industry partners to undertake cutting-edge discovery and translational research. The combined expertise can prove very powerful and attract considerable funding to conduct mutually beneficial research. Consortia need to have robust internal relationships at every level, to be well organised, and to have a joined-up approach to defining project scope and in all negotiations around deliverables, finances, IP and contracts. Strong project management and planning skills are needed to ensure successful delivery of the research and to secure continued collaboration with business.

IMPACT:

- Academic collaboration spanning three countries
- Research support from three large businesses, including £15 million contribution from Nestle. Four families of patents filed (two granted)
- High-level exposure for academic-business partnership
- Discoveries linking maternal diet in pregnancy to children's health
- Foods beneficial to health to be developed by business partners

UNIVERSITY OF WARWICK

Building an international team to revolutionise car manufacturing with remote laser welding

Warwick leads a large multinational academic-industry partnership which has developed the IP and a portfolio of software solutions to make remote laser welding a reality for car manufacture. The potential savings with remote laser welding are huge, but the computational and organisational challenges associated with making it work presented such a paradigm shift that industry was not yet prepared to take on the development risk. Funding for the ambitious project is drawn from both the European Factories of the Future (FoF) initiative (€3.9 million) and the Korean government (€900,000), which shortly after granting this award initiated a funding programme similar to FoF. Additional support came from the UK EPSRC project EP/K019368/1: Self-Resilient Reconfigurable Assembly Systems with In-process Quality Improvement (RAS-IPQI) (£2 million).

Summary details

UK University:	The University of Warwick
Department:	Warwick Manufacturing Group (WMG)
Partnering with:	The Computer and Automation Research Institute of the Hungarian Academy of Sciences Politecnico di Milano The University of Patras The Swiss Federal Institute of Technology in Lausanne The University of Molise Jaguar Land Rover Limited, Stadco Ltd. Comau, PRECITEC KG, EnginSoft, UNIST
Project:	RLW Navigator – ‘Remote Laser Welding System Navigator for Eco and Resilient Automotive Factories’
Website:	www.rlwnavigator.eu
Interviewee:	Professor Darek Ceglarek

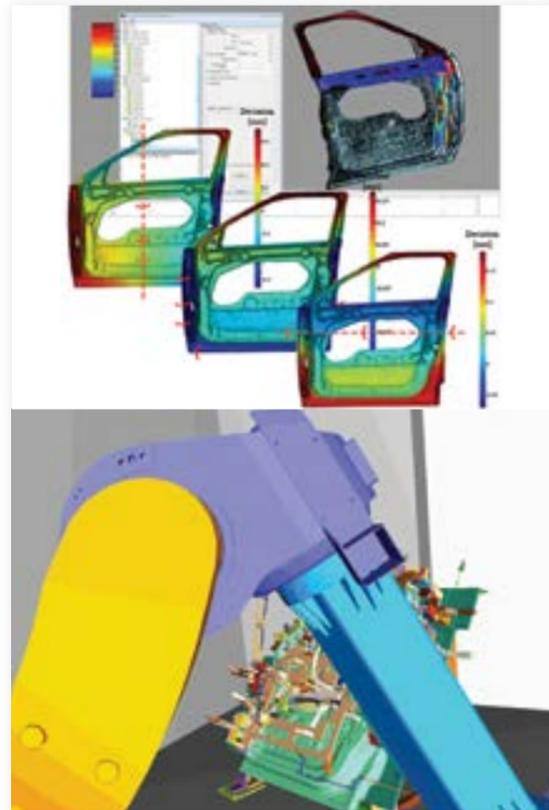
HUGE EFFICIENCIES IN TIME, SPACE, COSTS AND INCREASED FLEXIBILITY

Remote laser welding (RLW) has the capacity to overhaul assembly lines: laser welding is five times faster than spot welding for an equivalent strength weld. Studies have also shown that for the equivalent process, a laser welding cell occupies 60% less floor-space, involves 65% fewer robots, a shorter production line and 10% lower operating costs. It can weld with access from only one side of the parts being joined,

unlike current spot welding which requires two-sided access. The main reason RLW has not been adopted more widely is the lack of methodologies for precise and effective planning and simulation of its application that will ensure it works right first time.

HARNESSING THE EU'S FUNDS TO STIMULATE EUROPEAN MANUFACTURING

Professor Darek Ceglarek and his colleagues at the Warwick Manufacturing Group (WMG), the University of Warwick, were approached in 2010-2011 by Jaguar Land Rover, who were looking for enabling technologies. They were also contacted by other companies interested in applications of RLW. Since some of the earlier research conducted by Professor Ceglarek generated fundamental models for variation simulation analysis of remote laser welding (UK EPSRC STAR Award), he suggested applying for a grant from the €1.2 billion Factories of the Future (FoF) programme under FP7. The idea was to focus on key enabling technologies that could be brought into use within two years of the completion of a project.



Computational challenges. A key part of remote laser welding is understanding how to handle all the potential variations and errors in the materials to be welded.

Professor Ceglarek found key academic experts in Italy, Hungary, Switzerland and Greece, as well as a number of business partners involved in the necessary manufacturing process for the €3.9 million project. He also found a team in Korea (who could participate under the EU-Korea bilateral agreement) that could handle certain areas that would mitigate technical risk, such as testing the methods with more powerful lasers. The Korean government also provided an additional €900,000 to fund their researchers in the consortium. This forged a new link with Korea, which soon after launched its 'Connected Smart Factories' programme to mirror the EU's FoF initiative, inviting Professor Ceglarek's team to present at the launch.

ACADEMIC OUTPUT AND MARKETABLE GOODS

The project team started with small components, planning to build up to welding larger components, a method which would enable them to provide evidence of both the potential impact of the technology and its relevance to this sector. The emphasis was on developing software and computational power to develop flexible models which could handle different scenarios and be sold and used. Starting with small components, the team has worked up to welding whole doors for Jaguar Land Rover's models.

COMPARING UK, EU AND US CULTURES FOR ACADEMIA ENGAGING WITH BUSINESS

Having gained his PhD in the USA and taught there, Professor Ceglarek noticed important differences in regard to research values and engagement with business. US funding is focussed on end results, whereas EU funding is focussed on the process of delivering the results. He sees many opportunities for UK innovation should they encourage a mix of the American flexible/entrepreneurial work culture with Europe's large international programmes aimed at bringing together academia and business. He suggested that Innovate UK is in a good position to pick up EU-funded projects and help them to continue to commercial completion.

In terms of working cultures in business-academia partnerships, he emphasised that developing key enabling technologies is just part of the equation. Their rapid deployment is of equal, if not higher, importance. This requires mid-size pilot studies that focus on testing real products and services. Such testing is important, as it will yield essential understanding about the maturity of the technology and factors required to embed these technologies into the production system.

The project has won various academic awards, including a best paper award in 2014 and a best conference poster award in 2013. The project has developed 12 exploitable software tools which are key enabling technologies (KETs), placed into three IP bundles that are associated with commercial agreements, a commercial lead and IPR (Intellectual Property Rights) breakdowns across the contributing partners. The team organised an international symposium to showcase the developed tools to new markets, looking to pilot the capacity in different manufacturing environments. The event also served as a call for further funding to bring the technology closer to market and to explore research directions identified during the project.

KEY FINDINGS

Developing a new technology in collaboration with a big business partner can be challenged by evolving drivers such as new regulations, materials, technologies, services and communications, as well as pressure on cost and sustainability. Accomplishing a successful collaboration requires a new level of verification and validation of the developed key enabling technologies via mid-sized pilot studies that go beyond simplified case studies by including provisions for testing with real products and services.

IMPACT:

- RLW solutions delivered major efficiencies in terms of processing speed (5x faster), joint strength, weight, number of robots required, and both investment and operating costs
- Twelve exploitable software tools (in 3 IP bundles) developed
- Delivered a number of industry firsts including fully digitally developed RLW assembly process and in-process weld quality monitoring
- 48 peer reviewed articles and 30 conference presentations
- 8 prizes won at scientific conferences and competitions by the project's PhD and MSc students
- Selected by the EU as a success story for outstanding research and industrial relevance

HARPER ADAMS UNIVERSITY

Building innovative and sustainable farming in Zambia

AGCO, a global leader in the design, manufacture and distribution of agricultural equipment, has a 99-year lease on a piece of land in Lusaka, Zambia, where they are developing a demonstration farm. The Future Farms programme will showcase innovative technologies and provide training and education for Zambia's entrepreneurial farmers. Harper Adams University, which has long-standing relationships with AGCO, the project's lead industry partner, is the academic partner. The university undertakes knowledge transfer (KT) to ensure farmers can evaluate products from commercial businesses and understand the benefits to their farm before acquiring them. Working for farmers and corporate businesses alike, the Harper Adams team of consultants, researchers and students strive to safeguard values of competent management and sustainable, environmentally sound practice in farming.

Summary details

UK University	Harper Adams
Department:	Land, Farm and Agribusiness Management
Project:	Future Farms
Partnering with:	AGCO Corporation Bayer Plc (Bayer CropScience) Yara International ASA Precision Decisions Rabobank (Dutch)
Website:	http://agcofuturefarm.com
Interviewee:	Martin Wilkinson, Senior Lecturer

LONG-STANDING LINKS WITH AGRI-BUSINESS BRINGS HARPER ADAMS TO ZAMBIA

Harper Adams has taught 30% of the UK's agricultural graduates and is home to the only Agricultural Engineering department in the UK. A key part of the University's programmes involves linking to industry, and all undergraduate programmes have a placement requirement. The long-standing relationship with AGCO (an American multinational agricultural equipment manufacturer based in Georgia, USA) made Harper Adams the academic partner of choice for AGCO's Future Farms initiative in Zambia.

In Zambia, most rural land is controlled by chieftains. AGCO negotiated with a chieftainess in Lusaka for the lease of land for a 99-year period. AGCO then brought in complementary industrial partners like Bayer (crop science division), Yara (a Norwegian international fertilizer manufacturer), Precision Decisions (high-tech farming equipment)

and Rabobank – a leader in sustainability-oriented banking for food and agriculture financing.

The training centre opened in May 2015, but Harper Adams had already been providing training on the Future Farms initiative for 12 months using the existing facilities while the training centre was under construction. That training has included agriculture and farm management subjects, with participants ranging from senior management in AGCO to commercial farm managers and agricultural development officers working in Zambia (government-funded).

THE THREE DIFFERENT TYPES OF ZAMBIAN FARMER

It is important to adapt the farmer training courses to the appropriate level of farm. In Zambia, there are three different categories. Firstly, there are the commercial farms, western-backed or western in style, some even of European origin. They number between 400 and 600, each running several hundred to tens of thousands of hectares and utilising modern technologies. Secondly, there are the emergent farmers, a few thousand in number, usually native Zambian and running 20-30 hectares each. They are often more entrepreneurial and operate on land granted non-permanently by the chieftain or chieftainess of the local area. Thirdly, there are the subsistence farmers, numbering 1.2 million, with 1-2 hectares each.

The target audience for these courses are the emergent farmers or, more accurately, the extension officers working with emergent farmers. Harper Adams has developed an emergent farmer business model to demonstrate the economic sustainability of investment in new technologies and adoption of best practice. Training is provided in budgeting techniques, capital availability and responsibility. The individual emergent farmer or the local community collaborating to share in new technologies needs confidence that investment is worthwhile. The university's staff provide practical and applied agricultural and

entrepreneurial training for this emergent farmer sector.

GETTING THE TECHNOLOGY LEVEL RIGHT TO DEVELOP SUSTAINABILITY FOR ALL PARTIES

The researchers' academic interests lie in understanding and evaluating, impartially, the core viability of farming in Africa. Transferring this knowledge to participants, they can help forge win-win relationships between ambitious entrepreneurial farmers and agricultural companies who offer a range of products and services. Understanding the core dynamics at work in these farms helps Harper Adams' academics identify the most relevant areas to research. They then involve their students in this work. The university sends PhD students to the Future Farm to engage in precision farming training and to learn about the management of soil – a vital resource.

Harper Adams has a memorandum of understanding with the university in Lusaka. A long term partnership there would help solidify their two-way relationship with the area and provide a model for wider collaborations and training.

TAKE HOME MESSAGE

Universities find a natural business model in the interface between big business and communities. There they can research productivity and needs, becoming valued consultants for both suppliers and consumers, whilst also keeping their innovative research relevant due to the direct engagement.

IMPACT:

- Students and staff develop expertise in working with industry and understanding the needs of farmers in Zambia
- The development of a consultancy model that can be exported to other countries in the region

UNIVERSITY OF ST ANDREWS

Re-purposing marine imaging technology

A geophysicist with a background in the oil industry led a team from the University of St Andrews on a project which crosses industry boundaries. With academic and commercial partners in Washington DC, Panama and Qatar, they re-purposed marine imaging technology originally designed to detect and scan for drilling sites, for a startling variety of other purposes.

Summary details

UK University:	University of St Andrews
Partnering with:	Smithsonian Institution and others
Period:	2000-present
Interviewee:	Dr Richard Bates, Senior Lecturer, Earth Sciences

NEW PURPOSES FOR OLD TOOLS

In the late 1990s, Dr Richard Bates left the oil and gas industry after a career with Thermo-Electron and Coleman Energy. He turned to academia, examining how oil and gas technology for seismic imaging of hydrocarbon reservoirs could be used to monitor, manage and protect internationally important marine assets. In 2000 his research received a boost when the EU's new Water Framework Directive meant new technologies were needed to conduct wide and detailed investigations of the sea floor.

Dr Bates' work with colleagues at St Andrew's Department of Earth and Environmental Sciences, has led to the establishment of over

107 internationally important sites of Marine Special Areas of Conservation and Marine Special Protection Areas. Since then, the sonar methods have become part of internationally adopted practice across the EU and elsewhere in the world, such as in the protection of fishing control areas off Panama.

Over time, Dr Bates and his team adapted these methods for use in the management of marine cultural heritage, such as wrecks, underwater structures and drowned landscapes. Practically, this approach can allow for the ongoing management of wreck sites. At the same time it has had huge repercussions for the archeologists and historians. For example, research on the submerged Neolithic remains around World Heritage sites in Orkney revealed a lost world. In Jersey and Norfolk (Happisburgh) researchers have uncovered new insights into early human expansion in Northern Europe, including the discovery of the earliest known human footprints in Britain. Aspects of the work in La Cotte de St Brelade in Jersey and Happisburgh in Norfolk, featured in a popular special exhibit, 'Britain: One Million Years of the Human Story', in the Natural History Museum in London in 2014.

Dr Bates and his colleagues adapted the technology for four distinct applications: oil and gas-related scanning, conservation and fisheries scanning, salvage and wreck scanning and archaeological/'human heritage' scanning. The wide range of outputs made the team attractive partners for a wide range of international research and government-related bodies. Dr Bates and his team are regularly approached on an academic-to-academic basis by researchers working on applied problems in countries around the world. Often, the work undertaken can be funded at least in part by industry, while the data gathered can then be shared with other agencies and academics.

Notable international partnerships include collaborating with the Smithsonian Institution to survey the Hannibal Banks off Panama looking at both its biosphere and its potential for natural resources. The team also partnered with the Qatari government to manage conservation, heritage and archaeology issues around the

country's development.

Other applications have been in the study of rapidly retreating glaciers and areas of sea-ice melt in Greenland, the habitat of some of the most threatened species in the world, such as the polar bear. This research was highlighted in the award-winning 2012 BBC programme 'Operation Iceberg'.

The need to adapt the scanning technology itself and to come up with new software tools to analyse the data at various stages and in different ways, means that every collaboration and new setting for applying the technology is by definition a moment when there is a challenge to innovate. And the new data generated by a new scanning technique or a new analysis tool cycles back into the data gathered in previous generations of the work, enhancing the findings from past studies as well as enabling future ones.

TAKE HOME MESSAGE

Innovation comes not only in the form of developing a new technology for a problem, but also in re-purposing current technologies for new roles. Multidisciplinary teams can work together to respond to the world's grand challenges via this route.

IMPACT:

- Re-use of underwater seismic imaging for protection of marine assets
- Development of tech for marine site management, wreck and archaeological scanning
- 107 marine special areas for conservation or protection established
- Partnerships with Smithsonian and Qatari government among others
- Natural History Museum exhibit
- Study of glaciers featured in BBC programme 'Operation Iceberg'

UNIVERSITY OF THE WEST OF ENGLAND (UWE BRISTOL)

Developing a resource to link foreign graduates with world-class jobs in their home countries

The University of the West of England's (UWE Bristol) 'GradLink UK' is now widely used by other universities. International students studying in the UK can gain online access to a selection of top employers in their home countries specifically looking for their talent and skills.

Summary details

UK University:	The University of the West of England (UWE Bristol)
Project:	GradLink UK
Partnering with:	Taylors University, Malaysia National Economic University (NEU), Vietnam HSBC, IBM, Intel, Microsoft, GSK, Deloitte, PwC, M&S and many other recruiters China-Britain Business Council, British Chamber of Commerce Thailand, ACCA Global
Period:	2012-present
Website:	www.gradlinkuk.com
Interviewee:	David Gee, Global Employability Development Manager

A NATIONAL ONLINE RESOURCE WITH GLOBAL IMPACT

GradLink UK is a universal careers website for international students. It is a holistic advice and jobs resource, with links to the home countries of graduates. There are dedicated sub-sites for India, ASEAN, China, Africa, Bangladesh and Canada.

The project began in 2012, when David Gee applied for and won a £4,500 Prime Minister's Initiative 2 (PMI2) grant from the UK government. The call focused on helping international students and Gee's idea was to assist Malaysian students at UWE Bristol find employment in their home country. Rather than just offering a careers service page, Gee wanted

to build links with international recruiters. He travelled to Kuala Lumpur, where UWE Bristol had recently opened a new regional office, and made connections with local businesses interested in Malaysian students with a UK education. Bringing in early partners took some time, but when big names including PwC and the Malaysian Bar Council came on board, the project flourished.

EXPANDING A SUCCESSFUL MODEL

In the first six months, the GradLink page received 4,500 visits. The Association of Graduate Careers Advisory Services (AGCAS) promoted the PMI2 project and other universities started to express their interest in the site. It became clear that the model was a potential universal resource that needed expansion.

UWE Bristol supported Gee in setting up an independent website in June 2013. He found an alumnus willing to develop it for a mere £6,000 and prepared to expand the model to China and India. For the latter, Gee toured Bangalore, Mumbai and Delhi, while in China visited Shenyang, Shanghai, Beijing and Guangzhou (Bristol's sister city in China). UWE Bristol provided the travel finances and UWE Bristol alumni helped set up meetings in India. The government-sponsored Bristol China Partnership (BCP) also helped forge Chinese links. The China-Britain Business Council officially endorsed the GradLink website, making it the only careers website to gather such endorsement.

BRAND INDEPENDENCE OF THE HOST UNIVERSITY

The website launch used the AGCAS network for promotion, under the branding of GradLink rather than as a UWE Bristol initiative. It was launched in India, China and Malaysia and soon expanded into Kenya, Ghana, Nigeria and Canada. The project dovetailed with UWE Bristol's mission to establish a stronger presence

in these African countries and in Canada. To help develop GradLink ASEAN, UWE Bristol reached employers by working with the careers services teams at its partner universities in South East Asia.

There is a sharp contrast between costs and benefits. The costs are website management, student employment and travel when there is a need to add new territories. The benefits have been huge in terms of establishing the project, and recognition of UWE Bristol as the UK experts in international graduate career-building. Much of the success of the resource is attributable to its independence from its original host university and the establishment of the venture as a UK-wide resource.

WHAT'S IN A NAME?

The biggest hurdle was engaging employers overseas. The University of West England was not as well-known as some other UK institutions, particularly in India, so opening doors was a challenge. Subsequently, developing GradLink ASEAN was much easier as the team could present a well-developed, universally-used website with 300 employers across the world, including many companies that are globally recognised.

NEW FEATURES

GradLink continues to evolve, with new features and countries added each year. It has 11,000 followers on social media and the website now receives over 95,000 visits per year. The website has experienced a 50% increase in usage in the last year. In April 2014, the team launched a sub-brand: 'Go-CV!' On this platform students can build and submit their CVs for prospective employers to search. There are now 1,800 CVs uploaded and all of the UK's top 100 universities are represented.

Gee attributes GradLink's success to the counter-intuitive model of developing a resource that was not selfishly guarded by its host institution, but instead opened to the rest of the university sector. Having filled the niche GradLink quickly became the universal sector resource.

TAKE HOME MESSAGE

Brands can be built from scratch with a university's support and investment and when allowed to develop independently. Due to its early adoption of a pan-UK focus in its working model, GradLink was rapidly adopted by many UK universities. UWE Bristol can now claim unique expertise in a key area and to build reputation, networks and research capacity accordingly.

IMPACT:

- 11,000 followers on social media
- 95,000 visits per year. Usage increase of 50% in the last year
- >1,800 CVs uploaded covering the top 100 UK universities
- Database of over 370 employers across the world including HSBC, IBM, Intel, Microsoft, GSK, Deloitte, PwC, M&S
- Dedicated website sections focussing on India, ASEAN, China, Africa, Bangladesh and Canada
- Times Higher Education award winner and Guardian award runner-up



GradLink boasts an impressive global network of employers, with the main subsections of the website targeted to geographical regions.

SETSQUARED PARTNERSHIP

Supporting the development of Italy's entrepreneurs

SETSquared is a long-standing partnership between the universities of Bath, Bristol, Exeter, Southampton and Surrey, which grows high-tech start-ups through its incubation programme and other business acceleration services. It is ranked by the University Business Incubator Index as the best in Europe, and second best in the world. Over the last decade it has helped over 1,000 high-tech start-ups to develop and raise more than £1 billion of investment. It collaborates with Fondazione CRT, an Italian charitable foundation, to deliver entrepreneurial training to graduates from Turin's universities.

Summary details

UK University:	SETSquared partnership (Universities of Bath, Bristol, Exeter, Southampton, Surrey)
Partnering with:	Fondazione CRT, Turin
Period:	2011-present
Interviewees:	Simon Bond, Innovation Director Karen Brooks, Project Director

BUILDING A STRONGER PRIVATE SECTOR IN ITALY

Following the financial crisis, Italian banks agreed to start new initiatives to increase the strength of the private sector economy in Italy, in part by harnessing and funding the expansion of the educational work of existing regional charitable foundations, to support start-ups and enterprise activity.

Following an invitation from UKTI to address their Italy team, Karen Brooks of SETSquared initiated discussions with the Turin (Piedmont and Aosta region) foundation, Fondazione CRT. This led to the creation, in 2011, of a programme based on SETSquared's Springboard programme in the UK.

As a way of helping initiate the collaboration, four Italian students undertook internships at the SETSquared base in Southampton. This allowed a transfer of knowledge on the enterprise education techniques used in SETSquared to the Italian operation.

DEVELOPING THE PROGRAMME

In Turin, the programme started with 150 participants who wanted to learn more about enterprise, and who were willing to commit to six months of Saturday sessions. At the end of these sessions, SETSquared directed a selection programme, bringing 'outside' objectivity, to choose the most promising 45 candidates; it then ran a second programme with them, focused on how to pitch ideas to investors and develop ideas into marketable value propositions. In 2011, this second stage was a weekend programme, but since 2012 it has been run as a full week, including pitching to active investors during a summative event. The best participants are also offered the opportunity to participate in further programmes and workshops in the UK.

DEVELOPING THE PROGRAMME

The advent of crowdfunding as an option for early stage funding has changed the focus of the programme. Its goal has become either to raise seed stage funds directly from investors or to develop a plan for crowdfunding. The programme has gained a further boost with the Italian government's adoption of tax-favorable treatment of investment in early-stage startups (much like the EIS scheme in the UK), which has significantly boosted the total funds available to scheme participants from both direct and crowdfunding sources.

The first CRT Fondazione-run element of the programme, which changed from six months of lectures to experiential, team-building-based activities was developed following feedback from SETSquared. With participants ever keener to be selected for the second, SETSquared-run, element of the programme, the team has seen increased focus on quality business idea generation during the initial phase.

Perhaps one of the most impactful outcomes of the collaboration is the creation of a network of the 150 second-stage participants so far. As enthusiastic practitioners and supporters of the startup mentality, and working with Turin Polytechnic's I3P business incubator, SETSquared is becoming an influential group in the Piedmont and Aosta regions for the support of enterprise and new business creation. This was recognised in 2015 when the UN Economic Commission gave SETSquared and I3P an award for their support of enterprise activity.

TAKE HOME MESSAGE

UK universities are developing significant expertise relating to start-ups and entrepreneurship. Internationally this capacity is highly marketable and can both positively impact university reputations and strengthen their business networks.

IMPACT:

- Helped >1000 high-tech start-ups raise >£1 billion in funds
- 150 second-stage participants in Italy
- Strong link with Turin Polytechnic I3P business incubator
- Award from UN Economic Commission in 2015

SHEFFIELD HALLAM UNIVERSITY

A powerful global research network targeting online security threats

The Centre for Excellence in Terrorism, Resilience, Intelligence and Organised Crime Research (CENTRIC) is a multidisciplinary international network based at Sheffield Hallam University. CENTRIC is now a driving force in EU and US applied research and policy on international management of online threats to security.

Summary details

UK University:	Sheffield Hallam University
Partnering with:	Harvard University, USA University of Virginia, USA Erasmus University, Netherlands Fraunhofer Institute, Germany University of Madrid, Spain West Yorkshire Police King's College London, UK Bavarian Police College
Period:	2011-present
Website:	http://research.shu.ac.uk/centric
Interviewee:	Professor Babak Akhgar, Director of CENTRIC

UNITING THE BROAD BASE OF STAKEHOLDERS IN ONLINE SECURITY

CENTRIC is a multidisciplinary and end-user focused research network based at Sheffield Hallam University. Its global reach encompasses and combines academic and professional expertise across a broad range of disciplines, providing unique opportunities to progress ground-breaking research in order to tackle a range of threats. CENTRIC's primary strategic aim is to facilitate triangulation between the key stakeholders in the security domain, namely: government, academia, the public and private industry.

YORKSHIRE POLICE EXPRESS AN INTEREST IN INFORMATICS ASSISTANCE

The presentation by Professor Akhgar of his informatics paper, *Application of knowledge management for law enforcement agencies*, at an EU conference on security was pivotal to CENTRIC's development. Representatives of North Yorkshire police who were present at this conference asked Professor Akhgar for his help solving a gun-related database problem. It was the expertise he devoted to this problem that led to the award of a €3.4 million EU grant for a project linking Sheffield Hallam with various police forces.

Project Odyssey was built by a team of police experts, industrialists, computer scientists and researchers. It has since produced and developed a technological resource which enables police organisations to automatically share information about gun crime and terrorism across the European Union. The project has also led to snowballing requests from police forces for data management and related technology applications.

In 2011, the team decided to consolidate this and a variety of other projects it had subsequently become involved in. Its multinational line-up from various European countries now applied for further funding from the EU exploring social media crisis management (the Athena Project). EU officials were keen to work with US partners. The American Department of Homeland Security soon showed an interest and suggested including two US universities – Harvard and the University of Virginia – where the FBI had helped establish a Critical Incident Analysis Group (CIAG). CIAG specialised in individual and group behaviour. It was on the basis of this prototype that Professor Akhgar decided to establish a comparable group in the UK.

MULTI-STAKEHOLDER COLLABORATION IN RESEARCH DRIVES INTERNATIONAL POLICY

The mission of CENTRIC is to provide a platform for researchers, practitioners, policymakers and the public to focus on applied research in the security domain.

The Vice-Chancellor of Sheffield Hallam has been redoubtable in his support of the new centre, allowing independence of governance, bricks-and-mortar housing and allocating seed funding to establish core functioning. An executive board now sits in CENTRIC, with representation from major industry players and police forces, including SAS, SAP, Blackberry, **United Nations Interregional Crime and Justice Research Institute** (UNICRI), United Nations Office on Drugs and Crime (UNODC), South Yorkshire Police, West Yorkshire police and CIAG.

CENTRIC IMPACT

Since 2011, CENTRIC has been running eight or nine live projects focusing exclusively on security research. These have a total value of £22 million. From its modest starting line-up of three personnel, CENTRIC now has 35 permanent

university staff members working alongside 15 temporary colleagues. In addition to its regular turnover of academic publications, CENTRIC has produced 10-12 practitioner books on counter-terrorism and broader security concerns. The Cyber summit in the Hague (2015) brought together 58 ministers from a variety of countries and the final communiqué featured three key references from CENTRIC's Cyber Crime book.²⁹ This underscores the group's growing stature as a defining force on cybercrime and cyberterrorism in Europe and beyond.

Professor Akhgar's personal remit is to aim high, to shun geographic restrictions and to ensure that the work is designed to be multidisciplinary. Work constricted to one discipline does not have the same potential to continue to provide innovative outcomes in the short term of a few years – which is critical in this field.

As director of CENTRIC, he also recommends engaging with UK government officials regarding EU policy and funding programmes. Via personal engagement researchers can glean key information before it filters down through slower information channels. This intelligence can be productively fed back to UK research institutions.

TAKE HOME MESSAGE

Building a research capacity that is university-independent, multi-stakeholder and multidisciplinary ensures that the capacity to make an impact on policy at home and internationally continues beyond the initial project term. Without the multidisciplinary links, research will not maintain the same level of broad relevance after the first few years.

IMPACT:

- System developed to share gun crime data across EU
- Development of European Cyber Crime research roadmap
- Independent centre formed, leading multiple projects focused on high tech/ data solutions for police forces across Europe
- Links with law enforcement agencies to help develop UK capacity to research individual and group behaviour dynamics
- Linking of government, business and public interests in understanding online crime and terrorist threats from user perspectives
- Undertaking 12 security projects with value of £22 million
- 12 practitioner books published
- Major summit featured five key references from CENTRIC

²⁹ Akhgar, B et al. *Cyber Crime and Cyber Terrorism Investigator's Handbook*, 1st, 2015. Elsevier

APPENDIX I

GENERAL UUKi CASE STUDY FRAMEWORK

[REVISED VERSION, FOLLOWING EARLY STAGE REPORT]

Departments/partners:

Brief history of the participating departments or partners. Their size (staff), when founded, with what missions?

Origin of the project/ initiative:

How was the concept conceived, how was the international contact first made? What were the steps that brought it into reality (including finding funds)? What is the core innovation?

Development of the project:

What have been the greatest successes and barriers? Any particular barriers associated with the international nature of the project (relevant funds, culture, language, distance, time differences, bureaucracies, financial)? What were the key resources tapped? If you could do it again, what might you do differently? What assistance that should have been there was missing? If others were going down a similar route, what advice would you give?

Global environment:

Are there similar initiatives elsewhere in the world? Are there direct competitors? Are there other related market niches to open or emerging demand from potential clients/partners? Is there an adequate broader research environment/network around this?

Future focus:

How do you intend to expand? Are there new channels of opportunity, markets, networks, partners? Where do you see the greatest impact?

Reflection:

How has this benefited the UK university so far and how will it likely benefit in future? What have been the major drivers of success (internal resources, external resources, key behaviours needed)?

Anonymous commentary:

Sometimes comments about difficulties dealing with university management, industry, SMEs, foreign parties, and so on are sensitive. We want to capture insights useful to senior management teams, but acknowledge that people may not be willing to blame certain parties and put their individual or institutional name to such things. So we will ask for contributions to an anonymous commentary section, so that the interviewees can speak freely and frankly to us about issues of importance (if this is relevant to their case). This input/content will find its way into the report, but in an appropriate format covering general trends and observations rather than specific examples.

APPENDIX II

The authors would like to thank Dr Nick Rousseau, former Head of International Innovation Strategy at the UK Department of Business, Innovation and Skills, for initiating this fascinating piece of work and for his involvement, insights, and support throughout the project.

STEERING GROUP FOR PROJECT

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Assistant Director, Policy, Universities UK International

APPENDIX III FURTHER READING

What is the relationship between public and private investment in science, research and innovation?

Economic Insight for Department for Business, Innovation & Skills (BIS) (July 2015)
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