BRITISH COUNCIL

OPPORTUNITIES, MODELS AND APPROACHES FOR UK-EAST ASIA HIGHER EDUCATION PARTNERSHIPS TO DEEPEN UNIVERSITY COLLABORATION WITH INDUSTRY AND BUSINESS ENTERPRISE

Prepared by Research Consulting and KE Metrics on behalf of the British Council

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EXECUTIVE SUMMARY

This report is the final output of a project undertaken for the British Council to undertake a scoping study on University-University Links between the UK and 12 East Asia countries: China, Indonesia, Hong Kong, Japan, Korea, Malaysia, Myanmar, Philippines, Taiwan, Thailand, Singapore and Vietnam.

The British Council commissioned Research Consulting and Adrian Day (KE Metrics) to undertake the project, which was delivered through desk research, input from the British Council country teams and a series of inputs from stakeholders in the relevant countries. This included responses to an on-line survey. In addition, the consulting team attended British Council workshops in December 2018 and March 2019.

The report covers three aspects of University-Industry (U-I) engagement:

- Perspectives on the UK and East Asia context, developments and status in University-Industry engagement areas;
- Country specific assessments and overviews to inform the potential for partnership development; and
- Collaborative models and options to that have the potential to support partnership development between UK and East Asia universities.

Through this study we found evidence of both commonality and diversity in terms of University-Industry interaction in the UK and the selected East Asia nations. Based on the available analysis and input, and in terms of U-I activity and engagement, we have broadly identified two groups of countries in East Asia. These comprise a *mature* group, comprising China, Japan, Hong Kong, Korea, Singapore and Taiwan and a *developing* group (Malaysia, Indonesia, Myanmar, Philippines, Thailand & Vietnam).

We have identified the characteristics of each group, and associated challenges. While the UK has not solved all the challenges of embedding University-Industry policy it is widely recognized as a model for good practice.

The report identifies areas in which current partnership links are in evidence and areas where opportunities for development can be supported through the British Council teams.

COMPARING COUNTRY PERFORMANCE: INDICATORS AND BENCHMARKS

A scarcity of specific and comparable data on U-I was expected. However, we also found that there are few complete and robust sources of general data on Higher Education such as Research/Teaching income, numbers of staff, students, post-graduates, that can be compared to UK data available from the Higher Education Statistics Agency (HESA). This makes it difficult to put comparative U-I data in context, e.g. to demonstrate productivity/efficiency, relative scales of activity and the balance of research and teaching activities.

Consequently, there was a reliance on Global League Tables (such as THES, QS etc) to provide comparative assessments. Whilst informative, these are not generally considered to be robust for policy development in the UK.

In terms of innovation indicators, World Bank, World Patent and World Economic Forum data were the main sources (also referred to in this report) but there was limited comprehension on how incomplete these data are in telling the full story of how higher education benefits the economy and society. Research indicators, such as publications and citations, provide further context for country research performance but are not well matched to U-I contexts.

In terms of promoting UK models we make recommendations for where (existing) collaborative programmes could support further UK-EA collaboration and where there are opportunities for EA economies to adopt and adapt specific UK policy/funding infrastructure. The types of programme and partnership approaches that

will be successful are also aligned to the *mature* and *developing* groups – different approaches are needed to allow partnerships to succeed in local contexts.

There is much commonality in the 'grand challenges' identified in the UK and across EA such as climate change, ageing populations, future cities, food and energy sustainability etc. There are numerous HE collaborations already in place and it is likely further opportunities can be identified and promoted. The British Council could also signpost EA HEIs toward opportunities to work on these issues with UK counterparts (i.e. as detailed in the UK Industrial Strategy).

The British Council would be well placed to organize a significant conference to bring UK experts and practitioners to the region to share good practice and develop collaboration opportunities (like the PraxisAuril conference model). Indeed, it would likely be preferable to have two events – for the separate clusters we have identified.

Staff exchange is valuable – both between academia and industry but also internationally. Academics who have spent time in the UK seemed to be more enthused over U-I in general. As part of this project we have assessed the levels of academic (and student) presence in the UK from these East Asia countries. For example, the significant employment of Chinese academics in UK universities has undoubtably aided UK-China partnership development.

Observations and recommendations – mature economies

In the group of *mature* countries, we found much evidence of specific public policy (and usually funding) to support U-I. These were based mainly on short-term, competitive processes as opposed to the UK's embedded formula-based approach. There was considerable interest in learning from UK experience in terms of developing specific metrics to support U-I.

Networks for U-I professionals exist but may be limited in scope (i.e. UNITT in Japan being mainly focused on Technology Transfer or the A*Star network in Singapore being linked to specific public policy). There is an opportunity to establish a more comprehensive – practitioner-led – network and promote international networks also.

For mature economies U-I can be seen through progress towards open innovation[1] – how companies have shifted from so-called closed innovation processes towards a more open way of innovating. The UK has adopted a range of activities and approaches to working with industry, including jointly developed research projects, co-location of facilities and expertise, technology transfer and a range of activities linked to the development of skills and knowledge for industry employees. Open innovation underpins much of this development and has seen inward investment by Chinese companies for R&D partnerships seeking to access this.

Post-graduate (doctoral) training has played a significant role in supporting university-university partnership, alongside international collaboration. We identified several examples during the study, and it offers scope to build partnerships that can be sustained.

Observations and recommendations – developing economies

For the group of developing countries, while there was no shortage of documentation, we found that there was often a lack of clearly articulated and joined-up policy on U-I. Respondents noted they would like to see clear leadership from national governments in terms of policy, funding and metrics.

There was limited evidence of professional networks to support and develop academic staff engaged in U-I. Malaysia for example is developing such networks and taking steps to grow the professional expertise needed to support technology transfer. We recommend

1 Open Innovation describes how companies have shifted from so-called closed (internal) innovation processes towards a more open way of innovating where innovation stimuli – ideas, expertise or facilities - are increasingly accessed collaboratively (externally).

engaging with organisations such as PraxisAuril who can provide bespoke training (linked to international accreditation).

Specific policies can be adapted from the UK; Knowledge Transfer Partnerships (KTPs), for example, was widely seen as a model that could be successfully transplanted. Similarly, model contract templates developed in the UK following the Lambert Review could be adapted and offered to potential partners in order to minimise the perceived risk during early negotiations.

HEIs with existing links to UK counterparts (i.e. TNE provision) were already exploiting these relationships to learn more about UK U-I policy and practice – this type of relationship development could be easily encouraged further.

We have seen evidence that UK partners are very willing to offer advice and guidance on developing staff reward and recognition processes for U-I as well as providing opportunity for staff exchange which can be very effective in providing a step-change for how academics perceive U-I.

Teaching elements of U-I were also highlighted frequently – for example, how to engage with employers to enhance the curriculum (and thereby address graduate employability options). Such activity is likely to be specific to the individual nations and could be followed up by national workshops drawing on UK good practice.

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1 INTRODUCTION

ABOUT THE STUDY

The British Council commissioned Research Consulting and Adrian Day to undertake a scoping study on University-University Links between the UK and 12 East Asia countries: China, Indonesia, Hong Kong, Japan, Korea, Malaysia, Myanmar, Philippines, Taiwan, Thailand, Singapore and Vietnam.

The main aims are as follows:

1. To provide an overview of university-industry links in East Asia and analysis of key national policies and priorities as well as challenges.
2. To provide an overview of UK Higher Education sector engagement with industry and business enterprise, its systems, structures and advantages to foster technology transfer, innovation and economic growth. This will include current Government funding support and future planned initiatives.
3. To map out key university-business enterprise or knowledge exchange models in the UK; identifying how these models work and their corresponding challenges; and providing an analysis of what models might work best in the East Asia context.
4. To identify opportunities and collaborative models where UK Higher Education Institutes (HEIs) can partner with EA governments and HEIs, with the support of British Council, to deepen connections with industry and business enterprise.

Approach and Methodology

The project was delivered through desk research, input from the British Council teams and a series of inputs from stakeholders in the relevant countries. This included responses to an on-line survey. In addition, the consulting team attended British Council workshops in December 2018 and March 2019.

The latter was the British Council's East Asia Regional Policy Forum: UK-East Asia Higher Education Partnerships for Industry Engagement, 7-8th March 2019 in Manila, Philippines. The British Council originally intended that the Forum in would serve as a means for further discussions on UI and data gathering from key stakeholders for the scoping report.

Adrian Day facilitated a contributing workshop at this event, and the notes from this session are included in this report as Appendix 5. A full report of the overall event is held separately by the British Council.

The Forum brought together university engagement managers, researchers, policymakers and innovation and entrepreneurship managers for across East Asia to share and discuss concepts on university-industry interaction, partnership models, strategies and platforms to deepen collaboration with industry and business enterprise. The forum also heard from local business leaders and their experiences in working with universities.

2 AN OVERVIEW OF THE UK LANDSCAPE FOR UNIVERSITY-INDUSTRY ENGAGEMENT

UK POLICY CONTEXT

Within the UK, University-Industry (U-I) engagement has been an area of consistent policy focus for over 20 years and the current Industrial Strategy further reinforces the role of R&D and innovation in national productivity and competitiveness. Several policies and practices have been consistently supported in reviews, including:

- the importance of measures to address **business demand for R&D**;
- **recognising the breadth of activities** HEIs undertake that contribute to University-Industry engagement;
- the **development of metrics**, predominantly income-based, to understand the trends and growth;
- the development of Innovate UK as **a national funding agency focused on industry-led R&D**, driving business-led R&D projects in collaboration with universities; and
- the development of **sustained funding streams** (allocated and competitive) that allow universities to develop and maintain supporting U-I infrastructures (e.g. people, seed funding).

There have been a significant number of reviews relevant to U-I engagement, and Appendix 3 details these. A number provide valuable reference sources for the development of U-I in other countries and are discussed in detail.

Increased professionalisation for all aspects of U-I engagement is a notable development within the UK. This includes rewarding academics for U-I alongside teaching and research activity and formalizing professional networks of those whose roles are dedicated to supporting U-I activities.

Whilst U-I can be viewed by some as being somewhat separate from traditional views of research and teaching, it is increasingly seen as an integrated activity essential to delivering high quality outcomes in both areas. There are specific objectives and impacts of U-I that lay outside outcomes normally associated with research and teaching, such as economic growth and social development. Research is increasingly viewed in terms of its 'impact (as now assessed under the UK Research Excellence Framework along with peer review and environment metrics) and graduate employability and skills clearly rely on successful U-I to inform teaching practice and experiences.

Research and teaching are largely funded through different mechanisms and Government agencies and are organised differently in HEIs. Accordingly, there are certain types of U-I that are more relevant and important in different institutional contexts. Research intensive HEIs may be expected to have higher levels of technology transfer and commercialisation relative to others although producing graduates and post graduates is the most significant channel of transferring knowledge from academia to the economy, so teaching-intensive HEIs have an equally important role to play. It is worth noting that these distinctions will not always be relevant in industry and wider economic policy i.e. increasing productivity from manufacturing will likely require both technological innovation as well as professional training for the staff.

A trend in recent years has seen greater focus applied to the management of significant industry partnerships – adopting account management principles and a holistic approach to the partnership that considers all aspects of the interface with the university. This is evidenced in university structures and support roles, and the approach is replicated within some major companies.

OVERVIEW OF THE UK LANDSCAPE FOR UNIVERSITY - INDUSTRY ENGAGEMENT

The UK's higher education sector is significant, with 162 HEIs supporting over 2 million students and £6bn in national (public) funding for research grants and contracts. It also highly diverse – large, globally-connected research-intensive universities, broad-based teaching intensive universities and a range of smaller / specialist institutions (e.g. the Royal Veterinary College).

For research, most of the income to universities comes from UK public Government funding (63%), with about 4% from UK business. Charities, particularly the large medical research funding charities (e.g. the Welcome Trust), account for ~11% of this income. Since 2000 there has been a national collection of data relating to individual university performance and income from U-I activities.

The evolution of the policy environment

For approaching 20 years there has been a broadly consistent policy context for university-industry engagement – largely set within the context of the knowledge economy, innovation and productivity performance. A series of Government commissioned reviews during this period have reinforced this and consistently supported key pillars that underpin University engagement capacity, and demand-side incentives; these include:

- The increasingly focus on real world impact from research, at the level of new project funding decisions and in research assessment contexts (catalysed by the 2014 Research Assessment Exercise);
- The formation and ongoing development of Innovate UK, and allied initiatives like Catapult Centres and the national KTP scheme;
- The sustaining and evolving the funding stream that is HEIF, a key funding stream for universities that allows the employment of U-I staff and provides funds that can seed new U-I relationships or activities;
- The development of metrics and feedback mechanisms that allow better understanding of performance and the range of activity underpinning U-I success (and are now linked to the allocation of HEIF); and
- The promotion of business participation in R&D and Innovation through incentives (e.g. R&D Tax Credit, Patent Box), business-led case studies and value statements, currently aligned to the target to raise R&D to 2.4% of GDP.

UK Higher Education in numbers

In 2016–17, there were 162 higher education institutions in the UK in receipt of public funding via one of the UK funding councils with 2.32 million students. Aggregate statistics for the UK are:

- Undergraduate: 1.76 million
- Postgraduate: 551,585
- Full time: 1.80 million
- Part time: 518,930
- Students from the UK: 1.87 million
- Students from the EU: 134,835
- Students from non-EU countries: 307,540
- Academic staff employed at UK universities: 206,870
- Non-academic staff employed at UK universities: 212,840[2]

2 HESA **https://www.hesa.ac.uk/data-and-analysis/providers**

OVERVIEW OF THE UK LANDSCAPE FOR UNIVERSITY - INDUSTRY ENGAGEMENT

Aggregated incomes for UK higher education institutions are available and can be examined at institutional level in some detail, figure 2.1.

Formalised data collection includes a broad range of indicators, including a range of U-I specific metrics, figure 2.2. Income is used as a proxy for impact and figures both make the case for public funding and provide a mechanism to allocate funds. These are collated annually by Government under the Higher Education Business and Community Interaction Survey (HE-BCIS).[3]

Direct measurement of research and U-I engagement impact directly, and in a way that can be collectable routinely and without significant effort remains hugely challenging. For that reason, metrics for U-I activity have generally used 'income' for example from private sector organisations, as a proxy for impact and value considerations. Technology transfer, through patents, spin-outs and investment is perhaps the only areas where wider metrics are viable.

3 HESA **https://www.hesa.ac.uk/data-and-analysis/business-community**

Figure 2.1: UK Higher Education Institutions – the relative proportion of income by income type at national level (2016/17).

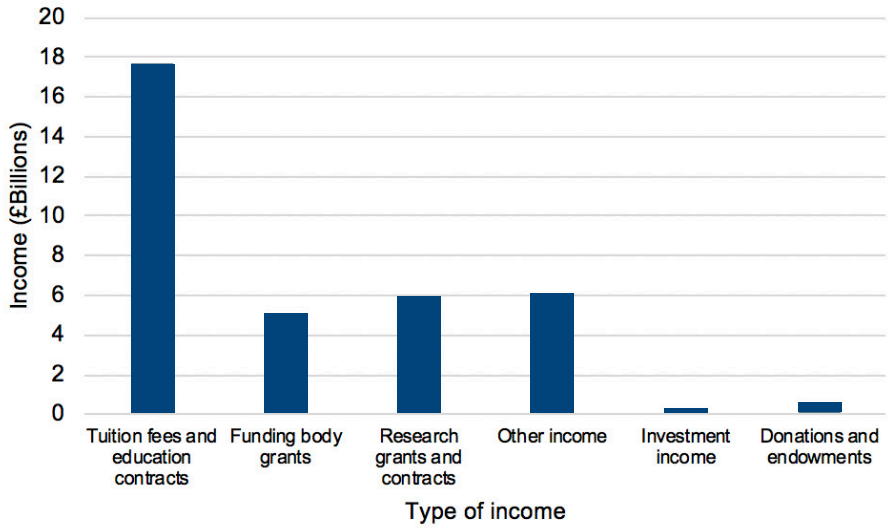
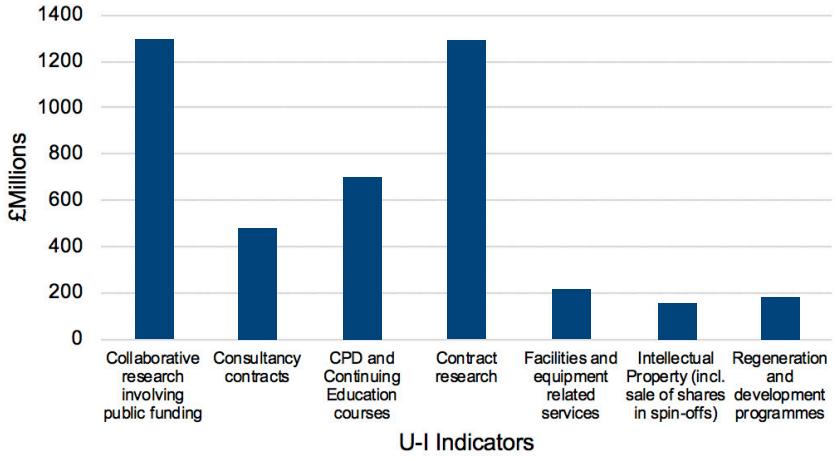


Figure 2.2: U-I indicators in the UK – sourced from the Higher Education Business and Community Interaction Survey (HE-BCIS) 2016/17[3]



To demonstrate the diversity evident in UK universities, we have used examples of a research intensive (Cambridge), teaching intensive (Coventry) and specialist HEI (Harper Adams). Each HEI is active across the indicators shown in figure 2.2, but relative proportions vary, figure 2.3. The same data are then presented in absolute terms to demonstrate the difference in scale, figure 2.4.

Figure 2.3: U-I indicators in the UK – illustrative differences in shape for example UK universities in relevant U-I metrics. Sourced from the Higher Education Business and Community Interaction Survey (HE-BCIS) 2016/17

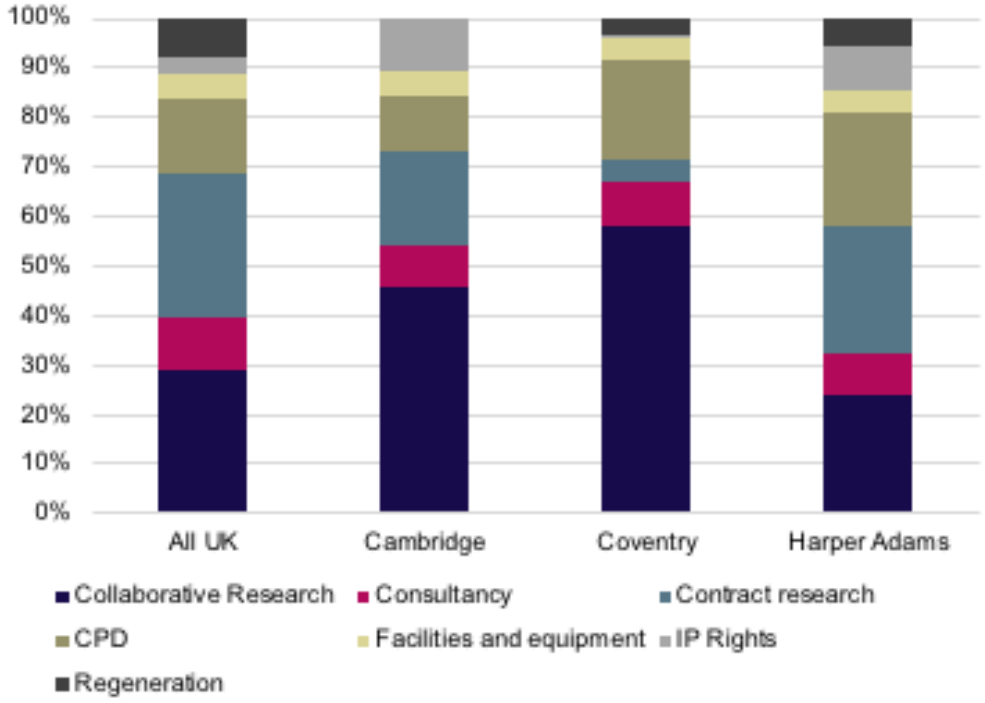
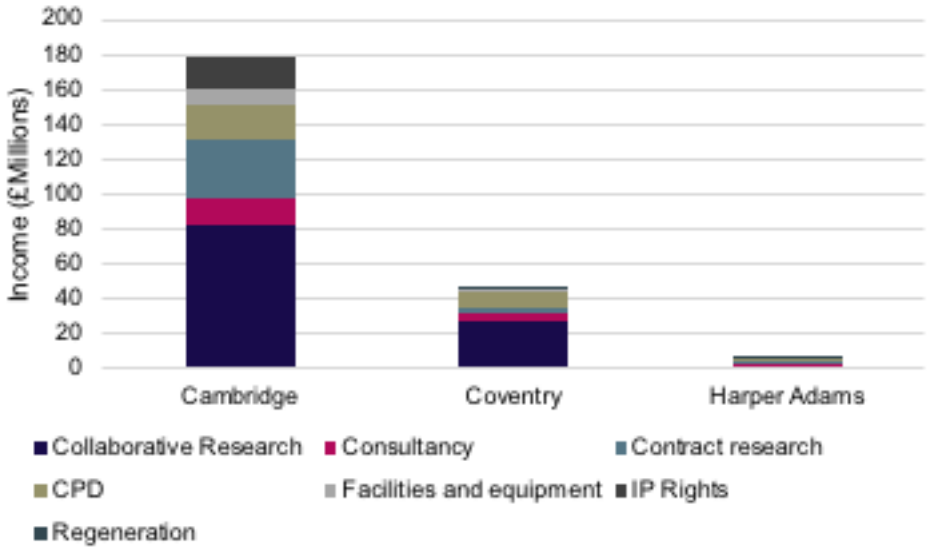


Figure 2.4: U-I indicators in the UK – illustrative differences in scale for example UK universities. Sourced from the Higher Education Business and Community Interaction Survey (HE-BCIS) 2016/17



OVERVIEW OF THE UK LANDSCAPE FOR UNIVERSITY - INDUSTRY ENGAGEMENT

Examples of UK funding models supporting U-I engagement

The study identified models and approaches to U-I partnership and collaboration, drawing on successful UK experience and examples from across East Asia. Consideration has been given to:

- Policy level approaches to national funding, metrics and schemes, 'what works' at policy level;
- University level models and good practice (structures, professionals, training, exchanges) and academic-led approaches (e.g. joint PhD programmes, research-area synergies; and
- Network levels, working with existing and developing new networks, using networks to foster international collaboration.

We have also sought to distinguish between models that work within the UK that could be scaled/transferred to another country and models that explicitly support international activity in and from the UK.

Appendix 4 provides an extensive overview of current and developing UK contexts for U-I engagement. Below we summarise some of the key areas through which UK approaches have been improved and developed.

Policy and Funding

- Developing professional support for U-I and engagement: the importance of the HE Innovation Fund (HEIF) as a sustained capacity building fund for U-I – people and infrastructure. HEIF covers a broad range of activities and hence allows HEIs to focus on their strengths when embedding U-I within their mission
- 'Core' funding for U-I from schemes like HEIF allow HEIs to invest in specific (human) resource for U-I and to further develop their (internal) recruitment and reward strategies to reflect and incentivise U-I. The majority of UK HEIs now have explicit mention of U-I activity in staff contracts alongside teaching, research and administration.
- Delivering funding programmes that are effective in addressing the demand for R&D by business and supporting effective U-I engagement: for example, Knowledge Transfer Partnerships (KTP) and the collaborative R&D programmes of Innovate UK. KTPs are a formalised graduate recruitment process where a specific opportunity is highlighted and an academic works with the graduate to solve the issue and develop a U-I relationship.
- Co-location of science and innovation parks alongside universities, creating local eco-systems that retain and grow industry skills and innovation alongside universities. Embedding the Knowledge Transfer Network (KTN) to encourage sector-specific problem-solving.
- The funding and extent of U-I engagement within PhD training environments and increased U-I through this: examples include the EPSRC Industrial CASE doctoral studentship scheme and local university schemes that support short industry placements for doctoral students.

Practice and professionalisation

- University and industry led approaches to the co-location of a facilities and expertise, often funded directly between industry and the university, but some funding schemes (e.g. UKRPIF, Appendix 4) have supported these developments. Notable examples include:
  - The Rolls Royce University Technology Centres and Siemens university partnership programme
  - The Materials Innovation Factory (University of Liverpool and Unilever). The latter initiative seeks to accelerate materials

discovery through co-location of industry and academia, and the use of robotics and high-performing computing.
  - New developments include the National Automotive Innovation Centre (University of Warwick, Jaguar Land Rover, and Tata Motors UK).
  - The Southampton Marine and Maritime Institute (SMMI) co-located alongside Lloyd's Register at the new £140m Boldrewood Innovation Campus in Southampton.

- The UK Research Partnership Investment Fund (UKRPIF) provides public money to match capital investment by private business in these large-scale projects.
- Innovation with an international focus such as the Global Challenges Research Fund (GCRF) which is aligned with Newton to support innovative approaches to global questions.
- Initiatives and approaches development by U-I practitioners that are tailored to meet the different needs and approaches that SME business require. Examples include the Innovation Community Lab pioneered by Nottingham Trent University and which develops SME innovation capacity via graduate recruitment.
- Improving the outreach and initial engagement with businesses and industry. Universities in the UK have increasingly identified sector or thematic groups of academics, often on a multidisciplinary basis, who have the critical mass to engage industry at scale.
- Developing a professional group supporting U-I. Of the order of 10,000 KE professionals in UK universities, supported by professional associations including PraxisAuril and ARMA. Both are engaged in the delivery of training, both within the UK and internationally. For KE professionals, PraxisAuril has championed the development of international accreditation for technology transfer and knowledge exchange professionals[4].

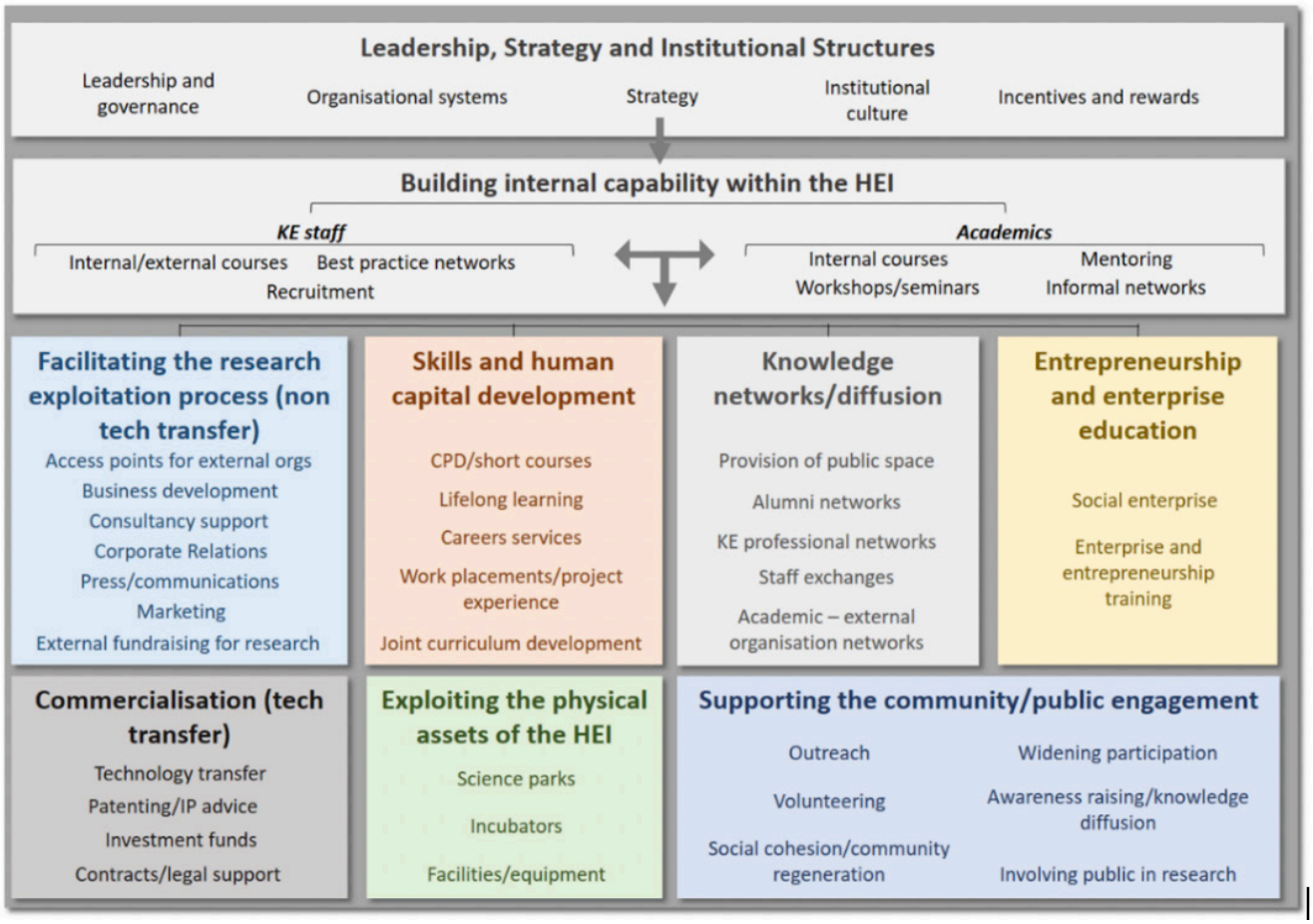
Policy platforms that have common relevance for country priorities, research collaboration and industry engagement are opportunities for alignment. For example, the UK Government has launched a programme to accelerate the transition to low carbon economies in SE Asia. Operating in Malaysia, Philippines, Myanmar, Thailand, Vietnam and Indonesia, allied U-I activities on a thematic basis could be developed by the British Council.

The breadth of knowledge exchange activities is illustrated in figure 2.5, a conceptual view of knowledge exchange and U-I that has underpinned policy reviews and development in the UK. The UK's Higher Education Innovation Fund (see Appendix 4) supports activities across this framework through funding to universities.

4 The Registered Technology Transfer Professional (RTTP) accreditation, managed by the Alliance of Technology Transfer Professionals, (ATTP) an alliance of twelve knowledge and technology transfer associations.

OVERVIEW OF THE UK LANDSCAPE FOR UNIVERSITY - INDUSTRY ENGAGEMENT

Figure 2.5: A conceptual framework for knowledge exchange in the UK. Source: Conceptual Framework for Knowledge Exchange, T Coates Ulrichsen, (2017).



3 AN OVERVIEW OF THE EAST ASIA LANDSCAPE FOR UNIVERSITY-INDUSTRY ENGAGEMENT

OVERVIEW

The 12 East Asia countries in the study present a wide range of scales, maturity and funding landscapes relating to U-I activities. Although consistently applied metrics that directly relate to U-I activity are not evident across East Asia, international rankings and UNESCO data (for example PhD numbers), provide context.

We have considered a range of characteristics for these countries, see Appendix 2, in order to inform the approach for onward partnership work. This has been informed by desk research, and information secured through the Forum, interviews and survey. Scale, quality and the platforms from which partnership work can develop are considered.

The information provides a context for the recommendations on future partnership work, considering factors such as the level of existing links between the country and UK and the scale of relevant activity, for example doctoral graduates (3.3).

The characteristics of the East Asia countries broadly fall into two groups: 'mature' and 'developing'. This can be observed in Appendix 1 and Figure 3.1, which looks at the Research and Industry Income elements of the THES World University Rankings 2019 for the highest ranked university in each Country.

Appendix 2 includes data relevant to the extent of in country doctoral training. This is an important area to consider for several reasons:

- It already forms a platform for a range of UK – East Asia partnership approaches;
- It is a pathway into future academic careers with the potential to significantly influence future U-I engagement because of this; and
- In the UK significant progress has been made in doctoral training environments that incorporate significant U-I elements into the programme.

Figure 3.3 outlines the relative landscape of doctoral (e.g. PhD) level graduates from the East Asia based on UNESCO tertiary education data (ISCED level 8). Significant differences in scale are observed.

Barriers and enablers

Through workshops at the Regional Forum, supplemented through inputs from the British Council and stakeholders in each country, an overview of each country was developed, which examined elements contributing to U-I activity.

Common Characteristics of research and U-I landscapes

The following table outlines characteristics observed in "mature" and "developing" countries and aligned challenges/opportunities.

From this analysis, and the U-I perspective, we observe two groups that emerge for the East Asia countries. Inevitably, some countries at the margins exhibit some features that may be closer to another group, but overall the groups appear well aligned.

The groupings inform the British Council teams of the U-I actions and approaches which may best suit the relative strengths and weaknesses of the UK and context for that East Asia country.

AN OVERVIEW OF THE EAST ASIA LANDSCAPE FOR UNIVERSITY-INDUSTRY ENGAGEMENT

The **mature group** includes China and Japan – in research terms the leading countries in this group of East Asia countries:

- China's sheer scale, and increasing emergence as a global powerhouse in research, perhaps suggests it should be considered separately. As a result of the policy compact between the UK and China, there exist a significant range of UK-China collaborations and activities supporting integration – students and academics. China also displays investment into the UK's universities by Chinese industry.
- Japan is strong in research, but exhibits weaker levels of UK-Japan activity aligned to U-I. For example, in publications, Japan's level of international co-authorship is low. There are some schemes supporting exchange, and some evidence of Japanese industry investment into UK universities. Policy currently highlights weaknesses in open innovation approaches.
- The group also includes smaller, high GDP, mature countries – Hong Kong, Taiwan, Korea and Singapore.

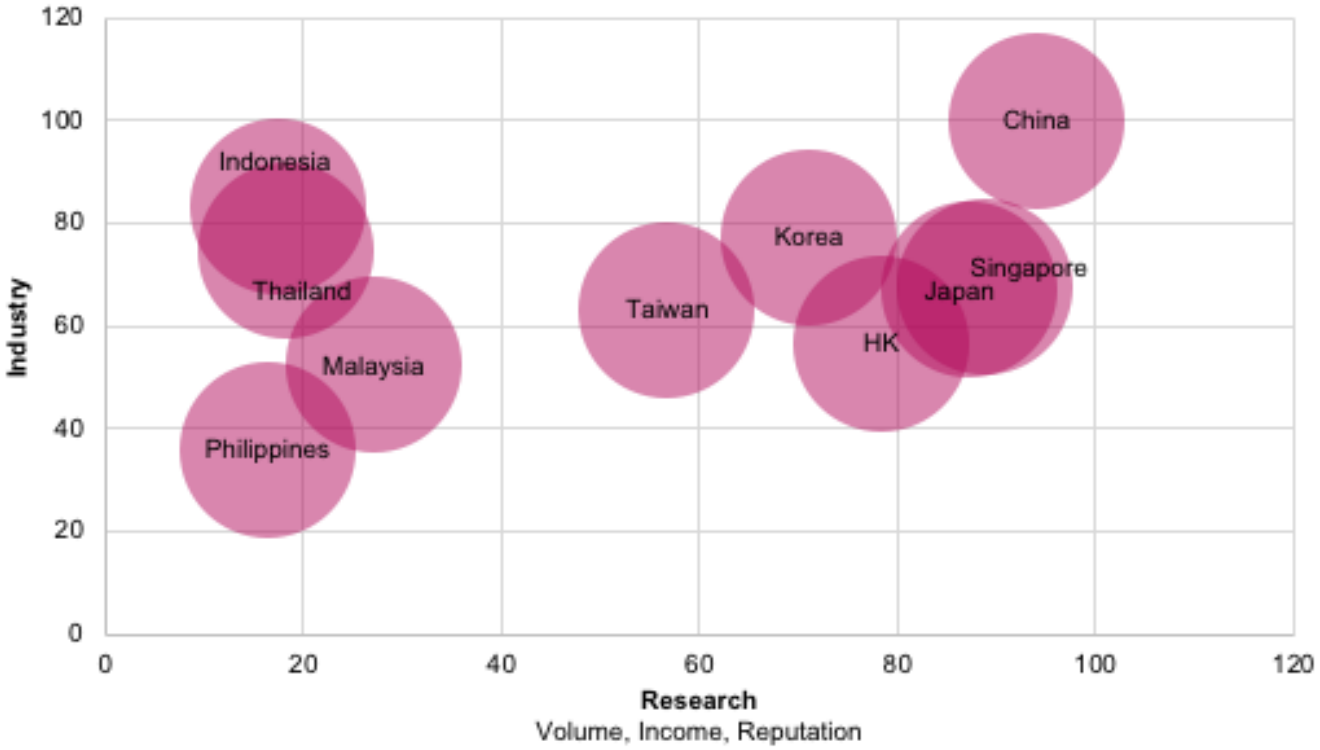
The **developing group** ranges from Malaysia at the more developed end, and Myanmar as one of the least developed.

- Maturing and developing (scale, quality) Malaysia, Thailand, Vietnam, Philippines. Approaches might include:
- Building on ITMA (Malaysia), developing KE professionals, building individuals with experience (e.g. RTTP status);
- Developing university Governance and developing policy/proactive that delivers across the spectrum of activities that support KE; and
- Supporting widening of U-I doctoral training programmes in these countries.
- Myanmar is at an early stage of development and the scale of activity low. We found very limited evidence of existing linkages to the UK. Joint visits UK-Myanmar with institutions looking to develop links in a range of areas, include U-I, may be the best approach here.

GROUP	CHARACTERISTICS	CHALLENGES / OPPORTUNITIES
MATURE	• Mature R&D and university infrastructures, including policy contexts and funding supporting U-I collaboration • Universities highly positioned in global rankings for research, range of existing UK partnerships and connections • Networks and support structures within and across universities in evidence • Higher performance on economic indicators and GERD.	• Developing enterprise culture i n academia • Developing professionals and good practice on U-I, linking networks and facilitating professional exchanges • Extending existing partnerships with leading UK universities and industry, emphasising the U-I elements • Increasing collaborations for research quality, including PhD training and U-I factors. • Clear (long term) policy objectives from Government with associated funding and metrics • Raising and embedding profile of U-I alongside Teaching and Research

GROUP	CHARACTERISTICS	CHALLENGES / OPPORTUNITIES
DEVELOPING	• Elements of the R&D and innovation eco-system are developing, including university support structures • Increasing investment in R&D and (for example) PhD training • Local industry less R&D intensive, fewer researchers in industry (compared to academia) • Some participate in the Newton Fund • Limited evidence of mature networks supporting U-I good practice, and for collaboration	• Developing experience and good practice, with new or embryonic networks • Evolving in country funding and metrics to maximise outcomes • Approaches to engaging industry partners (outreach) and developing trust • Funding levels to support activity and sustain professional support • Development of supporting guidance and leadership contexts for U-I activities, including technology transfer

Figure 3.1: Research and Industry Income elements of the THES World University Rankings 2019 for the highest ranked university in each Country[5].



5 Times Higher Education World University rankings 2019 (Myanmar and Vietnam are not included). 'Industry income' and 'Research' represent scores given in the ranking system. The top ranked university in each country is used as a proxy for overall country performance: China - Tsinghua University; Hong Kong - The University of Hong Kong; Indonesia - The University of Indonesia; Japan - The University of Tokyo; Korea - Seoul National University; Malaysia - The University of Malaya; Philippines - The University of the Philippines; Singapore - The National University of Singapore; Taiwan - National Taiwan University; and Thailand - Mahidol University.

AN OVERVIEW OF THE EAST ASIA LANDSCAPE FOR UNIVERSITY-INDUSTRY ENGAGEMENT

Figure 3.2: **Research and Industry Income elements of the THES World University Rankings 2019 for the highest ranked university in each Country. Including UK and USA for reference.**

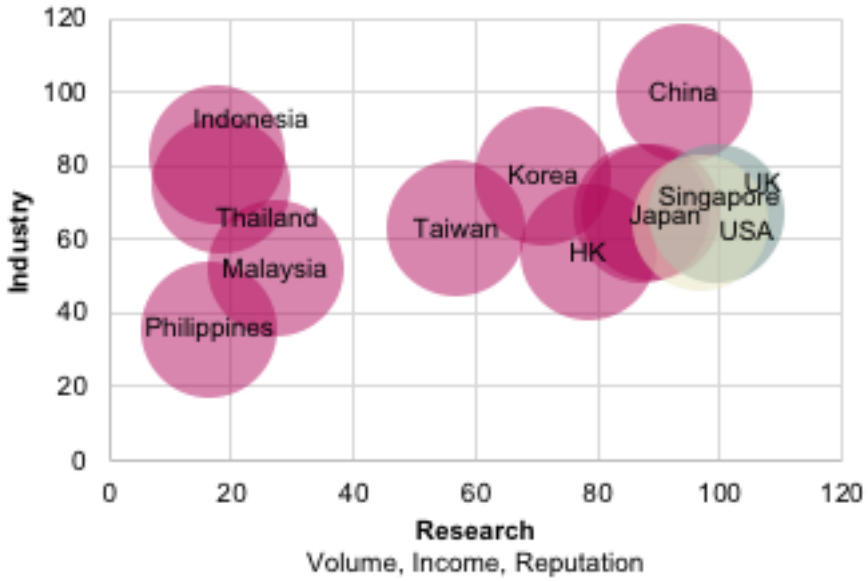
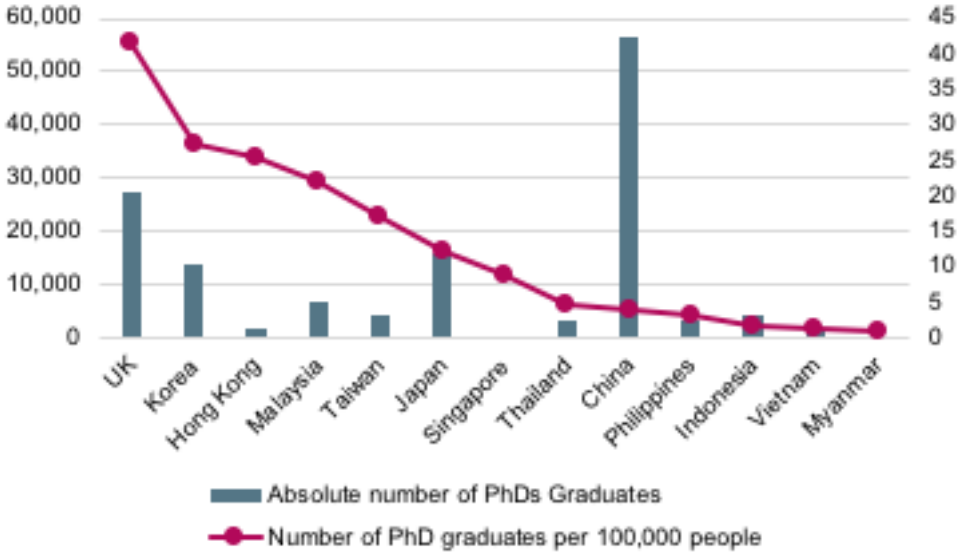


Figure 3.3: **The relative landscape of PhD level graduates from East Asia based on UNESCO tertiary education data (ISCED level 8). Source: UNESCO tertiary education data.**



For Figure 3, the statistics are based on ISCED 8 graduates which is doctoral / PhD equivalent level. This data did not include Taiwan - data for Taiwan was collected from NSF science and engineering indicators for 2018. Illustrating the challenge in accessing comparable data, the statistics were not available for all the countries in the same year: 2017 (Malaysia, Indonesia, China and Philippines); 2016 (Japan, Korea Thailand, Singapore, Vietnam and UK); 2012 (Myanmar); 2006 (Hong Kong). Some care must therefore be taken when interpreting this data.

4 OPPORTUNITIES AND MODELS TO SUPPORT PARTNERSHIPS

The study has identified areas where existing engagement and exemplars support opportunity for partnership development. These are grouped under three headings:

- Capacity building measures;
- Developing business demand, aligned to sectoral approaches and open innovation; and
- Policy engagement.

CAPACITY BUILDING MEASURES

Enhancing U-I capacity through doctoral training: There is already evidence of UK-East Asia university collaboration in this area, although not always with a strong U-I emphasis. U-I engagement is now a core element of doctoral training in the UK, including industry co-funding, the co-creation of research aims, alignment to industrial challenge areas and hosting student placements. We had evidence that indicated that in at least some East Asia countries, doctoral graduates can rapidly progress to full academic roles. Strong U-I elements in doctoral training may quickly prove beneficial in creating academics with stronger U-I skills and experience.

Developing skills for Enterprise across industry: The needs and aims of those East Asia countries where U-I activity is already strong is recognized in policy priorities to enhance 'soft' skills of industry leaders in areas such as leadership, innovation and entrepreneurism.

University infrastructures to support U-I: There is a significant body of experience within the UK on approaches to university support for U-I engagement, from specialist activities like Technology Transfer, through to wider relationship-based approaches to working with major industry partners. Good practice includes: people support to facilitate increased U-I activities, internal management information, structures for effective support and approaches to industry outreach and initial engagement. UK university structures typically include central and Faculty-based staff fulfilling a range of functions contributing to enhancing U-I engagement. They may be aligned to the wider research and innovation office or located in specific "partnerships" teams. Professional networks, like PraxisAuril in the UK, would play an important role in partnership work in this area.

Developing business demand, aligned to sectoral approaches and open innovation

Developing business demand for R&D and U-I engagement: Within the UK universities have a role and incentive to developing and stimulating business demand for R&D and wider engagement with the university. Increasingly these are seen holistically, building an offer for external partners that extends from graduate recruitment through to research and beyond into alumni networks. Individual projects and universities have piloted measures designed to address specific issues, for example innovation in local SMEs.

Sector or discipline-based partnership approaches: Industrial R&D challenges for the East Asia align to many UK priorities and research strengths. Academic-led partnerships based around synergies in R&D and industry sectors can draw on international funding for projects (e.g. Newton Fund, Horizon 2020). Factors to consider include, access to high end facilities enabled through partnership, synergy between the relevant industrial landscapes (UK/EA) and scope for researcher/PhD mobility.

Open innovation: the UK's track record of working closely with industry in open innovation contexts offers an approach for partnership development that is inclusive of business. An open innovation study tour to the UK has the

potential to seed partnership opportunities, for both companies and universities. Already established as a priority for Japan, open innovation will underpin U-I development across East Asia. Activity may include, visit to university groups who work closely with industry, talks and engagement with UK companies strongly engaged in U-I partnership, exploring approaches to SME engagement and PhD training environments that best support U-I. Such policies are a far more useful approach than getting bogged down in complex issues around Intellectual Property Rights (IPR) law.

Policy engagement

Policy engagement: There are areas of UK policy development, around funding incentives, metrics and understanding of university U-I performance, where further UK-EA partnership work has value.

The development of the Knowledge Exchange Framework as an evolution of UK policy is relevant, aligned to the (now mature) annual collation of university KPIs around important U-I activity metrics.

Other important and sustained policies / practices include, the Higher Education Innovation Fund (strongly linked to capacity building in universities), the Research Excellence Framework (a research quality assessment, that informs finding allocations, which now looks for "impact" as 20% of the contributing evidence). Both underpin culture change linked to capacity building in universities.

The development of Innovate UK, and funding streams for collaborative R&D has done much to stimulate business demand. One example is KTP which has supported bilateral U-I collaborations for many years through the KTP scheme. This has strong benefits for smaller businesses, for many of whom the scheme represents the first substantive collaboration with a university.

APPENDIX 1

OVERVIEW OF COUNTRY CHARACTERISTICS AND CLUSTERS

This Annex is a supplement to the main report and provides the actual figures relating to the country comparison graphic in Appendix 1 of the main report.

The actual data are supplied to support any future work or analysis by the British Council.

Through desk research we examined a range of metrics and indicators that inform the context of U-I activity, and the wider university landscape, in the East Asia countries of interest. A visual presentation of this information is included in the main report.

Three following tables present an assessment of the East Asia countries relative position across a range of indicators. The indicators provide a context for the development of partnership approaches. The tables are based on a review of relevant metrics, including publications, the levels of international co-authorship, university rankings and other indicators. Elements are not always well defined in available metrics, and a subjective view of activity has been taken by the consultants based on available information.

The tables focus on:

- Economic indicators and assessments of performance around innovation, IP protection and U-I collaboration drawn from the World Economic Forum
- The research environment, including publications, numbers of doctoral graduates and evidence of U-I professionals and associated networks.
- Indicators that inform the potential for UK – East Asia collaborations, including funding and presence of academics from that country in UK HEIs.

COUNTRY	CHINA	INDONESIA	HONG KONG	JAPAN	KOREA	MALAYSIA	PHILIPPINES	TAIWAN	MYANMAR	THAILAND	SINGAPORE	VIETNAM
Publications with international co-authors (% in 2017)	23	21	66	29	28	38	51	33	84	40	64	68
% of global scientific publications in 2017	17.3	0.65	0.64	4.18	2.75	1.06	0.11	1.2	0.01	0.53	0.71	0.22
H index	712	196	479	920	576	249	205	437	64	289	492	183
# students from that country studying in UK universities (000s)	90	3	16	3	5	17	1	4	1	6	7	4
# academics from that country in UK academic posts	4,460	115	130	665	430	525	50	190	0	100	200	170
Ranking of the #1 university (QS world university ranking)	17th	292nd	25th	23rd	36th	87th	382nd	72nd	-	271st	11th	700-750
No of Universities in the THES 2019 Asia-Pacific top 300	71	5	6	90	29	9	2	30	-	12	2	-
# campuses UK universities campus presence	8	0	1	0	0	6	0	0	0	0	1	0
Actual numbers doctoral students (000s)	57	4	1.8	16	14	7	3	4	0.5	3.3	0.5	1.2

OVERVIEW OF COUNTRY CHARACTERISTICS AND CLUSTERS

Economic indicators and contexts for U-I activity:

COUNTRY	CHINA	INDONESIA	HONG KONG	JAPAN	KOREA	MALAYSIA	PHILIPPINES	TAIWAN	MYANMAR	THAILAND	SINGAPORE	VIETNAM
GDP per capita (£GBP) 2016	●	•	●	●	●	●	•	●	•	•	●	•
Company spending on R&D (WEF)	●	●	●	●	●	●	•	●	No data	•	●	•
Capacity for Innovation (WEF)	●	●	●	●	●	●	●	●	No data	●	●	●
IP protection (WEF)	●	●	●	●	●	●	•	●	No data	•	●	•
U-I collaboration (WEF)	●	●	●	●	●	●	•	●	No data	•	●	•

The research and U-I environment:

COUNTRY	CHINA	INDONESIA	HONG KONG	JAPAN	KOREA	MALAYSIA	PHILIPPINES	TAIWAN	MYANMAR	THAILAND	SINGAPORE	VIETNAM
No of Universities in the THES 2019 Asia-Pacific top 300	●	•	•	●	●	●	•	●	—	●	•	—
Is the #1 university in the global (QS world univer-sity ranking) top 100?	✓		✓	✓	✓	✓		✓			✓	
Country-level H index	●	●	●	●	●	●	●	●	•	●	●	●
% of global scientific publications in 2017	●	•	●	●	●	●	•	●	•	●	●	•
% of publications with international co-authors (2017)	•	•	●	•	•	●	●	●	●	●	●	●
Number of PhD students (total, UNESCO)	●	●	•	●	●	●	●	●	•	●	•	•
Experienced university U-I professionals evident (# RTTP registered individuals)	●	—	•	●	—	—	—	—	—	•	●	—

OVERVIEW OF COUNTRY CHARACTERISTICS AND CLUSTERS

Indicators for UK collaboration: scale, existing integration and approaches:

COUNTRY	CHINA	INDONESIA	HONG KONG	JAPAN	KOREA	MALAYSIA	PHILIPPINES	TAIWAN	MYANMAR	THAILAND	SINGAPORE	VIETNAM
Extent of existing UK linkages – R&D	●	•	●	●	•	●	•	•	•	•	●	•
# students from that country studying in UK universities	●	•	●	•	●	●	•	•	•	●	●	•
# academics from that country in UK academic posts	●	•	•	●	●	●	•	•	—	•	•	•
Currently eligible for the Newton Fund programmes?	✓	✓	✗	✗	✗	✓	✓	✗	✗	✓	✗	✓
UK university 'campus' presence in country?	●										•	
Evidence of existing or developing KTTOs in Universities	?	?	?	✓	?	✓	✓	✓	?	?	✓	?
Is there a formal professional association for U-I support professionals (e.g. PraxisAuril equivalent)	✗	✗	?	✓	✓	✓	✗	?	?	?	✗	?

KEY TO THE TABLE, REFERENCES AND SOURCES:

This section describes the source data and context for the assessments in the previous tables.

INDICATOR	SOURCE, REFERENCES AND METHOD
GDP per capita (£GBP) 2016	Source: World Bank. The size of the icons correlates to the relative score for that country
Company spending on R&D (WEF)	Source: World Economic Forum. The size of the icons correlates to the relative score for that country
Capacity for Innovation (WEF)	Source: World Economic Forum. The size of the icons correlates to the relative score for that country.
IP protection (WEF)	Source: World Economic Forum. The size of the icons correlates to the relative score for that country.
U-I collaboration (WEF)	Source: World Economic Forum. The size of the icons correlates to the relative score for that country.
No of Universities in the THES 2019 Asia-Pacific top 300	Based on the **THES Asia-Pacific best universities** ranking 2019, where the number present in the top 300 is correlated to the size of the icon. The overall ranking features more than 300 universities from 13 different nations. The size of the icons correlates to the relative score for that country.
Is the #1 university (QS world university ranking) top 100?	Based on the QS World University Rankings 2018. The row indicates w hether that country's #1 ranked university is listed in the top 100.
% of global scientific publi-cations in 2017	Source: **Scimago**. Presented as the % of global output in 2017. The UK was 6.5%, the US 21%. The size of the icons correlates to the relative score for that country.
H index	Source: **Scimago**. UK is 1281 and US is 2077. The h-index is an author-level metric that attempts to measure both the productivity and citation impact of the publications of a scientist or groups of scientists (e.g. in a country). The index is based on the set of the scientist's most cited papers and the number of citations that they have received in other publications. The size of the icons correlates to the relative score for that country.
Publications with interna-tional co-authors	Source: **Scimago**, based on the % of papers from that country in 2017 having an international co-author. The US is 35%, the UK is 55%. The size of the icons correlates to the relative score for that country.

INDICATOR	SOURCE, REFERENCES AND METHOD
Number of PhD students (total)	Source: UNESCO tertiary education data, based on the latest available data for that country – ISCED 8 graduates. Taiwan was not included in this data set; the number was sourced from NSB Science and Engi-neering indicators 2018. The size of the icons correlates to the relative score for that country.
Experienced university U-I professionals evident (# RTTP r egistered individuals)	Source: ALLIANCE OF TECHNOLOGY TRANSFER PROFESSIONALS (**ATTP**), an alliance of twelve knowledge and technology transfer associations. ATTP manages the Registered Technology Transfer Professional (RTTP) designation, the international professional standard for knowledge transfer and commer-cialization practitioners working in universities, industry and government labs. The first RTTP designations where granted in 2010, Currently, there are over 450 RTTPs. The size of the icons correlates to the rela-tive score for that country.
Extent of existing UK linkages - research	This is a subjective assessment based on a range of factors, including the observed extent and scale of UK-country engagement, policy priority and the existence of activity to support this. The size of the icons correlates to the perceived extent of engagement for that country.
# students from that country studying in UK universities	Source: HESA for 2017/18 academic year. Non-UK HE students by country of domicile. The size of the icons correlates to the relative score for that country.
# academics from that country in UK academic posts	Source: HESA for 2017-18 academic year. Academic staff by nationality, working in UK higher education institutions. The size of the icons correlates to the relative score for that country.
Evidence of existing or de-veloping KTTOs in Universities	To what extent to universities have Knowledge and Technology Transfer Offices established in universities. There is no single metric that identifies this, so the measure is inferred and subjective.
Is there a formal professional association for U-I support professionals	This looks to see if there are professional associations or networks available that support the development and identity of support professionals working in U-I areas. It includes this working around Technology Transfer, brokering industry-university partnerships and areas like academic consultancy. We are looking for equivalents of PraxisAuril or ARMA (UK), AUTM in the US, UNITT (Japan) and IMTA (Malaysia).

APPENDIX 2

INDIVIDUAL COUNTRY REPORTS

Individual summary reports for each country are presented in this section. These build on input from sources including the surveys, Forum and input from the British Council teams.

CHINA

The scale and growing international competitiveness of Chinese universities, alongside significant UK-China engagement makes China a unique case amongst the East Asia countries in this study.

There is extensive evidence of UK-China partnerships and U-I activity, supported by strong policy and significant funding platforms. This engagement extends into other areas, including significant numbers of Chinese academics working at UK universities (4,500) and 90,000 students studying within the UK. These totals are significantly more than all other East Asia countries combined.

Further, in 2017 the UK and Chinese governments launched what is possibly the world's first joint science and innovation strategy, spanning basic research through to commercialisation of new technologies, in areas including life sciences, food security, renewable energy and environmental technologies.

Funding

The UKRI has had an established China office, since 2007, which has supported significant engagement in R&D areas. Since it was established the combined UKRI investment totals £420 million across 60 joint programmes and many project-level grants.

The UK China Research and Innovation Partnership Fund, launched in 2014, has seen more than £60 million of UK funding, matched by China, invested in over 460 research projects in areas such as food and water security, energy, creative economy, urbanisation, education and health. A further 39 joint projects have been funded by the Global Challenges Research Fund in topics such as environmental change and sustainable food systems.

Significant funding and policy incentives, including the Newton Fund, have supported a range of collaborations. Other specific examples include:

- the BBSRC China Partnering Award which supports access to research facilities;
- in 2014 EPSRC and NSFC announced a new £20M, three-year programme in low-carbon innovation

UK-China collaboration

Just under 4,500 Chinese academics work in UK universities. The UK is second only to the US as a partner in collaborative research for Chinese counterparts, producing over 60,000 co-authored publications since 2013.[6] The quality of research collaboration is also high: analysis has shown that the top 12% of UK-China research papers score more than four times the world average in citation impact.

Chinese students are the biggest group of international students in the UK (more than one in five international students in the UK is Chinese). There are eight UK universities with campuses established in China, and a wider group have partnerships with Chinese Universities for student teaching. Experience of working in China is increasingly being developed as part of UK student global employability.

The level of engagement has driven the need for highly specialized and specific support measures relating to U-I activity including advice and guidance on the management of IP in UK-China partnerships, for example the guidance produced by PraxisAuril with the IPO, British Embassy Beijing and UKTI.

6 The benefits of collaborating with Chinese universities. Wonkhe. (2018) **https://wonkhe.com/blogs/the-benefits-of-collaborating-with-chinese-universities/**

Chinese companies have invested in R&D collaborations with UK universities, and UK companies BP, Shell, Unilever collaborate with Chinese universities. There is also evidence of Chinese companies investing into UK-based universities for R&D and skills collaborations. Illustrative examples of activity include:

- Changan UK R&D Centre, which was originally established in Nottingham in 2010. CAUK is dedicated to Powertrain design and development for Changan's next generation vehicles, in 2015, CAUK relocated to Birmingham where it set up its UK long term base. Changan has three domestic R&D centres in China and four overseas R&D centres which give Changan a global R&D structure of 'Five Countries (China, Italy, Japan, UK and USA).
- In aerospace, the University of Nottingham announced in 2012 a £3m deal with ACAE (ACAE - AVIC Commercial Aircraft Engine Company Limited, one of China's biggest aerospace businesses) to develop a new University Innovation Centre based on composites R&D. Alongside this the company sponsored 20 of its own employees on postgraduate and masters studies at the University.
- Huawei's UK Research Centre on Cambridge Science Park, and **announcements** regarding joint R&D programmes between the University, BT and Huawei.

HONG KONG

Hong Kong is a service-based economy, supported by policies of 'positive non-intervention' in business. It is highly dependent on international trade and finance. There are low levels of private sector investment in R&D: only 40% of total R&D investment comes from the private sector, as compared to 66% across the EU, and 78% in mainland China.

Historically it is reported that the academic mindset in HK has not sought to prioritise or value U-I engagement. Funding on contracted-out R&D activities in the business sector in 2013, higher education institutions accounted for less than 8% and this figure remains similar in the latest reports (Hong Kong Innovation Activities Statistics for 2013 and 2017).[7] A more detailed examination of how activities in universities are supporting the delivery of contracted out business R&D is needed – including the support funding/resources. UK universities use a range of activities to engage on "contracted out" activities, including consultancy and access to R&D facilities. This may be an area of partnership opportunity, building on the UK's experience and approach.

The 2017 Policy Address set out plans to double the expenditure on research and development as a percentage of the gross domestic product from 0.73% to 1.5% in five years. This ambition mirrors UK contexts – the current R&D GDP target as part of the UK Industrial Strategy, and the measures introduced following the Lambert Review (see Section 2) to increase the value of university R&D to industry (business demand, support for university U-I engagement staff).

In September 2018, the **report** of the **Task Force on Research Policy and Funding** drew attention to the trend for funding agencies overseas to put increasing weight on research with commercialisation potential and on business-focused research

7 Hong Kong Innovation Activities Statistics Reports 2010 - 2018 **https://www.censtatd.gov.hk/hkstat/sub/sp120.jsp?productCode=B1110010**

collaboration programmes. It made a series of recommendations to provide incentives to universities to engage and collaborate with industry and other end-users; and to encourage them to engage in research commercialisation and knowledge transfer with industry. These measures include a Research Matching Grant Scheme of $3bn for an initial three years. The report assessed the international trends in national funding bodies, noting that "(business) collaboration and research impact are the main focuses in the latest trends of research development."

The UK was amongst the overseas territories examined to inform this report, which recognised the UK developments around formation of the UKRI (Section 2 and Appendix 3). The report recognises that although Hong Kong has made great strides in academic excellence over the past decade, looking forward actions supporting the advancement of knowledge beyond the academia are required. *"Industries should be incentivised to join hands with academics and researchers for more engagement in academic-industry collaboration, with an objective to translate academic output into impact on the economy and society, and in the form of product innovations and commercialisation."*

So, although Hong Kong is in the upper group when looked at on the "economic" and "academic" criteria in Appendix 1, when it comes to the U-I areas around translational research or commercialization, it has more to do in terms of academic culture and business demand. Exchanges, and training, around open innovation (see also the Japan section) and research impact may well be valuable. Insights from UK *industry* partners, such as those we have evidenced in the report, may also have value.

Funding

Currently the main funding bodies are the **Research Grants Council** (equivalent to the UK Research Councils) and the **Innovation and Technology Commission** (equivalent to the UK's Innovate UK). Funding from the RGC is mainly focused on universities, but includes some aspects that encourage collaboration with industry:

- applicants are asked to submit an optional technology transfer plan;
- assessors are asked to consider the potential for collaborative research and joint funding with industry; and
- some schemes include a requirement to submit a dissemination plan to communicate with relevant industrial sectors.

The Innovation and Technology Commission (ITC), through its Innovation and Technology Fund currently provides around HK$2bn per annum (equivalent to £200m) for applied R&D and technology ventures. The ITC objectives include:

- promotion and support for applied research and development, and technology transfer and application;
- fostering an innovation and technology culture in the community, and promote technological entrepreneurship; and
- input to the Government's policies, programmes and measures to promote innovation and technology.

Schemes include:

- Innovation and Technology Support Programme for university or public research institution projects with a 10% contribution from industry, supporting about 200 projects a year ~£60m funding;
- University-Industry Collaboration Programme to stimulate private sector interest in R&D by leveraging knowledge in universities, with 50/50 funding, supporting about 90 projects a year with £14m funding.

In 2018, a 5-year £50m scheme was launched focused on supporting local companies to train their staff in advanced technologies, especially those related to "Industry 4.0". The **Reindustrialisation and Technology Training Programme** supports individuals and companies to access existing training courses and tailor-made courses for companies. **This skills development approach may have wider value across East Asia (and the UK) aligned to the need to stimulate business demand for R&D.**

The **Technology Start-up Support Scheme for Universities** (TSSSU) supports universities in starting technology businesses and commercialising their research and development (R&D) results. Focused on start-up companies in six universities, **it has an operational approach not dissimilar to the UK's HEIF funding** – a block grant of £800k is provided to each university, allowing them to support a range of costs associated with setting up start-up companies involving students, alumni or academic staff. However, we observe that, unlike the UK's HEIF funding, this doesn't appear to support wider U-I interactions that would contribute towards contracted out R&D activities being placed with universities.

The innovation and technology industry

A comprehensive overview of innovation and technology industry in Hong Kong is available from the Hong Kong Trade Development Council, which notes:

- Hong Kong's innovation and technology sector together with that of Shenzhen – the Shenzhen-Hong Kong technology cluster – ranked the world's second largest based on the Global Innovation Index 2018.
- The start-up ecosystem is thriving. Some 2,000 start-ups were in Hong Kong employing over 5,000 employees in 2016. In 2017, the number of start-ups continued to rise by 16%
- Biotechnology, artificial intelligence, smart city and financial technologies were identified as the four areas of strength for development.

U-I Collaboration

In 2015, the British Council commissioned work to examine the extent of collaboration between Hong Kong industrialists and UK academics. However very few collaborations with UK academia and Hong Kong industry in the area of science and engineering could be identified. Academic to academic contacts in scientific research between UK and Hong Kong universities were identified, and the report noted that many of these were maintained by former Hong Kong PhD students subsequently employed in the UK. The UK academics reported little encouragement or incentive to work with HK industry.

- Traditionally U-I collaborations are not prioritized or seen as a necessity.
    - In 2013 less than 8% of funding for contracted-out R&D in industry came from academic institutions.
    - Research tends to be funded by the government or the Innovation and Technology Fund.
    - This might be due to the nature of the economy – there is a greater emphasis on services and trade over manufacturing.
    - Previous work (2015) examined the linkages between UK academics and Hong Kong industrialists – which were found to be largely absent.
- Steps have been made to increase the capacity of Universities to collaborate with industry
    - Universities, such as the Hong Kong University of Science and Technology, are forming innovation centres.
    - In 2014 the "Technology Start-up Support Scheme for Universities" was launched.

Universities and UK engagement

Four of Hong Kong's universities are consistently ranked amongst the top 100 universities in the world in the QS World University Ranking (based on the 2016 and 2019 outcomes). These are The University of Hong Kong (25th), The Hong Kong University of Science and Technology (37th), The Chinese University of Hong Kong (49th) and City University of Hong Kong (55th)[8]. The numbers indicate the 2019 ranking position and are very similar to the 2016 positions.

8 QS World University Rankings 2019. **https://www.topuniversities.com/university-rankings/world-university-rankings/2019**

There is significant UK-Hong Kong university engagement in terms of TNE and student mobility / study abroad schemes. This aligns to the significance of HK as a country of origin for international students into the UK: it is the 4th most significant country for international student recruitment into the UK. Overall numbers are par with the US (3rd) and Malaysia (2nd) (~17,000 each).[9] HK is one of the leading TNE countries for UK universities: Malaysia, Singapore, Hong Kong, China and Oman are the five countries hosting the greatest numbers of UK HE TNE students.[10]

However, we found much less evidence of engagement between universities in areas of activity supporting U-I engagement. The report of the Task Force on Research Policy and Funding provides a basis for further examination of the issues and opportunity for partnership in U-I areas and practices.

MALAYSIA

The Government's economic reform agenda emphasises strengthening the innovation ecosystem through integration and collaboration between industries, academics, society and the Government. Historically there have been relatively high levels of Government funding for research, with industry expenditure on R&D being relatively low (at 0.7% of GDP) compared to Singapore, Taiwan, and South Korea.

The landscape of U-I activity in Malaysia is relatively well understood and actions to address certain aspects of U-I activity have already been actioned. Detailed assessments of the science landscape in 2015 and 2017 by the Academy of Sciences Malaysia (a government body focusing on science, technology and innovation), provide an in-depth analysis of key STI trends including industry engagement. These demonstrated growing strength and reputation in Malaysia's universities, but recognized some weaknesses in U-I various contexts (research commercialisation, overall levels of U-I activity, business demand for R&D and innovation performance).

Policies and strategies

U-I engagement is targeted towards 12 National Key Economic Areas (NKEAs), which are: oil, gas and energy, palm oil and rubber, financial services, wholesale and retail, tourism, information and communication technology, education, electrical and electronics, business services, private healthcare, agriculture and Greater Kuala Lumpur/Klang Valley.

A key policy group is the Malaysian Industry-Government Group for High Technology (**MIGHT**), established in 1993 as an is an independent non-profit technology think tank under the purview of the Prime Minister's Department and chaired jointly by the Science Advisor (to the Prime Minister) as well as a senior captain of the industry. MIGHT has supported several strategic national initiatives. A "**membership programme**" indicates a number of significant industry members (including companies with significant UK R&D engagement: RR, Thales, BAE Systems) and that the platform is an opportunity for members to mobilize and manage partnerships. However, it has not been possible to fully understand the extent of activities under this programme, nor the extent to which universities (at practitioner level) are able to engage.

Recent strategies have sought to significantly uplift the numbers of doctoral students trained in Malaysia. Most doctoral graduates go into University academic roles – partly a factor of the availability of academic roles (compared to the UK environment). The majority of Malaysia's researchers are found in universities, in contrast to the high performing economies whose researchers are mostly in Business Enterprises. The extent of U-I integrated into UK doctoral training programmes is an area of partnership opportunity with Malaysia.

9 Universities UK 2017 International Facts and Figures **https://www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/International/International_Facts_and_Figures_2017.pdf**

10 Universities UK Analysis of TNE programmes **https://www.universitiesuk.ac.uk/International/heglobal/Pages/what-is-transnational-education.aspx**

There is evidence of past activities to support U-I at practitioner levels that appear to have not been sustained, for example the Malaysian Academia Industry Network (MyAIN) was established to improve university and industry links. MyAIN "creates an environment for its members as well as other professionals to share and exchange knowledge in various areas of university-industry interactions". Whilst the website is still live, the latest news dates from 2016 and it appears to have ceased activity. The objectives of MyAIN aligned to the NCUB and PraxisAuril in the UK.

Driven by the 2015 Blueprint for Higher Education, a programme of actions focused on **technology transfer** is in place, which includes;

- training and development for technology transfer staff, the formation of ITMA, the Innovation and Technology Managers Association Malaysia and an active British Council/MoE partnering activity which has seen recent UK-Malaysia university partnering workshops;
- expectations around delivery of IP-related outcomes (patents) from Government grants and funding; and
- most HEIs now have a Technology Transfer Office for research commercialization, but face challenges in terms of experience, funding for commercialization projects and the overall business demand for university IP. Leadership of the TTOs tends to be via academics assigned the responsibility for ~3 years.

Whilst the focus on TT as one aspect of U-I is positive, there may be lessons learned from the UK regarding the breadth of supporting activity for U-I (and that TT is a relatively limited part of the wider picture).

Within Malaysia there are strong of examples of approaches to supporting U-I activity, which also address the business demand aspect. These have relevance for UK partnership, but also the development of greater understanding of good practice across East Asia.

For example:

- CREST, launched in 2012 and a model for supporting U-I partnerships, across R&D and graduate talent. Focused on one industry sector (E&E), with multiple university and industry partners, the model does not yet appear to have been repeated elsewhere within Malaysia. And **the model has wider potential for adoption across East Asia in countries within this cluster.**
- PLatCOM, established as a technology transfer initiative focused on supporting SMEs to innovate. It is the s the national technology commercialisation platform of Malaysia. It is a wholly-owned subsidiary company of Agensi Inovasi Malaysia (AIM) formed in collaboration with SME Corporation Malaysia under one of its six High Impact Programmes (HIPs) in SME Master Plan 2012-2020. Technology transfer in particular is an activity where collaboration between universities has a strong business case and opportunity for added value.

UK-Malaysia collaboration

The UK Science and Innovation Network notes that British education is highly regarded and popular in Malaysia. Nottingham, Reading, Newcastle, Southampton and Herriot-Watt universities have campuses in Malaysia, and most are expanding from teaching into research. This provides a valuable platform for collaborative developments between the UK and Malaysia.

Under the **Newton Ungku Omar Fund** there is now extensive collaborative research and innovation between Malaysia and the UK, including a £14million 'Research and Innovation Bridges' programme on sustainable urbanisation, led by InnovateUK, Research Councils UK and MIGHT.

JAPAN

Alongside China, Japan is a strong research power in East Asia and globally. It has many highly ranked universities, a track record of Nobel Prize winners, has a large pool of PhD graduates and a large volume of publications (4% of global publications in 2017).

Around 29% of Japanese authored publications have international co-authorship – although comparable to China (23%) this is lower than most East Asia countries, and lower than the UK (55%) or US (35%) who have comparable volumes of publication.

Industry is responsible for about 70% of Japan's total R&D investment but only 2.7% of HE R&D expenditure. Investment in R&D has exceeded 3% of GDP every year for the past 16 years, well above the OECD average (2.35%) and the UK (1.69%).

Over 75% of R&D investment comes from the private sector and Japan's top ten businesses spend more on R&D than the whole of the UK public and private sector combined. However, there are policy concerns around the levels and effectiveness of U-I activity in Japan, particularly around open innovation practices.

U-I Collaboration

In 2016 there were 27,000 collaborations between academic institutions and private companies or the government agencies. However, these projects are usually small – on average valued at around US$18,000. Further Universities and academics are not considered to be easy partners to work with, administrative hurdles and rigid views around IP have been cited as issues.[11] The 5th Science and Technology Basic Plan recognizes the gap between what companies want and what universities provide.

Against this context, the Japan Revitalization Strategy 2016, set the goal of "Tripling the current investment value from companies to universities and national R&D institutes by FY2025 to surpass the average investment level of other OECD member states". In addition, the "Guideline for Enhancing Industry-Academia-Government Collaboration Activities", was published in 2016, clarifying issues and the prescriptions to strengthen the Industry-Academia-Government collaboration function from the perspective of the industry side.

Japan is notable in having the long-established University Network for Innovation and Technology Transfer (**UNITT**), possibly the only *mature* professional association for U-I practitioners in East Asia. Formed in 2000, it has been instrumental in the development of the University Technology Transfer Survey which on an annual basis has compiled metrics against a range of U-I performance areas. **Uniquely for East Asia, the UTTS generates available metrics that can be compared to equivalent metrics in the US (via the AUTM survey on which UTTS is based) and the UK (via HE-BCIS).**

The University Technology Transfer Survey provides statistical data on technology transfer activities from universities, TLOs and national research and development corporations to the industry. UNITT has issued every year since fiscal 2007, the latest version is the "2017 edition of the University Intellectual Property Annual Report – University Technology Transfer Survey" published in May 2018.

The UTTS indicates, for example, that industry funded research operates at about 7.5% in the UK and US, but at 2.4% in Japan. The rates of IP-related income and spin-out company formation, comparable for the UK and US, are significantly lower in Japan when compared on a normalized basis. The difference is less marked when looking at patents granted, suggesting that a difference between input (patents filed/granted) and outputs (commercialised IP generating income and spin-out companies).

Differences may be accounted for in how widespread commercialization activity is in Japan – in the US 80% of universities report spin-out company formation: in Japan the figure was 27%.

11 In Japan, corporates make reluctant partners. Nature Index (2017). **https://www.natureindex.com/news-blog/in-japan-corporates-make-reluctant-partners**

Government Input

Key Government departments are the Ministry of Education, Culture, Sports, Science and Technology (**MEXT**) and Ministry of Economy, Trade and Industry (**METI**). METI has responsibility for SMEs, industrial policy and manufacturing. METI agencies include the Japan Patent Office.

MEXT is responsible for the 2017 White Paper on Science and Technology – the development of **open innovation practices** being a major element. **A failure to adopt open innovation practices more quickly and effectively, is noted as a comparative weakness compared to competitor nations.**

"Industry expects universities and R&D agencies to serve as platforms for collaborative value creation by making use of their profound knowledge and insight to map out visions of the ideal future that should be pursued in partnership with society, and also by driving fully fledged joint research with companies."

2017 White Paper on Science and Technology: To achieve the open innovation ambitions, the White Paper recognizes the importance of a variety of supporting staff recognizing that as well as a diverse array of researchers with specialist expertise, universities and R&D agencies undertaking open innovation require a variety of other personnel to facilitate the creation of advance knowledge and promote its social implementation.

It identifies the need for Universities to clarify the career paths and statuses of the diverse personnel involved in innovation.

MEXT also produced "**Indicators of Science and Technology 2016**" (in Japanese, translation not available to the consultants).

Funding

There are two main agencies funding research and relevant U-I activity: Japan Science and Technology Agency (JST) and Japan Society for the Promotion of Science (JSPS).

The Japan Science and Technology Agency (JST) is one of the core institutions responsible for the implementation of science and technology policy in Japan, including the government's Science and Technology Basic Plan. In fiscal 2010 (April 1, 2010 — March 31, 2011), JST's initial budget allocation for programs promoting technology transfer and innovation amounted to 25,201 million yen. This represents approximately 23% of JST's total expenditures.

Japan Society for the Promotion of Science (JSPS), supports schemes that are relevant to UK-Japan partnership, including international exchanges for researchers. Unlike some of the UK-China schemes, these have limited scale, visibility and uptake in the UK.

UK-Japan collaboration

The British Council are supporting RENKEI **(Japan-UK Research and Education Network for Knowledge Economy Initiatives)**, a network of 6 Japanese and 6 UK research-intensive universities (Liverpool, Bristol, UCL, Southampton, Leeds and Newcastle) aiming to develop a platform of international research collaboration to address some of the global challenges through engagement with industry and government. The British Council in Japan is its secretariat. It was originally launched in 2012 and relaunched in November 2018.

There is also evidence of Japanese industry investment into the UK, examples include:

- **Hitachi Cambridge Laboratory (Hitachi and University of Cambridge)**. The University of Cambridge and Hitachi Limited started collaborative research in 1989 through working with the Microelectronics Research Centre at the Cavendish Laboratory.
- Mitsubishi Heavy Industries and Imperial College London - Imperial College London have been partnering with Mitsubishi Heavy Industries (MHI) since 2005 to improve turbocharger design. In 2017, the new partnership expanded to cover work with the Combustion and Tribology Research groups.

- **Eisai and UCL** - Eisai Co., Ltd. is a leading global research and development-based pharmaceutical company headquartered in Japan. **Eisai and University College London (UCL)** initially agreed a research collaboration in 2012, in December 2018 they **announced** that it had been extended for a further 5 years to 2023. It was established as part of Eisai's Open Innovation strategy to collaborate with leading researchers in order to translate new research findings into innovative treatments for patients with neurodegenerative diseases. At the same time, they announced preparations for Phase I clinical studies on E2814, the first clinical candidate from their drug discovery collaboration, in Alzheimer's disease patients.

INDONESIA

Indonesia is well placed to implement a step-change in U-I with evidence of government and institutions taking the activity seriously alongside – and underpinning – teaching and research.

- Huge market (potential demand) – growing strengths in HE and Innovation (WEF Global Rankings)
  - Academics (rather than HEIs) are leading in establishing collaborative activities such as, service and training, patenting, collaborative R&D, networking events, industrial collaboration for education, incubators, SME support, and science parks
  - Limited public Research Funding (0.8% GDP)
- Master plan for Acceleration and Expansion of Indonesia Economic Development) 2011-2025
  - Highlights importance of U-I in infrastructure development, human capital, climate change and rapid urbanisation
- Success though collaboration
  - Newton Fund - UK Royal Academy of Engineering and Ministry of Research, Technology and Higher Education working to enhance industry input into engineering curricula, bilateral collaboration in engineering research and knowledge-sharing between industry and academia (Imperial, Southampton, Oxford)

The Ministry of Research, Technology and Higher Education notes the mission statement:

- Improve access, relevancy, and quality of higher education to produce qualified human resource;
- Improve innovation and science & technology capability to add value of their products; and
- Realizing good governance in the framework of bureaucratic reform

With specific goals:

- Improvement of higher education learning process and student quality
- Improvement on Science & Technology Institutions and higher education quality.
- Improvement on relevancy, quality, and quantity of human resource for higher education and science and technology
- Improvement on relevancy and productivity of research and development; and
- Strengthen innovation capability

The focus on STEM subjects appears to reflect the fact that they are fewer courses offered than social & health sciences. Care should be taken though not to focus on traditional technology transfer indicators (i.e. patents and commercialisation). Building relationships with economic and social actors will be the most effective way to enhance quality of education and student employability as well as strengthening overall innovation capability.

Current areas of research focus (2017-19)

1. Foods - Agriculture
2. Energy – New and Sustainable
3. Health-Drugs
4. Transportation
5. Communication and Information Technology
6. Defence and Security
7. Advanced Materials
8. Maritime
9. Disaster Management
10. Socio Humanity–Education-Art Culture

The areas of research focus have substantial overlap with UK (and other EA) industrial strategy which is no surprise given many of these are global challenges. It does suggest the potential for increased collaboration; for examples these priorities are reinforced in Indonesia's Newton Fund objectives. There are also clear opportunities for further collaboration at institutional levels where UK HEIs have world-leading research (as well as potential for engaging with Catapult Centres in relevant sectors).

The Government is committed to providing the policy (and legal) framework to develop U-I along with specific funding although there have been structural changes since 2015. While funding levels have been somewhat reduced, they are still at a substantial level and likely to have positive impact [12]

12 Research and Innovation in Science and Technology Project. RISET (2017)

CURRENT COMPONENT NAME	PROPOSED COMPO-NENT NAME	INITIAL FUNDING (US$M)	REVISED FUNDING (US$M)	ACTION
Improving Innovation Policy Framework and Performance of Public Research Centres.	Strengthening the innovation system and technology transfer at public research agencies	4,000,000	**2,500,000**	Revised
Strengthening Public Research Funding.		4,000,000	**2,500,000**	Revised
Developing Science and Technology Human Resources Capacity.		80,000,000	**68,000,000**	Revised
Project Management.		7,000,000	7,000,000	No change
	TOTAL:	95,000,000	80,000,000	

While commitment to improving U-I is clear, R&D spending as a share of GDP is still relatively low in Indonesia – at less than 0.1%, compared to 2.19% in Singapore and 1.26% in Malaysia, according to World Bank figures – other indicators suggest activity in this area is accelerating. Rankings on the 2017 Global Innovation Index also demonstrated progress. Although Indonesia ranked relatively low in terms of total spending on R&D, at 105th out of 127 countries, it scored significantly higher on university/industry research collaboration (27th), cluster development (28th), and graduates in science and technology (47th).

Research Output

Over the course of 2001-2010, Indonesian researchers published less than 8,000 articles in international journals, well below Singapore, Thailand and Malaysia, with each country accounting for around 30,000 articles. The Ministry of Education in 2012 tried to remedy this situation by making research publication a compulsory condition for all post graduate and doctoral students to be able to graduate. This has attracted widespread criticism not only for the difficulty in implementing such a measure but also for its failure to address the fundamental barriers to research writing; the lack of funding being made available by the government and the private sector. Furthermore, Indonesia lacks enough accredited journals to accommodate such a volume of research publications (Indonesia has only 9 internationally accredited journals) which will lead to poor quality journals being created to meet the demand so that students can graduate.

Indonesia ranks the lowest in the number of patent applications filed among the G-20 member nations. In 2012, the country filed 7,032 patent applications, a 14.7% increase from the year prior, yet 87.3% of the filings in 2011 were submitted by foreign filers (Indonesian Intellectual Property Office, DGIP).

Recent legal changes have also opened the door to higher education institutions (ranked in the world top 200) establishing formal presence in Indonesia although it is Australian HEIs that were first in line to build on their existing collaborations. Such collaborations may go some way to enhancing both quality and quantity of post-graduate students which is currently a notable barrier to development plans for HE.

Overall, Indonesia appears to have the political will to make long term commitments to developing HE in general and U-I in particular. The British Council should capitalise on this opportunity to share UK good practice in terms of focussing on the big picture to build industrial links which will provide direct economic benefit while meeting the diverse needs of the economy and society. This will help mitigate the risks of adopting narrow targets around things that can easily be measured (i.e. patents and citations).

KOREA

The Korean economy punches above its weight in terms of economic success based on technological innovation. There is currently a policy shift to develop leadership and entrepreneurial skills to similar levels as commercialisation of research.

- Ahead of the UK on % GDP invested in R&D >4% (world leading)
  - U-I key pillar in policy to enhance student employability/enterprise and develop curriculum
  - HE seen as central to developing industrial leadership – specific public funding schemes
  - Some student recruitment concerns – sector being reformed to address
- Some evidence that U-I is still a linear process
  - Highest rate of patenting per capita in survey group, strong overall performance in WEF rankings (especially capacity for innovation) Ranked 8th in the world for overall innovation capability
  - Broader U-I still in infancy but plans to embed dynamic exchange of knowledge
- Good partner in East Asia and beyond
  - Strong UK Collaboration links including SIN and partnership with University of Surrey's 5G Innovation Centre (5GIC)
  - Numerous collaborations across EA including recent programme to support ICT development in Myanmar

The Ministry of Education drew up the "Five-Year Basic Plan to Invigorate Academic-Industrial Cooperation" in 2016 to create more than 50,000 new jobs in the next five years by invigorating academic-industrial cooperation.

1. Provide small but strong enterprises with outstanding talent and technology of universities. In addition to producing industry-customized manpower, set up a local foundation upon which local businesses or

even small businesses can grow together with the universities.
2. Provide active support to undergraduate and graduate students' start-ups, vitalize "university holding companies," reinforce universities' efforts to support start-ups, and create university-originated jobs for young people.
3. Invite domestic and international companies to university campuses. Companies and universities educate, conduct research, and transfer knowledge together, all in an effort to pioneer value-added future industries through the convergence of knowledge.
4. Elevate the ecosystem of academic-industrial cooperation. Further elevate the "academic-industrial cooperation personnel system," which has been well-established with the likes of the Leaders in Industry-university Cooperation (LINC) program, so that academic-industrial cooperation achievements will be properly recognized, and the culture of academic-industrial cooperation will take firm root in companies and on campus.

The LINC (Leaders in Industry-university Cooperation) programme is one of the most successful and embedded U-I schemes in East Asia launched in 2004 it has been broadened and deepened in a similar manner to HE Innovation Funding in the UK.

UNIVERSITIES	INDUSTRY
Reorganization of University system to industry-university cooperation friendly system	Customized support for competitive enterprises
Employing faculty members with industry career	R&D
Offering convergence interdisciplinary majors	Employee training
Designing education programs	Utilizing the public equipment
Incorporating industry cooperation	Industry-University cooperation council
	Customized total enterprise support (All-set)
STUDENT	**COMMUNITY**
Nurture skilled manpower to reinforce industry-university cooperation	Creating a local community ecosystem
Customizing curricula according to the industry demands	Operating community council
Internship and capstone design course	Industry-University cooperation council
Education on start-up and career planning CSI (CT,ST,IT) specialized programs	Win-Win cooperation agreement with community
	Support in education, employment, business start-up
	University-Community-Industry Interactive Cooperation

A report in the Times Higher in 2017[13] suggested that South Korean universities were among the world leaders in research collaborations with industry, with three universities - Pohang University of Science and Technology (POSTECH), Sungkyunkwan University (SKKU), Korea Advanced Institute of Science and Technology (KAIST) – among the top twenty.

13 South Korean universities lead way on industry collaboration. Times Higher Education.
https://www.timeshighereducation.com/news/south-korean-universities-lead-way-on-industry-collaboration

This may be the result of the strong focus on collaboration adopted by the National Research Foundation (NRF), which includes, under its Directorate of Academic Research, and Office of University-Industry Collaboration. The NRF groups its programmes for the support of research under nine main heads:

- basic research
- fundamental technology
- nuclear energy and safety
- big science
- university education capacity enhancement
- academic research capacity enhancement
- infrastructure and human resources for science and technology
- science and technology promotion
- international co-operation.

Most of the programmes under five of those heads involve co-operation with companies. Thus, for example:

- Fundamental technology covers 20 programmes in areas including climate change, disruptive technologies, cognitive technologies, and creative materials, which all involve university-industry collaboration.
- Nuclear energy and safety has 9 programmes, all of which involve such collaboration.
- Big science, including the satellite and other space programmes again all involve similar collaboration
- Infrastructure and human resources includes specific programmes to foster human resources for university-industry collaboration
    - support for university technology licensing offices
    - support for the establishment of technology holding companies and conversion of university enterprises into subsidiaries of technology holding companies
    - support for commercialization of exceptional fundamental technologies
    - to utilise the research experience and knowledge of highly experienced scientists and engineers to analyse S&T information and support industry-academia-research R&D activities
    - support for commercialization of R&D outcomes in Huge Enterprise Organizations
- S&T Promotion includes support for securing future national growth engines by supporting the application and industrialization of research outcomes.

These programme areas sit alongside others to support basic research and the development of academic capacity for research; but given the scale of the schemes outlined above, it is perhaps not surprising that collaboration with industry is clearly a strong feature of university research in South Korea.

Start-ups

The MoE five-year plan notes “Curricula and academic programs focused on start-ups and venture capital are needed in order to make Universities the centre of innovation and start-ups. Start-up programs were introduced, and academic programs were revamped to shift the university paradigm to focus on start-ups, and university venture fund investment (17.1 billion Korean won in 2017) was made to encourage students to start new companies without feeling the burden of failure”. This has led to a massive increase in start-ups from around <400 in 2014 to >900 in 2016. Sales of these companies have also increased substantially with academic start-ups out-performing those of students – a similar trend to that found in the UK and not unexpected. The UK has tried to move away from counting numbers of new enterprises toward measures of success (i.e. looking at the number that survive three or more years) so as not to simply incentivize setting up companies that stand little chance of being productive. Models such as iCURE and SET2 may be useful to explore to this end (see notes in UK section).

MYANMAR

Myanmar is one of the later adopters in the region in terms of formal U-I policy and activity; indeed, there is much work being done to develop the HE sector to the point where it can more usefully engage with industry.

- Low baseline activity – limited data available (so far)
  - HE one of nine pillars in long term planning "Higher education Students have equitable access to a world-class higher education system, leading to better opportunities for employment and significant contributions to a knowledge-based economy"
  - U.S. Mission to ASEAN assisting in developing IP and University, Research Institute and Industry (URI) collaboration practice
- Department of Research and Innovation (part of Ministry of Education) aims:
  - To implement development activities and carry out technology transfer & delivery issues concerned with science, technology and innovation for the nation
  - To implement standardization, accreditation and metrology development activities.
  - To establish and promote Intellectual Property (IP)system in Myanmar
  - To be graded and accurate analysis works on laboratory testing & services
- Growing International Partnerships and potential to catch up to the early adopters
  - Key sectors: Renewable Energy, Electronic Technology, Chemical Technology and Materials.

Myanmar is something of an outlier in the survey group given the economic and political context; there is a low baseline of U-I and work is ongoing to develop core HE provision in teaching and especially research. That said, there is a clear desire amongst some HEIs to learn all they can from the UK and other EA nations in order to progress. The UK's Leadership Foundation was commissioned to explore barriers and opportunities in 2015; they noted

Enablers of the HE sector:

- Core values and the underlying ethos of service
- Morale character and personal resilience
- Energy and enthusiasm
- Intellectual drive
- Leading through example and as role models.

Barriers to development:

- Knowledge of Myanmar national government policy and objectives concerning higher education
- System level transformation including funding, quality assurance, institutional accountability, information management, planning and reporting
- Institutional level transformation and systems thinking including governance, frameworks and charters
- Establishing a clear vision for the institution
- Leadership behaviours and values encompassing relevant theory, personal resilience and the leader as a role model
- Institutional strategy development, KPIs and delivery including 'business' planning
- Institutional quality systems to drive improvement in research, teaching and assessment including training and development of academic staff
- Establishing collaborative partnerships both nationally and with international universities.
- Improving equality, diversity and inclusion
- Understanding and developing the university's research strategy
- Developing effective university systems and processes
- Producing good quality data and management information
- Establishing effective quality assurance processes
- Establishing effective performance management process

Further, the Leadership Foundation noted that, overall, there was limited understanding of how U-I could be beneficial in improving core HE provision (i.e. research quality, student employability) as it was seen as a separate activity of lower importance.

To address these points, Myanmar is – very sensibly – developing broad based partnerships with UK HEIs to advise on medium-long term development of the HE sector. This model has been successful in other parts of EA such as the UK-PH TNE programme where partners have broadened the programme to include good practice from UK U-I professional staff. Singapore and Malaysia are also models that are being followed – overall Myanmar is very much in an early information gathering stage which is to be commended as much effort has been wasted (in the UK and elsewhere) attempting to replicate commercialization models (i.e. the US) rather than developing policies that are a good fit with the specific local context. However, there are broader social issues that make some potential UK partners reticent to engage.

The central document for economic and social development is the Myanmar Sustainable Development Plan Strategy (2018 – 2030). Specifically, for U-I the plan intends to:

Encourage greater creativity and innovation which will contribute to the development of a modern economy.

- Develop and strengthen relevant legal and regulatory frameworks in support of greater innovation, creativity and a spirit of entrepreneurialism, including through the development of a National Innovation Policy
- Strengthen links between academia, research institutions and the private sector to develop a national innovation and creativity ecology
- Increase access to financing for research and development
- Facilitate greater access to finance and the commercialization of products and services produced by local entrepreneurs and 'start-ups'
- Encourage and support innovation and scientific research in all sectors
- Strengthen intellectual property rights, including through a Myanmar patent and trademark office to protect innovations and inventions
- Enable our transition toward an inclusive digital economy, expanding connectivity and access to online services, supporting innovation and data literacy while ensuring security and online privacy

These elements are familiar in both UK and other EA nations with many examples of good practice that can be adapted for Myanmar.

The plan also includes a key pillar to Increase the ability of all people to engage with government which may be a good example of where to include HE in social development (as opposed to overtly focusing on industrial engagement). UK Knowledge Exchange policy has always included the civic and social context alongside and the National Coordinating Centre for Public Engagement (NCCPE)[14] may be a useful model to draw on.

Wider economic context

Long term sustainability planning has a clear focus on developing private enterprise as the primary economic driver and job creator. However, there are still many State Economic Enterprises that play a vital role and will have the potential to benefit from engaging with HEIs. Given the acknowledged need to develop better data on which to base policy, the UK HE Business and Community Interaction survey may be a useful model to draw on since it gathers data on interaction between HE and SMES, large business and non-commercial organisations (therefore UK policy and funding recognizes HE's role in improving efficiency in the public sector equally with enhancing productivity in the private sector).

14 National Co-ordinating Centre for Public Engagement. **https://www.publicengagement.ac.uk/**

Further specific areas of interest are SMEs where, as mentioned above, the UK not only collects specific data on but double-weights this data in calculating grants for HEI's KE activity. This is to recognize that there is, in general, a higher opportunity cost in working with SMEs over larger business. There are examples of HEIs that have put SMEs at the core of their KE strategies (Hertfordshire, Coventry for example) but it's also important to note that SMEs needs are not uniform; the definition can be applied to medium scale manufacturing as well as a small handful of people writing code with the latter sometimes having substantially higher income than the former.

The agricultural sector is of central importance which suggests common ground for collaboration in EA (such as Indonesia and PH) as well as with UK institutions (Harper Adams and the Scottish Agricultural College would be good potential partners. We would also recommend looking at the National Centre for Universities and Business Task Force model – specifically that on Food Economy[15]. This model brings together senior leaders from business, academia and government to identify key challenges as well as approaches to address them. The senior group is then supported by an operational group from the same organisations that focusses on the detail of strategy and planning with the result tending to be realistic plans that meet the needs of all partners and therefore have a high probability of being followed through. The task forces themselves require modest investment of time and resources, but they may make recommendations for more substantial public interventions in future.

Next steps

With well-articulated aims such as included in the sustainable development plan the British Council should be able to recommend several actions to foster further collaboration. In particular, it would be useful for Myanmar to draw on UK experience in terms of describing investment in HE as something that underpins and drives (almost) all the areas of the strategy rather than thinking of it as a zero-sum game where funding either goes to HE or, say, transport, health etc. If Myanmar can develop robust and comprehensive data capture systems (i.e. not limited to commercialization activities such as patenting) it will be able to make the case for investment and effectively demonstrate the contribution to the economy over time.

PHILIPPINES

While still maturing its U-I policy framework the Philippines have a number of factors in their favour when it comes to embedding U-I such as a strong HE sector and growing economy; the high level of English Language skills across the population will also make collaboration more productive.

- Strong and clear commitment to internationalisation
- HE is key to long term and economic development in PH. Priority is on institutional and faculty capacity building through internationalisation, research and innovation. University-industry partnerships seen as crucial in developing these areas.
    - World bank data shows PH leads survey group on % high-tech exports but lags on % highly educated workforce
    - Education reforms are having a substantial impact, but structural barriers persist in wider innovation system according to WEF
- Mixed HE sector (public/private HEIs, some research intensives, many small specialists)
    - Top research-intensive Universities have established Tech-transfer offices and policies but are only now beginning to broaden the range of U-I collaborations. Majority of sector focused on student employability -> opportunity for U-I to develop curriculum

15 Food Economy Task Force.
http://www.ncub.co.uk/what-we-do/task-forces/food-economy.html

- Early Successes in International Partnerships
    - Strong UK collaboration via Newton Fund and UK-PH TNE (flagship British Council programme), academic strengths in maritime and agriculture (existing UK partnerships).

The Philippines has made substantial progress enhancing and embedding core HE delivery of teaching and research with successful international links supporting them. It is therefore timely that Government is starting to look at more formal and strategic U-I. The system in PH has many parallels with the UK in that the two major policy/funding organisations have differing but complementary objectives

Policy Context

The Commission on Higher Education (CHED) has responsibility to develop HEIs and their contribution to the economy and society while the Department of Science and Technology (DoST) aims to direct, lead, and coordinate the country's scientific and technological efforts geared towards maximum economic and social benefits for the people. As the UK began to formalize policy and funding for U-I it was the Higher Education Funding Councils that came together with the Office of Science and Technology (OST) to agree objectives and collect data to inform policy and evaluation. This led to the brining together of what had previously been desperate streams of funding to maximise the social and economic impact.

This process was not without challenges given the agendas, while complementary, still differed. In the UK the OST had an overly narrow focus on commercialization of research outputs, a policy that could be successful in the short term but was limited in terms of embedding academic culture in HEIs. While the funding councils acknowledged that greater benefits would flow to the UK when engaging the whole academic base with wherever there was demand in the economy, they lacked specific data and narrative to effectively communicate this.

The British Council is already well engaged building the UK-PH relationship and a delegation of senior officials visited the UK in January 2019. They were particularly interested in the UK's experience of using both competitive and formula (historic performance) funding to drive a step change in U-I and then embed that change in the core mission of HEIs. There were also wider points of innovation policy and practice that were highlighted as models that could be adapted for the Philippines in particular, U-I professional networks (PraxisAuril), U-I leadership networks (NCUB) and the UK Catapult centres (bringing together industry and academics around specific challenges).

CHED's Grants-in-aid program provides specific funding for U-I with an emphasis on:

- Food Production and Security
- Environment, Disaster Risk Reduction, Climate Change and Energy
- Terrestrial and Marine Resources: Economy, Biodiversity and Conservation
- Smart Analytics and Engineering Innovations
- Health Systems
- Education for STEAM

DOST's Research Priorities for Industry, Energy and Emerging Technology

- Food and Nutrition Security
    - Nutritious, safe and affordable food for all, at all times
- Countryside Development
    - More micro, small and medium enterprises (MSMEs) developing and producing competitive and world class products and services
- Competitive Industry
    - More industries enabled by state-of-the-art R&D, technologies and science-based policies, moving up the value chain and attracting foreign direct investments
- Delivery of Social Services
    - Innovative, accessible, affordable and efficient social services for all
- Intelligent Transportation Solutions
- Renewable Energy and Energy Storage Solutions
- Human Security
    - Protection of the country and its citizens against national threats

There is clear co-ordination of priorities between CHED and DoST, indeed, these sectors, unsurprisingly, have been highlighted a number of times across EA and have substantial areas where the UK has good practice and ongoing engagement offering numerous opportunities for collaboration. While there are clear opportunities for collaboration with the UK where academic strengths meet (identifiable via REF profiles and HEIF strategies for example) it would also be useful to involve academics from UK & PH in the design and evaluation of policies implemented to address these challenges.

While the Philippines has seen much success in developing both undergraduate and post graduate provision we have heard that there is still little formal industrial engagement in doctoral training for example – both in terms of identifying useful avenues of investigation as well as co-sponsorship. This was another area of UK practice that was of particular interest to CHED colleagues. UK Research Council approaches to promoting and supporting industrial PhDs along with more formal models such as the Doctoral Training Centres were considered a good fit for PH strategy in this area.

Setting the baseline

At a U-I workshop run by CHED in 2018 a group of ~30 HEIs provided qualitative data on their aspirations for U-I with clear messages that enhancing he curriculum, contributing to employability of students and developing academic entrepreneurship were higher priorities than a focus on traditional commercialization outputs such as patents. For this reason, several people have identified the UK Knowledge Transfer Partnerships (KTP) model as of interest as it builds on graduate employment to address specific industrial problems and form longer-lasting relationships between the organisations involved (University and employer). However, there will be challenges in quickly scaling up these activities due to limits on infrastructure and a lack of demand (understanding) from business. Care should be taken not to mandate particular models of internship/placements before such opportunities have been assessed to have a good chance of being genuinely beneficial to all parties as this could be detrimental to the trust that needs to underpin U-I.

Problem solving and collaborative research were also high priorities and some attendees were already advanced in technology transfer i.e. UP and DSL who have substantial portfolios and professional structures. These successes should be celebrated and retained but not used as the sole indicators of success given they are likely unattainable for the majority of HEIs in PH – and therefore will not provide the wider benefits to students and businesses across the country given the limited opportunity to work with one of these world-class HEIs.

Some of this success is likely linked to the USAID/Philippines Science, Technology, Research and Innovation for Development (STRIDE) Program which provided a useful baseline analysis of the PH innovation system and recommendations for development. There was, perhaps, an over-emphasis on commercialisation aspects to the detriment of more embedded U-I but such themes are common across EA and in the UK. The report acknowledges that more formal data collection and analysis are required and highlights some issues that are still present in 2019 such as procurement law barriers. Further investigation is recommended to understand weather these common issues have not been addressed though lack of understanding or if there are ongoing specific reasons for them.

In terms of barriers, HEIs identified ongoing constraints relating to Government procurement rules and a lack of incentives (e.g. tax credits for R&D activity). Lack of infrastructure within HEIs and a low level of interest for some academics were also highlighted. Similar issues have been faced in the UK and persist in some cases, but good practice is available. Influencing Government to remove these barriers would be most effective were senior industry and HE leaders to make the point together.

Next steps

Dialogue is ongoing and the British Council is working to support CHED in developing U-I policy and funding. There are clearly articulated needs in terms of better funding to support dedicated infrastructure, robust data and public policy objectives although, as is the case in the UK and across EA, such expenditure needs to be balanced with other vital areas such as health and security. To this end it would be advisable to concentrate on demonstrating how engaged Universities will contribute to addressing all these issues as opposed to framing the debate in terms of increasing funding for HE alone. CHED and the British Council are working to develop Government Innovation Grant for Academe-Industry (GIGA) partnerships which will formalise support for embedding U-I; GIGA will be based on a number of UK good practice models utilising elements from HEIF, Catapult Centres etc. Further collaboration will also support circulation of academics such as research fellowships in the UK where both research and U-I experience can be gained and transferred back to PH.

TAIWAN

Taiwan has relatively advanced policies for traditional technology transfer with longstanding support for innovation via the Industrial Technology Research Institute (ITRI) for example which was set-up in 1973 and has supported ~270 innovative companies; ITRI already has extensive international partnerships.[16] However, as noted by MoE, there are still challenges in terms o0f ensuring graduates and post-graduates have the skills (both technical and entrepreneurial) that are in demand from the economy.

- Regional powerhouse with established technology collaboration
  - High rank across all WEF competitiveness indicators, technology transfer established and embedded at research-intensive HEIs
  - Similar challenges to the UK: large business well linked with HE, more support needed to fully engage SMEs
- Focus on exploiting physical assets
  - 3% GDP invested in R&D – ahead of UK/OECD with focus on green energy, manufacturing, ICT, aerospace and the life science
  - Concerted efforts to develop incubation facilities have been successful with the majority of HEIs engaged as economic drivers in this regard
- Time to broaden the base
  - While start-up rates remain high, attention shifting to leadership skills of entrepreneurs; U-I can't rely solely on STEM, opportunity to draw on UK good practice in embedding enterprise/ entrepreneurship across whole curriculum for (future) leaders in public and private sectors

Ministry of Education (Taiwan) Objectives[17] for 2019 include:

"Optimize the practical training environments provided by technical and vocational education institutions, and strengthen the links between industry and academia, to narrow the gap between students' academic knowledge and their practical skills; train and educate highly skilled people who are knowledgeable about and can employ emerging digital technologies, to better meet the needs of industrial development and transformation; promote the diverse and flexible development of higher education, and devote more resources to training and educating, and attracting and retaining people with international level skills and expertise, to thereby mitigate any brain drain; boost universities' meeting their social responsibilities by strengthening their links with their local communities; assist colleges and universities that are changing their institutional status, and those that are closing down".

16 Ministry of Education Objectives for 2019 (January-December) **https://www.itri.org.tw/eng/Content/Messagess/contents.aspx?SiteID=1&MmmID=617731521661672477**
17 **https://english.moe.gov.tw/cp-9-17647-d7a42-1.html**

National Science and Technology Development Plan (2017-2020) Objectives

- Revive Economic Dynamics through Innovation
- Develop Robust Smart Living Technologies and Industries
- Foster and Recruit Talent with Diverse Career Paths
- Enhance the Innovation Ecosystem for Scientific Research

The National Science and Technology Plan demonstrates Taiwan's similarity to the UK and other EA nations in terms of future challenges and therefore the opportunities for mutually beneficial collaboration. Taiwan has a range of specific public programmes in place to address these for example:

- The Taiwan Industry Innovation Platform Program (TIIP) of the MOEA: Research funding are provided to encourage enterprises to engage in innovative R&D through both bottom-up and top-down R&D programs.
- The Small Business Innovation Research Program (SBIR) of the MOEA: SMEs are funded to develop innovative techniques and services, while R&D results are put into practice, and applied extensively and commercialized to meet market and customer demands, thereby aiding the sustainable operation and growth of domestic SMEs.

Setting the Baseline

While policy around challenges and opportunities is advanced there is a paucity of robust data to describe the broader range of ways academia and industry interact and therefore limited scope to effectively judge progress. Output data seems too often to revert to patent numbers and the related income and expenditure where the UK model is able to provide a more sophisticated view (less skewed towards sectors that utilise more patents such as aerospace to the detriment of bio-tech).

However, a number of institutions have substantial dedicated infrastructure to support U-I including dedicated staff it is therefore likely that more complete metrics (similar to HE-BCI in the UK) could be collected with minimal cost especially given the value of such metrics to strategy and planning in HEIs as well as policy/ funding bodies. Similarly, U-I networks are already active but focused more on technology transfer than broader U-I as was the case in the UK until recent years. It would be useful to expand these networks in order to provide a forum where industry can discuss skills needs at the same time as technology and academics can more easily apply lessons learnt while problem solving to update curricula and thereby address the perceived skills gap between graduates and employers.

Such an approach would fit well with the recent Higher Education Sprout Project (HESP) which, from 2018, will invest NT$ 86.85 billion (equivalent to approximately $ 2.9 billion). The aims are to:

- Reinforce Quality of Universities and Encourage Multi-faceted Development
- Enhance International Competitiveness

These will be achieved by stimulating activity across the HEIs to enhance teaching, research and engagement with the economy and society. The policy is not to be prescriptive but to invite HEIs to build on their strengths and respond to external demand – this includes both developing teaching and research but also opening specialist facilities to external use; this approach has been successful in the UK, particularly in engaging SMEs who do not have the same amount to time to develop research collaborations as larger enterprises. UK good practice from both HEIF and the new Knowledge Exchange Framework may be of interest and can be readily accessed and adapted though the existing UK collaborations.

THAILAND

Thailand has placed innovation at the heart of its policy to avoid the 'middle income trap' as it transitions from developing to developed economy. Growth has slowed as Thailand can no longer compete with other nations on low cost manufacturing but has yet to develop sufficient infrastructure to compete with high-value innovative economies. This intensive focus on innovation policy has led to a risk of 'planning overload' with the UNCTAD recommending a streamlining of roles and responsibilities of innovation agencies[18].

- 9th in WEF Global Rankings for Macro-economic environment
  - Highly-educated workforce but lagging on innovation environment and wider economic indicators – huge potential for U-I to bring economic actors together
  - Historically low investment in science, technology and innovation (STI) but growing
- 20-year National Strategic Framework to establish sustainable developed economy
  - National Science Technology and Innovation Policy and Plan 2012-2021 to drive knowledgeable and skilled human capital along with sufficient scientific and technological infrastructure and enabling factors are vital to the creation of a thriving innovation system
  - Support mechanisms - regional science parks, industrial technology assistance, tax incentives, and innovation financing
- Academics are committed to developing U-I
  - Knowledge Exchange & Commercialisation Training delivered in country by PraxisAuril (UK)

The main bodies responsible for Science, Technology and Innovation are

- **National Research Council of Thailand**
- **National Science Technology and Innovation Policy Office**
- **National Science and Technology Development Agency**
- **Thailand Research Fund**
- **Agricultural Research Development Agency (Public Organization)**
- **Health Systems Research Institute**

While Thailand has put Innovation at the heart of its development policies performance continues to lag behind other EA nations "From 2000 to 2011, Thailand still has low level of R&D expenditure to GDP, despite a significant increase in investment between 2009 to 2011 by 48 percent. R&D worldwide has risen exponentially during 1996-2007 as a result of the global economic growth.

In the Asia region, countries actively expanding R&D activities are South Korea, Japan, Taiwan, and China. The majority of R&D expenditure (more than 70 percent) in these countries comes from private sector. In 2011, it was the first time in Thailand that the share of business expenditure on R&D was greater than the share of R&D expenditure from government sector and other sectors. The number of R&D personnel in Thailand (full time equivalent: FTE) was only 8 persons per 10,000 population (data in 2011). When compared with Taiwan, Japan, and South Korea, the ratio of R&D personnel per population in Thailand was 7 to 11 times lower. In addition, in countries with high number of R&D personnel, most of R&D personnel are in private sector. For example, in Taiwan, Japan, South Korea and Singapore, 60-75 percent of R&D personnel work for private sector. On the contrary, in Thailand most R&D personnel work for government and other sectors"

Current practice

Staff exchange programmes and measures to stimulate R&D investment from the private sector are useful interventions although there is perhaps an over-reliance on patents as an indicator of innovation which is something many advanced

18 Science, Technology & Innovation Policy Review Thailand. UNCTAD (2015) **https://unctad.org/en/PublicationsLibrary/dtlstict2015d1_en.pdf**

economies such as the UK are moving away from.

The Technology Licensing Office at NSTDA has a Technology Licensing Office (TLO) which has responsibility for "managing intellectual property assents for NSTDA and promoting transfer and commercialization of NTSDA's patented technologies. Operating under the concept "From Lab to Market", this agency plays an important role in paving the way for economic and social development by helping turn scientific progress into tangible products. The TLO's responsibilities include promoting research and development that leads to the creation of intellectual property, protecting researchers' right to their works and promoting the use of scientific insights".

While there will likely always be a place for some limited infrastructure based around this linear model of technology transfer it is generally seen as a small part of the ecosystem – in the UK, income from this type of technology transfer is around 5% of the total value of knowledge exchange. In it generally understood that collaborating with external (private) organisations from the outset will increase both the likelihood of successful commercialization but also bring related benefits for all involved such as opportunities to enhance teaching and mobility.

Next steps

While there is good practice in the UK and across EA the challenges faced by Thailand in terms of stimulating private sector demand for U-I have not been fully solved anywhere. It would be useful for the British Council to look at adapting Lambert Agreements to the Thai context as these have help in the UK to take some of the risk out of early stage collaborations. Further, while there is no shortage of economic analysis in Thailand, much of it is based on global league tables (such as WEF and HE rankings etc) which are generally not sufficiently sensitive/sophisticated in terms of contemporary U-I policy.

While Thailand continues to face challenges there are also areas of outstanding activity such as Food Innopolis, a global food innovation hub focusing on research, development and innovation for food industry. This is an excellent example of bringing academia and industry together (literally given the co-location) and having a demand driven focus that includes research, innovation and skills development. Indeed, The British Council in Thailand is already running CPD/Enterprise courses for HE/Industry staff in partnership with Food Innopolis. It is likely that this could be a good cluster to develop with further UK good practice (i.e. from specialist HEIs in the Food Sector and drawing on knowledge from the NCUB Food Economy Task Force[19].

Thai academics have also been engaged in professional development with the UK's PraxisAuril which is one of the main recommendations of this scoping report. Challenges and barriers to developing U-I will not be easily overcome. Thailand may benefit from redeploying resources and simplifying structures i.e. introduce more 'bottom-up' thinking to allow relationships to form in an organic way.

SINGAPORE

Singapore is in many ways a model for successful U-I, although the factors that led to this are unique to the nation. It has invested heavily in infrastructure and positioned itself as a regional hub for trade, finance and knowledge. It is ranked 2nd in World Economic Forum's Global Competitiveness Index (2018) and has been successful in attracting international investment and talent.

- Top GDP per capita and scientific journal publication per capita of the survey sample
    - History of productive U-I collaboration on Research, effective public institutions/ support
    - Policy highlighting the need for enterprise & entrepreneurship skills for leaders alongside product/process innovation

19 Food Economy Task Force
http://www.ncub.co.uk/what-we-do/task-forces/food-economy.html

- Research Innovation & Enterprise (RIE) Strategy 2020
  - ~20% increase in funding for RIE since 2015 (to $SGD19Bn)
  - Key sectors • Advanced Manufacturing and Engineering • Health and Biomedical Sciences • Urban Solutions and Sustainability • Services and Digital Economy
- Growing focus on social/economic impact of research – deliver planned 'Smart economy'
  - Similar to UK Pathways to Impact
  - Numerous established UK partnerships (Manchester, Birmingham, Newcastle)

Latest figures (2016) show gross expenditure on R&D of S$9.5Bn (£5.3Bn) or about 2.2% of GDP, of which about 61% is from the private sector. R&D expenditure has remained steady since 2015. Key R&D pillars include

- Advanced Manufacturing and Engineering,
- Urban Sustainability & Solutions,
- Health & Biomedical Sciences
- Services & Digital Economy

These areas relate closely to priorities in the UK; there are over 4,000 British companies with a presence in Singapore alone, employing over 50,000 people numerous existing partnerships between Singapore and the UK including:

- A £10 million joint programme on Quantum Key Distribution between The UK and Singapore government was announced on 27 Sep 2018
- A £500,000 joint sustainable urbanisation competition between Innovate UK and the NRF launched in October 2015
- A £2.4 million joint cyber-security research call between EPSRC and the National Research Foundation launched in July 2015
- Recent joint workshops between leading academics on topics including data science, AI, marine science and health and life sciences.
- Photonics Institute – Nanyang Technological University in conjunction with the University of Southampton's Optoelectronics Research Centre launched the S$100 million institute in October 2014

In terms of specific priorities for the future the IRE2020 includes:

- Provide targeted support to help firms scale up
  - Government will provide equity co-investment funds for start-ups. The support will cover early-stage seed funding to post-Series A, to help start-ups scale up.
  - Government will partner MNCs and LLEs to co-invest into promising start-ups, incubators and accelerators. This will allow start-ups to access the management expertise and global supply/marketing networks of large firms.
- Foster stronger collaboration and cohesion
  - The role of Technology Transfer Offices in public research organisations will be expanded to include technology transfer, I&E education and incubation services to form integrated Innovation & Enterprise Offices (IEOs).
  - Government will establish a central fund that supports national collaborative initiatives amongst IEOs.
- Encourage greater industry participation
  - Expanded the size of the Industry Alignment Fund, which supports collaborations between public and industry researchers.
  - Intermediaries (e.g. Intellectual Property Intermediary, IPI) will be strengthened to facilitate the engagement between public researchers and industry.
  - Government will catalyse the flow of talent to industry by supporting full-time secondments and part-time attachments of RSEs to enterprises.

- Support domain-specific strategies
  - Funding will be set aside for initiatives that address domain-specific needs

The level of development and focus in Singapore's innovation strategy closely aligns with UK policy and practice although there is perhaps more emphasis on STEM in Singapore. While UK institutions invest a considerable amount of their innovation resources in dedicated staff, those staff a more likely to be embedded in senior management and across departments than in a separate TTO. Overall, a greater step-change is achieved by embedding enterprise and entrepreneurship throughout the HEI than simply increasing the throughput of patents and licenses.

Effective policy and funding infrastructure

Another clear example of good practice is the Agency for Science, Technology and Research (A*STAR). It is the most important provider to universities of competitive funding for research initiatives and projects. It has established programmes to enhance university-industry collaboration, including

- Technology Consortia to enhance knowledge sharing and technology transfer through collaborations among academia and industry partners. Companies can strengthen their technical competencies, attend technology seminars organised by university researchers to learn about the latest research, and hire researchers for their in-house R&D efforts. There are also opportunities for industry members to engage in joint research projects with the universities.
- Corporate Laboratories in Universities, under which industry partners can tap scientific and technological capabilities in universities to develop new products and services, while universities achieve impact by developing cutting edge solutions for problems faced by industry. Research areas are geared towards supporting business growth for companies, generating economic benefits, and creating high-quality jobs for Singaporeans. Corporate laboratories enable faculty and students to work alongside companies on research with direct relevance for industry, and to gain experience, preparing them for employment in high value-add sectors.
- Themed programmes in artificial intelligence, cybersecurity, marine science, and synthetic biology - along with strategic research programmes, national innovation challenges, research centres and institutes, all involve collaboration between universities and industry.

VIETNAM

Vietnamese HEIs do have existing UK partnerships around education and TNE (i.e. Northumbria, Northampton) which would provide a useful foundation to build on in terms of U-I. In terms of national policy context, there appears to be significant desire to develop innovation policy, but it is not always well coordinated.

- Strong macro-economy, improving innovation indicators
  - Uncertainty from TPP fallout but signs are the economy will continue to develop
  - OECD recommends that Vietnam focus on Innovation to grow the economy to the next stage
  - U-I underpins plans to develop leadership in both public and private sectors
- International Education links well-established
  - Development of R&D capacity and skills now a priority
- Ministry of Science and Technology developing international partnerships for good practice
  - Existing collaborations with OECD, Finland Innovation Partnership Programme, Centre for Agriculture and Bioscience International (UK)

- VNU Science and Technology Development Fund example of HEI developing core U-I policy

While Vietnam is still developing its U-I policy it has some strong drivers to promote academic and industry partnership. The Ministry of Planning and Investment, the Ministry of Science and Technology, the Ministry of Foreign Affairs, and the Ministry of Education and Training recently formed the Connecting Vietnam Innovation Network which brought together scientists (including those with international experience) with leaders from industry and the public sector to fine tune objectives and implementation plans. Further, in April 2016, Vietnam announced a bold new higher education agenda wherein the Vietnamese government will offer up to 10,000 government scholarships for overseas doctoral study between 2014 and 2020 (or 1,300-1,500 per year) to tertiary and research institute staff.

Funding Support

The National Technology Innovation Fund (NATIF) provides funding for applied research and innovative solutions for businesses through grant or soft loan. Examples of supported activity include:

a) Research and develop new, advanced and high technologies to create new products and services;
b) Incubate technologies; pilot production of new products;
c) Train S&T development manpower for technology transfer and application;
d) Transfer, improve, innovate technologies to produce key, hi-tech, and national products

2. Researchers and studies:

a) Study pre-feasibility research projects on new or advanced technology development for organizations, business and individuals;
b) To search and decode technologies, exploit patents and improve techniques for new and advanced technology development.

3. Technology innovation activities:

a) To introduce, popularize and transfer advanced technology applications for agricultural, forestry and aquatic developments in rural and mountainous areas (Article 35, Law on Technology Transfer 2006);
b) To train and improve S&T knowledge, outsource S&T domestic and foreign experts for new, advanced technology development, technology innovation of enterprises.

NATIF is similar in design and objectives to early (1995-2000) funding programmes in the UK where there was an assumption that STEM subjects were the core focus of U-I. However, the UK has learnt that all academic disciplines need to be engaged as each have their place in social/economic development (for example developing artificial intelligence requires philosophers and linguists to work alongside scientists. The British Council could provide advice demonstrating the improved return on investment seen in the UK when broadening U-I; there would be further synergy from drawing together other support schemes such ODA projects. Further context is provided through the OECD Innovation SWOT and World Economic Forum analysis chart later in this section.

ODA projects

U-I relevant ODA projects include World Bank loan and grant funded projects and USAID grant support.

- Foster Innovation through Research, Science, Technology (FIRST) project (World Bank loan) supporting policy development and capacity building for Government Research Institutes towards further linkages with market demands and promoting technology innovation in enterprises, and encouraging the establishment of S&T enterprises.
- **Vietnam Inclusive Innovation Project** (World Bank loan) supporting to adopt, upgrade and develop inclusive innovations for the benefit of the Base of Pyramid population.
- **Higher Engineering Education Alliance Program (HEEAP)**, a USAID grant, modernizes the top engineering and technical vocational universities in Vietnam by developing experienced university leadership, constructing

innovative and effective curriculum, and promoting university-industry engagement. Since 2010 HEEAP has trained 247 lecturers from 8 institutions.

- **Vietnam Climate Innovation Centre** (World Bank grant): supports SMEs to develop local solutions to climate change and increases business activity in the climate technology sector through the establishment of a climate innovation centre and its mentoring, training and funding facilitation activities.

Approaches to partnership

Numerous sources suggest that the systemic challenges facing Vietnam are not ones easily solved by technology. Improvements to the quality of teaching, and therefore employability of graduates, are being sought through international exchange of staff and good practice but should also be supported through U-I partnerships. For example, the Knowledge Transfer Partnerships model from the UK could be adapted to Vietnam. It would complement policy objectives by addressing immediate problems facing industry and thereby forming partnerships and embedding a more knowledge-intensive enterprise culture.

There are significant international HE partnerships already operating in Vietnam from USA, Australia and the UK. The majority focus on course provision but, as has been seen across EA, these existing TNE relationships are a good basis to expand collaboration to U-I. There are obvious opportunity sectors such as agriculture and high-tech manufacturing where UK experience could be useful in addressing the enterprise skills gap identified by MoET.

Given the identified willingness to enhance innovation in order to strengthen Vietnamese economic development there could be an opportunity for the British Council to focus more on aspects of skills provision and leadership (given technology policy is not the most significant barrier). The academic network model employed by the MoET is a useful one but could be complemented with something based on the UK National Centre for Universities and Business which is not only successful in enhancing innovation performance in its members but is able to provide constructive input to policy debate on a par with officials.

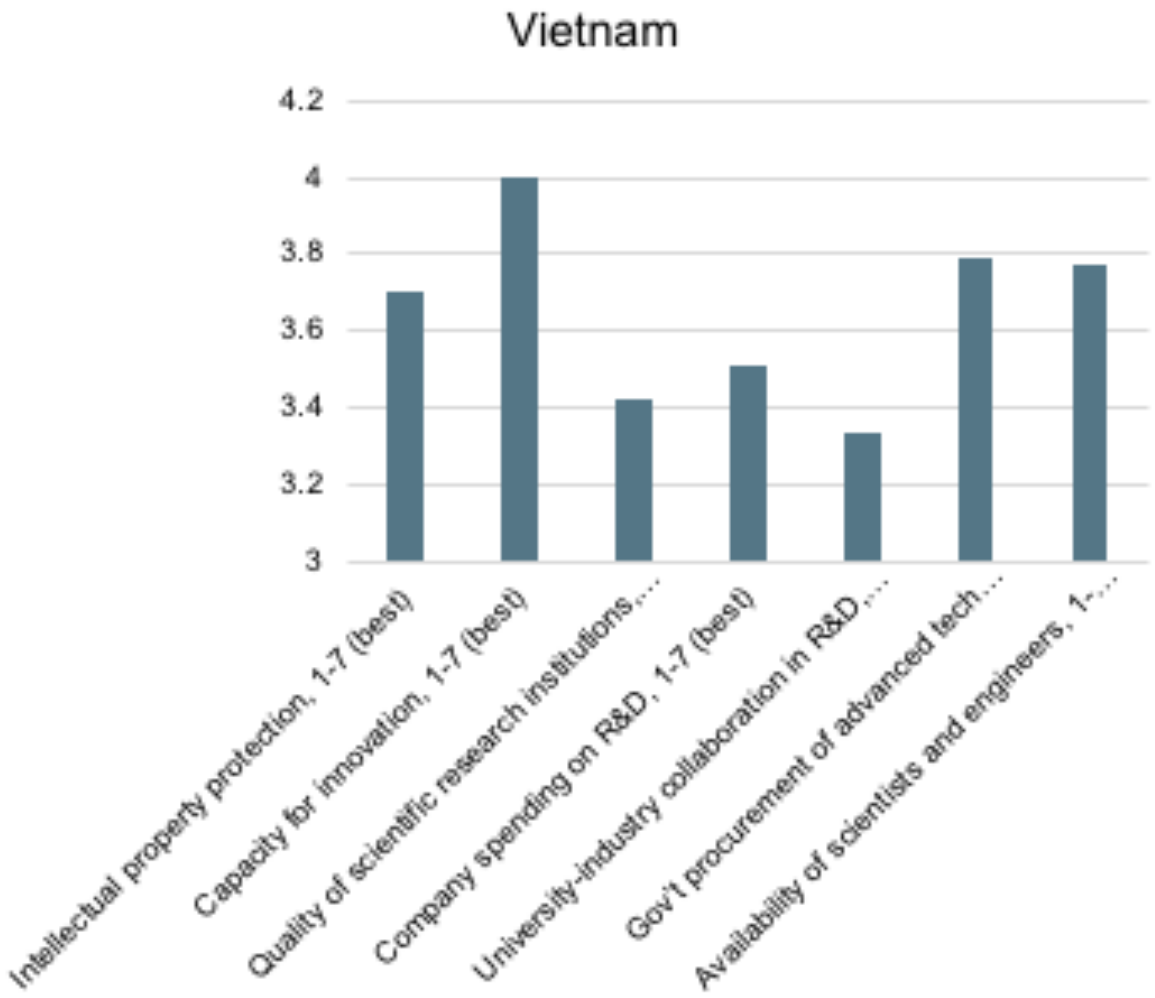
Innovation SWOT Analysis adapted from OECD[20]:

STRENGTHS:
Strong economic performance and diminishing poverty levels. Geographical location in one of the world's most dynamic regions.
Sizeable labour force and favourable demographics.
Substantial national education effort and good secondary education performance.
Attractiveness for investment by multinational enterprises.
Export strengths in a range of sectors.
Good reputation in science and technology (S&T) fields such as mathematics, and specialization in agricultural research and biology.
Progress in creating and sustaining a set of organizations and institutions to support innovation.
Regional initiatives of national benefit.
WEAKNESSES:
Low levels of productivity and income.
Inadequate framework conditions and disincentives for innovation.
Limited access to finance for enterprises.
Inefficiencies in state-owned enterprises.
Infrastructure deficiencies.
Weak performance of the teaching and learning system.
Low level of sophistication of production and exports.
Little innovation and even less research and development capacity in the business sector.
Weak performance of public-sector research.
Weaknesses in the S&T infrastructure as regards laboratories and research equipment.
Seriously underdeveloped information base for innovation policy making.
Inadequate STI governance arrangements and policy implementation.

OPPORTUNITIES:
]Further developing the human capital and skills base involving the sizeable Vietnamese diaspora.
Nurturing a dynamic business sector and its innovation capabilities.
Diversifying and upgrading the economy.
Developing a healthy attitude to risk-taking.
Improving effectiveness of the innovation system in terms of economic and social impact.
Strengthening inclusive growth.

THREATS:
Unfavourable macroeconomic developments and a slowdown in growth.
Failure to improve the institutional and business environment by tackling banking system reform and corruption.
Increasing brain drain.
Failure to prepare for increased international competition.
A looming middle-income trap.

Figure 2.1: **Positioning of Vietnam in World Economic Forum categories.**



APPENDIX 3

UK UNIVERSITY-INDUSTRY REVIEW OF POLICIES, PRACTICES AND KEY ORGANISATIONS

CONTEXT

University-industry (U-I) engagement is a generic term that encompasses a range of activities/ policies in UK Higher Education (HE) most specifically:

- Research Impact;
- Knowledge Exchange (KE); and
- Employer Engagement and Skills.

These areas reflect the distinct but complementary reasons for U-I from commercialisation of new knowledge (research impact) through problem solving and enhancing productivity (KE) to the pipeline of an educated and enterprising (graduate and post-graduate) workforce.

The key actors are, of course, Higher Education Institutions (HEIs), Industry and Government who each have complementary supply and demand strengths:

- HEIs create knowledge (research) and teach students (the main conduit for knowledge flow);
- Business needs knowledge and talented staff – it can offer resource (not limited to money); and
- Government – sets policy and provides funding to enhance productivity and improve quality of life in the UK and beyond.

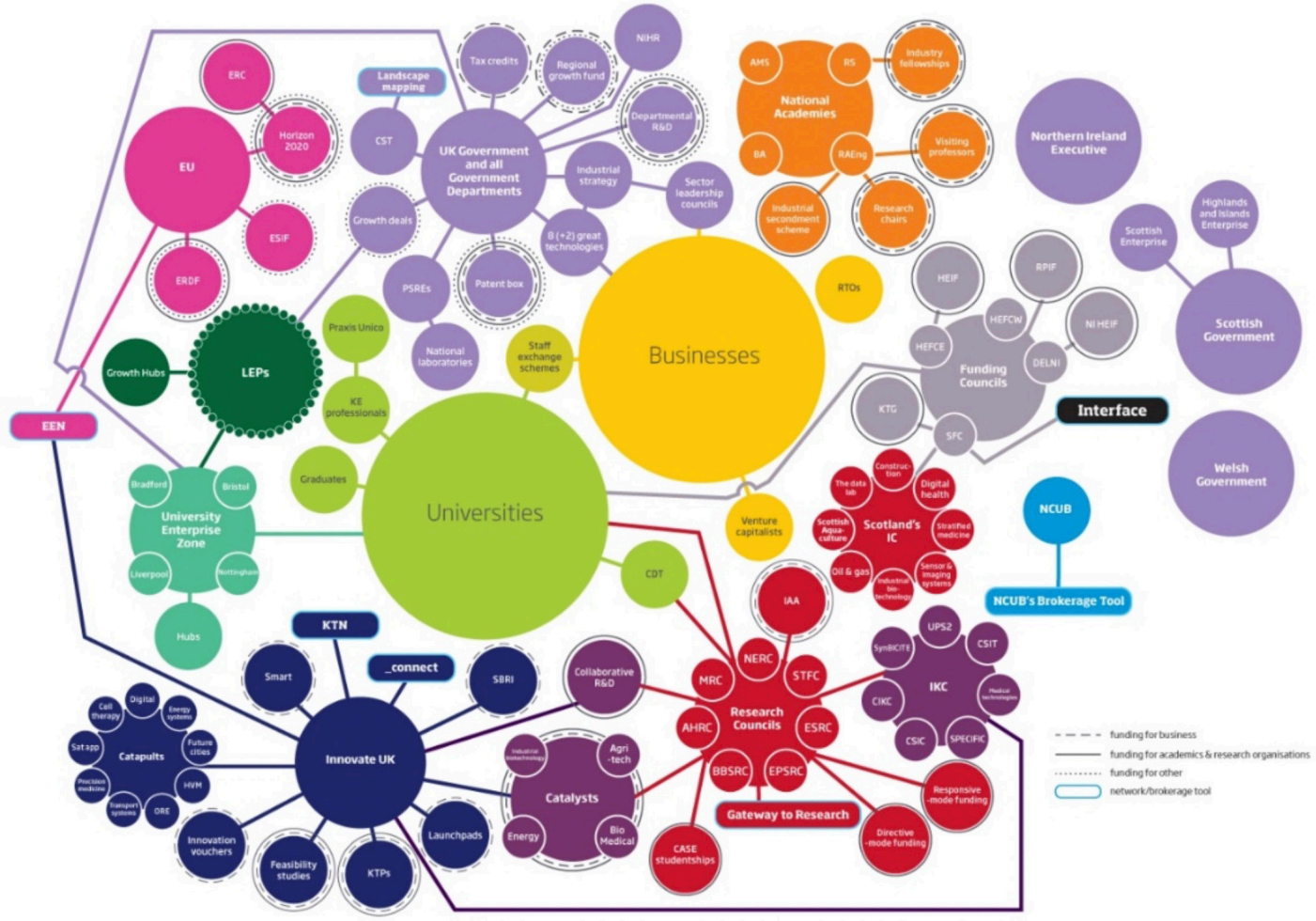
U-I is increasingly being described in terms of being either 'research-related' i.e. research collaboration, commercialisation, access to PhD/ post-docs or 'teaching-related' such as national skills policy, employability and access to talent. In very general terms, research policy tends to be managed at the UK level while teaching policy is devolved and varies between England, Wales, Scotland and Northern Ireland.

Further, the UK is undergoing a prolonged period of austerity in public finance with further uncertainty as it leaves the European Union. That said, the UK still ranks consistently highly for Teaching/Research and U-I by such measures as exist and is certainly a source of good practice and effective collaborator. Still, care should be taken when viewing policy and practice that is more specific to UK political context than may have been the case a decade ago.

Key Government and Public Policy and Funding Organisations

The UK Innovation system is diverse and complex with a range of public bodies having inter-linking responsibilities. Over the last 20 years structures of Government departments and funding bodies for Higher Education (HE) have been radically over-hauled – not least given devolution of power to UK nations. HE funding has been revised to be more student centric while research funding has been brought together under the new umbrella body UK Research and Innovation (UKRI). In 2015 Dame Anne Dowling (Chair of Royal Academy of Engineering) was asked to review the UK Innovation system and provide recommendations for further development; the review produced a conceptual model of the UK innovation System.

UK UNIVERSITY-INDUSTRY REVIEW OF POLICIES, PRACTICES AND KEY ORGANISATIONS

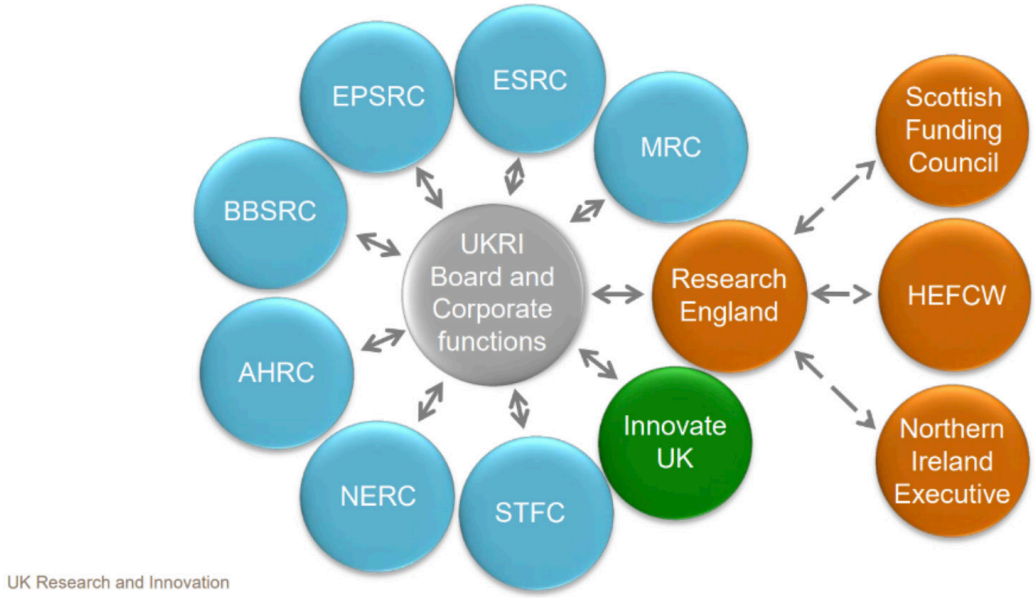


UK Research and Innovation (UKRI)

BEIS over-see **UK Research and Innovation (UKRI)** – a recently formed umbrella body comprising of the (discipline based research councils, Research England and Innovate UK – see further detail below) which manages the **Industrial Strategy Challenge Fund (ISCF)** a key part of government's long-term plan to raise productivity and earning power in the UK.

The fund is a core pillar in the government's commitment to increase funding in research and development by £4.7 billion over 4 years to strengthen UK science and business and progress toward boosting industry spending on R&D to 2.4% of GDP by 2027. Funding is available for a range of partnerships from HE, Industry and elsewhere to address specific challenges such as robotics, creative industries and ageing population.

Figure A3.1: **This figure shows the composition of UKRI and the associated agencies. The individual councils that make up UKTI are described later.**



In general terms, the majority of public funding for research and innovation is provided through a mechanism known as 'dual support' which refers to a combination of competitively secured project funding and core funding (allocated on a wider view of performance), as each has relative strengths and weaknesses. Project funding is useful for incentivising and evaluating specific policy/research areas as proposals can be assessed and monitored with a clear link between input and output. Project funding, however, is limited term by definition and momentum can be lost when having to reapply for further funding for example. It also tends to rely on more established activities/areas i.e. 'things that have names'. Core funding, meanwhile, tends to be allocated on the basis of more generic measures such as overall scale and previous success, i.e. 'track record'. As core funding is not directly linked to specific expected outcomes HEIs are have greater freedom to do genuinely ground-breaking work. Core funding is also more predictable in terms of short-medium planning at HEIs although it is more difficult to link the outcomes to the initial (public) funding which has been an issue in the UK recently due to the prolonged period of austerity.

Innovate UK (part of UKRI)

Innovate UK was set up in 2004 (originally named the Technology Strategy Board) and has seen its role become more significant as the UK develops its knowledge and innovation strategy. Innovate UK is the main 'demand side' funder in that they primarily engage with business/industry as opposed to the 'supply side' of HE (funded by specific bodies and research councils). Innovate are responsible for a range of pertinent schemes. Within the family of IUK activities and schemes, the following are notable:

Knowledge Transfer Partnerships (KTPs) is perhaps the longest running programme to support U-I as the model is simple and effective to meet a core strategic need and to identify innovative solutions to help that business grow. KTP often delivers significant increased profitability for business partners as a direct result of the partnership through improved quality and operations, increased sales and access to new markets. Social enterprises see improved results, too. The partnership is between an HEI and business where the academic or research

organisation partner will help to recruit a suitable graduate, known as an Associate. They will act as the employer of the graduate, who then works at the company on a specific project with technical support from the university academic. KTPs have given rise to a host of related projects such as mini-KTPs for small business and more informal collaborations based on this model. This model is highly recommended as an effective way to begin to develop strategic partnerships. There is a searchable database of **KTP projects**.

Catapult Centres are based loosely on an adaptation of the German Fraunhofer model and form a network of world-leading centres designed to transform the UK's capability for innovation in specific areas and help drive future economic growth. In 2010, the then Government Department for Business, Innovation and Skills commissioned a report into technical innovation from Hermann Hauser, an entrepreneur who had been active in information technology since 1978. The report recommended the establishment of a number of Technology and Innovation Centres. Catapult centres are organisations set up from 2011 onwards by Innovate UK in the United Kingdom to promote research and development through business-led collaboration between scientists and engineers to exploit market opportunities. They receive grants from public funds but are also expected to seek commercial funding. When set-up it was intended that the long-term funding split for each Catapult would be one-third core funding, one-third commercial funding, and one-third collaborative (public and private) research & development funding.

They are focused on broad challenges/sectors, as indicated below.

Objectives for Catapult Centres:

1. Work with industry, together with regional, national and international partners, to commercialise innovation in a way that drives long-term benefit to the UK economy.
2. Provide businesses in the sector or technology domain with access to the appropriate mixture of expertise, skills, facilities and equipment needed for them to invest in innovation and commercialisation where these are not readily available due to market failure or commercial risk.
3. Work collaboratively as part of the Catapult network, and with the wider R&D ecosystem, to enable the development of innovative solutions to key challenges in the Catapult's sector.
4. Take an active role in removing industry-wide barriers to innovation and commercialisation where they exist.

The current list of Catapult Centres operating in the UK:

- Cell & Gene Therapy - Twitter: @CGTCatapult
- Compound Semiconductor Applications - Twitter: @CSACatapult
- Digital - Twitter: @DigiCatapult
- Energy Systems - Twitter: @EnergySysCat
- Future Cities - Twitter: @Futurecitiescat
- High Value Manufacturing - Twitter: @HVM_Catapult
- Medicines Discovery - Twitter: @MedDiscCat
- Offshore Renewable Energy - Twitter: @ORECatapult
- Satellite Applications - Twitter: @SatAppsCatapult
- Transport Systems - Twitter: @TSCatapult

Knowledge Transfer Network, the KTN is a business facing network, which has evolved and changed quite significantly over the past. The KTN focuses on liaising with business to connect them to universities and other RTD organisations and promoting the business-facing grants available via Innovate UK.

Research England (part of UKRI)

Research England is a new organisation responsible for core (as opposed to project) research funding in England who also run the UK-wide **Research Excellence Framework (REF)**. REF is a large-scale process run every 5-7 years which assesses the research outputs of HEIs through peer review, environment and impact measures (the latter of which is most relevant to U-I, i.e. **research users**.

Higher Education Innovation Fund (HEIF) Research England also runs the **Higher Education Innovation Fund (HEIF)** which provides funding for Knowledge Exchange to the majority of HEIs in England based on data from the **HE-Business Interaction Survey (HE-BCI)** and is developing the **Knowledge Exchange Framework (KEF)** designed to provide a sophisticated intelligence on how HE interacts with the economy and society.

A detailed analysis of HEIF strategies[21] noted the main trends in KE activity were:

- Institutional trends towards increased number and diversification of partnerships, given the public funding constraints set out above;
- Development of activities and priorities driven by recent policies, such as the Teaching Excellence Framework (TEF) and degree apprenticeships;
- Increasing focus on collaborations and strategic partnerships – including long-term, multi-faceted collaborative relationships, and 'place-based' KE activity such as the Science and Innovation Audits (SIAs); and
- Strengthening of relationships between the economic and social impacts of KE and research and embedding of KE into other institutional strategies.

The barriers most commonly identified by institutions include:

- Low capacity or resources for KE;
- Lack of access to specialist facilities or suitable space;
- Low appetite from businesses and partners for some activities (e.g. adoption of technology); and
- Internal pressures within institutions to prioritise teaching excellence over KE activity.

21 The state of the English university knowledge exchange landscape. HEFCE (2017) **https://webarchive.nationalarchives.gov.uk/20180405120334tf_/http://www.hefce.ac.uk/pubs/rereports/year/2017/kelandscape/**

UK UNIVERSITY-INDUSTRY REVIEW OF POLICIES, PRACTICES AND KEY ORGANISATIONS

The most frequently cited enablers of KE activity exhibited in the strategies were as follows:

- HEIF funding is valued by institutions as a key enabler of KE activity;
- The prioritisation of KE as evidenced in having it included in HEI corporate plans and strategies;
- The development of external partnerships to broaden geographical and sectoral reach, and sources of funding; and
- The drive within institutions to embed KE into their corporate plans and strategies.

Econometric analysis of HEIF in 2015 suggested that the nearly £600 million invested into HE, primarily through HEIF has generated a minimum of between £2.9 and £4.2 billion in value for the UK[22].

HEIs in England are required to submit a high-level **Knowledge Exchange (KE) Strategy** to unlock their formula allocation from HEIF. These strategies are an excellent way to view the priorities and activities on HEIs in England and are all published online.

As reading all ~100 strategies may be labour intensive the funding council commended eight institutions as being particularly interesting/ innovative (although this does not imply that they are of higher quality). The eight are (with links to KE webpages for follow-up)

- University of Central Lancashire
- Institute of Cancer Research
- Cranfield University
- University of East London
- University of Hertfordshire
- University of Lincoln
- Royal College of Art
- Teesside University

A further five HEIs were commended for specific aspects of their strategies

- **Imperial College** – innovative goals and approaches to increasing engagement with small to medium-sized enterprises.
- **Kings College, London** – attention to academic promotions and embedding KE in academic practice through its institute system.
- **University of Oxford** – a focus on sustainable local growth, supporting the Oxfordshire high-tech cluster, and working closely with public and private sector partners and local communities.
- **Staffordshire University** – commitment to local and regional economic development in an under-performing sub-region – Stoke and Trent and Staffordshire – that has a significant productivity gap with the overall national economy.
- **University of York** – strength in partnerships; commitment to the success of the city, Yorkshire region and the North; and attention to the societal contribution of its students.

UK Research Councils (part of UKRI)

UK Research Councils primary fund research but also have developed **specific support** to enhance the impact of their funded projects

Impact Acceleration Accounts (IAAs) are strategic awards provided to institutions to support knowledge exchange (KE) and impact from their (publicly funded) research. IAAs allow Research Organisations to respond to opportunities in flexible, responsive and creative ways, aligned to their institutional strategies and opportunities. Responsibility for management of IAAs is devolved to the institution.

Pathways to Impact offers a chance for researchers to delve deeper into looking at who is likely to benefit from their work, how to engage with them, and how to go about increasing the likelihood of this happening. Whilst UK Research and Innovation demands excellence as the main factor in deciding upon funding, Pathways to Impact is viewed as an added criterion, amongst others, for research applicants to show the potential value of their work.

22 Evaluating Knowledge Exchange. HEFCE (2007). **https://webarchive.nationalarchives.gov.uk/20180405115251/http://www.hefce.ac.uk/ke/keeval/**

Global Challenges Research Fund[23](GCRF) is a £1.5 billion fund announced by the UK Government in late 2015 to support cutting-edge research that addresses the challenges faced by developing countries. Alongside the other GCRF delivery partners UKRI are creating complementary programmes that:

- promote challenge-led disciplinary and interdisciplinary research, including the participation of researchers who may not previously have considered the applicability of their work to development issues
- strengthen capacity for research, innovation and knowledge exchange in the UK and developing countries through partnership with excellent UK research and researchers
- provide an agile response to emergencies where there is an urgent research need.

UKRI International Collaboration Fund
UK Research and Innovation (UKRI) run schemes to support activities that foster international collaboration through initiating or further developing long term relationships between researchers in the UK and another country. These include establishing partnership links between research institutions, building on existing links between research groups and extending networks, and encouraging researchers from overseas to undertake research in the UK as well as UK researchers to spend time abroad.

There are a number of opportunities depending on the type of collaboration being undertaken:

- **Stage 1 - First links**: funds to cover the travel and subsistence for short term visits usually from the UK to another country.
- **Stage 2 - A broader relationship**: where there is already a more established relationship, researchers may wish to apply for funds to extend this relationship in the country of choice.
- **Stage 3 - Pilot studies**: where relationships are more mature it may be the case that researchers need financial support to carry out pilot research.
- **Stage 4 - Sustainable interactions**: dedicated schemes to support transnational collaboration or where the funding for international collaboration is embedded in the activities of programmes, often within the UK contribution to specific multilateral organisations.

Where HEIF, as detailed above, provides core funding for HE KE based on historic performance (external income as a proxy for impact) released against a high-level KE strategy[24] provided by the HEI the **Connecting Capability Fund (CCF)** supports university collaboration in research commercialisation through allocation of £100 million for competitive projects and formula funds. It aims to share good practice and capacity internally across the higher education sector, forge external technological, industrial and regional partnerships, and deliver the Government's industrial strategy priorities.

While the majority of U-I funding is based on revenue grants there is support for capital infrastructure through the **UK Research Partnership Investment Fund (UKRPIF)** stablished in 2012. The UKRPIF has provided over £680 million of capital funding to 43 research projects across the UK in its first five rounds, attracting £1.73 billion in double-match funding from non-public sources. UKRPIF's objectives are to:

- Enhance the research facilities of Higher Education Institutions (HEIs) undertaking world-leading research;
- Encourage strategic partnerships between HEIs and other organisations active in research;
- Stimulate additional investment in higher education research and;
- Strengthen the contribution of the research base to economic growth

23 For more information: The Global Challenges Research Fund explained **https://youtu.be/ZEgRcE6Ao2s**
24 HEIF Strategies are publicly available here **https://webarchive.nationalarchives.gov.uk/20180405122213/http://www.hefce.ac.uk/ke/heif/strategies/**

International Investment Initiative (i3) is designed to support the scaling up of existing strategically significant internationally collaborative research relationships between English Higher Education Institutions (HEIs) and universities and research organisations outside the UK. It aims to:

- Increase the scale and impact of existing international research collaborations that are based on excellent research
- Strengthen the contribution of international collaborations involving English HEIs to our society, pushing the frontiers of human knowledge, delivering economic impact and creating social impact by supporting communities to become enriched, healthier, more resilient and sustainable
- Contribute towards the delivery of government strategy, including the Industrial Strategy, by supporting sustained improvements in institutional capacity and capability in England.

The Research Excellence Framework (REF)

The UK's approach to measurement of research quality is now undertaken through an exercise called REF. The outcomes of REF in terms of judgements about quality and scale of university research inform the allocation of significant funding (in England via Research England). REF 2014 was developed from the predecessor exercise, the "Research Assessment Exercise". In 2014 the first REF crucially was the first time "impact" from research – on business, policy and social elements was considered, representing 20% of the overall exercise.

The RAE and latterly REF have influenced Governments and Funding Bodies globally, research measurement and assessment systems have often drawn from the UK's RAE/REF development.

For each submission Research quality is assessed by a combination of three distinct: the quality of outputs (e.g. publications, performances, and exhibitions), their impact beyond academia, and the environment that supports research. The most recent results are from 2014 and the next process will be carried out in 2021 (REF represents an immense amount of work for all involved so is not an annual process).

The subject areas are:

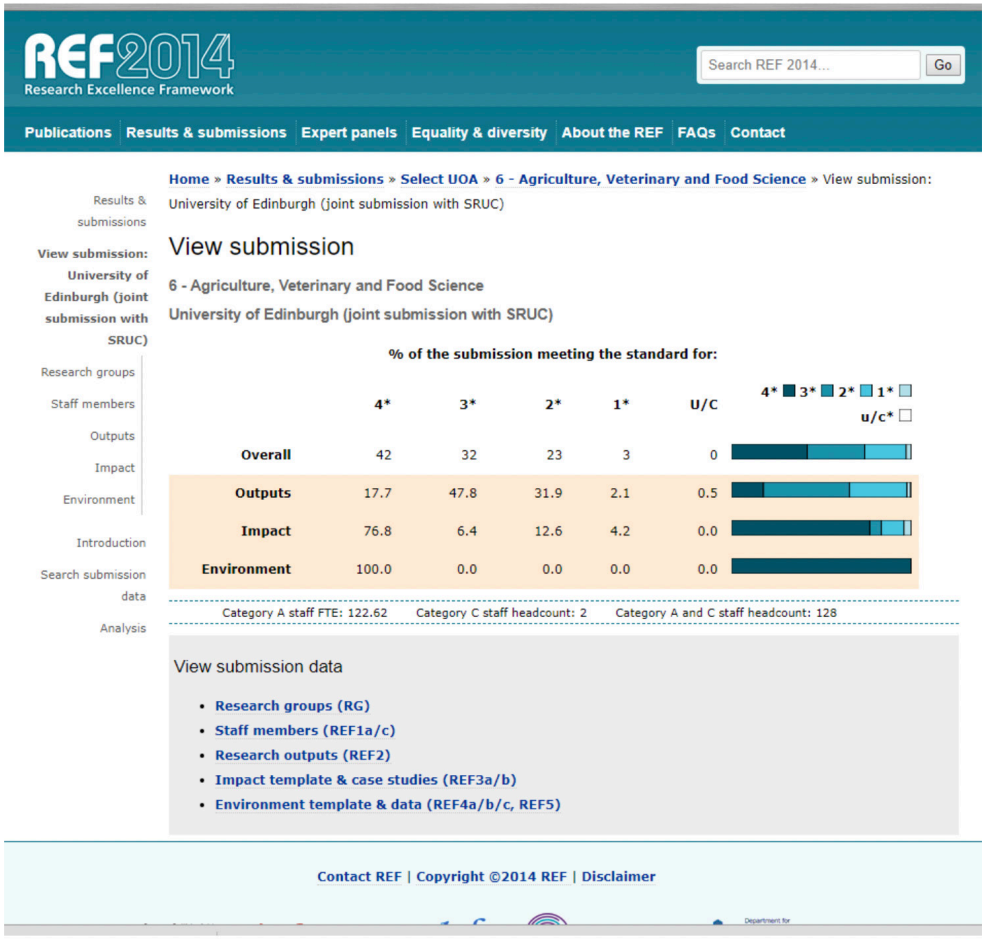
MAIN PANEL	UNIT OF ASSESSMENT
A	
1	Clinical Medicine
2	Public Health, Health Services and Primary Care
3	Allied Health Professions, Dentistry, Nursing and Pharmacy
4	Psychology, Psychiatry and Neuroscience
5	Biological Sciences
6	Agriculture, Food and Veterinary Sciences
B	
7	Earth Systems and Environmental Sciences
8	Chemistry
9	Physics
10	Mathematical Sciences
11	Computer Science and Informatics
12	Engineering
C	
13	Architecture, Built Environment and Planning
14	Geography and Environmental Studies
15	Archaeology
16	Economics and Econometrics
17	Business and Management Studies
18	Law
19	Politics and International Studies
20	Social Work and Social Policy
21	Sociology

MAIN PANEL	UNIT OF ASSESSMENT
C	
22	Anthropology and Development Studies
23	Education
24	Sport and Exercise Sciences, Leisure and Tourism
D	
25	Area Studies
26	Modern Languages and Linguistics
27	English Language and Literature
28	History

MAIN PANEL	UNIT OF ASSESSMENT
D	
29	Classics
30	Philosophy
31	Theology and Religious Studies
32	Art and Design: History, Practice and Theory
33	Music, Drama, Dance, Performing Arts, Film and Screen Studies
34	Communication, Cultural and Media Studies, Library and Information Management

Full details of HEI's REF profiles are freely available **here** and can be searched by institution or unit of assessment to assist identifying potential partners.

These profiles include a comprehensive breakdown of active staff and details of submitted projects example picture below:



Other UK HE Funding Bodies

The devolved administrations in Scotland, Wales and Northern Ireland managed some aspects of the research and innovation landscape directly. These are equivalent to the remit of Research England.

Scottish Funding Council (SFC)

Since 2004, the Scottish Funding Council (SFC) has invested over £140M in research pooling. Research pools are large, multi-university, discipline-based research collaborations. They were established by long term, significant investment by SFC, with partnership commitments from each of the participating Scottish universities.

The research pooling initiative was developed to support institutions to establish collaborative research pools with the aim of growing a critical mass of excellent research in the relevant disciplines in Scotland, in order to compete effectively for funding, research staff and students both nationally and internationally. SFC's original aims in funding the research pooling initiative were to:

- Enhance research competitiveness
- Achieve sustainable critical mass in the Scottish research base
- Improve the quality of research
- Provide a more attractive research environment.

SFC provides funding under their **University Innovation Fund** as an incentive to universities to work collaboratively

SFC have recently reviewed their **research pooling initiative**; research pools are large multi-university, discipline-based research collaborations established with the aim of growing a critical mass of excellent research in the relevant disciplines.

Higher Education Funding Council for Wales (HEFCW)

The Higher Education Funding Council for Wales (HEFCW) aims to promote a dynamic and sustainable research base within higher education institutions in Wales, which compares well with that in the rest of the UK in terms of quality and is capable of contributing to economic and social well-being in Wales and beyond.

HEFCW provides:

- £71 million a year through our main formula-based fund for research, QR.
- Funding to institutions for the training of postgraduate research students.
- Policy and funding for research, innovation and engagement is guided by the Research, Innovation and Engagement Committee.

Department for the Economy – Northern Ireland

The Department's primary funding tool for promoting knowledge exchange activity is the NI HEIF. The objective of **NI HEIF** is to encourage the higher education sector to increase their capability to respond to the needs of business (including companies of all sizes) and the wider community, with a clear focus on the promotion of wealth creation. The long term aim of this funding is to improve Northern Ireland's innovation performance as a key element in raising productivity and delivering economic growth. This core funding is currently approximately £4m per annum.

Independent U-I Organisations

The National Centre for Universities and Business (NCUB) is an independent and not-for-profit membership organisation that promotes, develops and supports university-business collaboration across the UK. NCUB's Council[25], drawn from senior business leaders and Vice-Chancellors from member organisations, contributes to the UK's long-term skills, graduate talent and innovation policy and infrastructure providing input on the big issues of sustainable growth and industrial strategy through high level networking.

NCUB delivers digital platforms for innovation brokerage and work experience, research and analysis feeding into every major review of business-university collaboration and change programmes mapping out clear and practical solutions for both sectors and regional economies.

- **State of Relationship**[26] aims to summarise university - business collaboration across the UK and provide an authoritative source on the spread and quality of collaboration activity taking place in the sector.
- **Konfer** is innovation brokerage at your fingertips. It opens up research, researchers and services in UK universities and research institutions, and for academics, it is a way to find impact partners.
- **Task Forces** - NCUB brings together the very best from universities and business to focus on a particular economic sector or issue and facilitates leaders and experts in their fields to work together to identify and solve problems such as Digital Health[27] & Care and Food Economy.[28] Each Task Force consists of a steering group of senior figures to co-ordinate the Task Force's work, co-chaired by one business and one university leader, and one or more working groups of experts that examine issues in depth.
- **Strategies for Growth**[29] offers new evidence on the patterns of and reasons for sustained growth of KE income across HEIs in the UK. More and better evidence of the benefits of academic activity outside academia is continuously needed by policy makers to justify the presence of dedicated incentives for KE activities, but evidence of progress may also be of use for the purpose of allocating these funds.

PraxisAuril is the representative body for KE (U-I) in the UK, it develops knowledge exchange and technology transfer professionals through:

- world-leading training (including international delivery);
- connecting members and stakeholders at events; and
- promoting best practice for the sector

PraxisAuril delivers training from the perspective of Knowledge Exchange practitioners and draws on a wide pool of experience and expertise from within the profession and build them into the course content, ensuring we are always delivering up to date, sector leading training and development[30].

Core training courses

- Fundamentals of Technology Transfer
- New Venture Creation 1: First steps towards spin-outs and start-ups
- New Venture Creation 2: Launching a high growth spin out company
- Creating & Managing an Organisation's Consultancy Service
- Growing Consultancy Business in a University or Research Institute
- Essentials of Business Development
- Fundamentals of Software Commercialisation
- Practical Licensing
- Research Contracts
- Developing Strategic Partnerships

25 Lead Council Members. NCUB. **http://www.ncub.co.uk/leadership-council-search.html**
26 State of the Relationship Report 2018. NCUB. **http://www.ncub.co.uk/reports/state-of-the-relationship-report-2018**
27 Digital Health and Care Task Force. NCUB. **http://www.ncub.co.uk/what-we-do/digital-healthcare-and-healthy-living-2030-task-force**
28 Food Economy Task Force. NCUB. **http://www.ncub.co.uk/what-we-do/task-forces/food-economy.html**
29 Strategies for Sustaining Growth of Income from Knowledge Exchange across Higher Education Institutions (HEIs) in the UK. NCUB. **http://www.ncub.co.uk/reports/ke-income.html**
30 Training and events. PraxisAuril. **https://www.praxisauril.org.uk/training-events**

Training is provided **throughout the world** which can provide U-I professionals with internationally recognised accreditation under the Alliance of Technology Transfer professionals **(ATTP)**.

PraxisAuril also run the largest annual conference[31] to:

- Promote UK capabilities in international collaboration
- Promote professional development in knowledge exchange
- Engage industry in PraxisAuril and member activities
- Connect KE professionals together to build strong networks

Reviews and Evaluations

This section provides an overview of the breadth and extent of the (significant number) of reviews and assessments relevant to U-I in the UK over the past 15 years.[32]

Although seemingly dated, the 2003 review by Sir Richard Lambert[33] remains one of the most influential in shaping what followed. The review was one of the first formal reviews to look at the broad picture of Knowledge Exchange and U-I engagement. The set of collaborative research agreements ("Lambert Agreements") that emerged from his review have significantly contributed to improvements in the contracting of research between universities and industries and they remain in use today.

The 2015 **Dowling Review**[34] is the most recent comprehensive review of U-I with discussion of achievements and recommendations for next steps. The Review revisited a number of topics addressed in previous reviews, including knowledge exchange funding, local support for business and mobility across the academia-business interface. It recognised that, while progress has been made in many cases, there is undoubtedly scope — and a need — for further improvement. It looked at previous reviews and summarised the nature of recommendations from these reviews. Dowling reported that nine previous reviews made a total of 297 recommendations, nearly half of which were directed at government. The recommendations were clustered into seven broad categories:

- Behaviour changes, for example sharing best practice on approaches to collaboration in Catapults or LEPs, publishing data on spending or numbers of projects, or improved communications;
- Organisational or strategic changes, including development of sector strategies and the Science and Innovation Strategy, and recommendations on Catapult ways of working or Key Performance Indicators KPIs);
- Public sector funding, for example increasing overall spending on R&D, increased funding for Innovate UK or Catapults, or further funding for specific schemes (such as HEIF);
- Private sector funding, for example ensuring that finance markets are working effectively or measures to increase private sector spending on R&D;
- Regulatory changes, including changes to the planning system, regulations governing the work of local authorities or LEPs, VAT, and public sector procurement rules;
- Infrastructure, for example new online platforms for collaboration, single points of contact in institutions and funding for physical infrastructure provision; and
- Further reviews or consultations, for example on the effectiveness of specific schemes (such as the KTN or SBRI) or the ways in which organisations/schemes engage with SMEs.

31 PraxisAuril 2019 Conference **https://www.praxisauril.org.uk/civicrm/event/info?reset=1&id=292**

32 Why are there so many reviews of university business collaboration? NCUB. **http://www.ncub.co.uk/index.php?option=com_docman&view=download&category_slug=presentations&alias=176-why-are-there-so-many-reviews-of-university-business-collaboration&Itemid=2728**

33 Lambert Review of Business-University Collaboration (2003) **http://www.ncub.co.uk/reports/lambert-review.html https://www.gov.uk/guidance/university-and-business-collaboration-agreements-lambert-toolkit**

34 Dowling Review of Business-University Relations (2015) **https://www.gov.uk/government/publications/business-university-research-collaborations-dowling-review-final-report**

UK UNIVERSITY-INDUSTRY REVIEW OF POLICIES,PRACTICES AND KEY ORGANISATIONS

Below are a selected set of reviews and sources of information supporting U-I policy and practice development:

1. **Lambert Review of Business-University Collaboration** (2003). Sir Richard Lambert, HM Treasury.
2. **Business-university collaboration: the Wilson review** (2012). Department for Business, Innovation & Skills. A broad review of systems and outputs with specific policy recommendations.
3. **Encouraging a British Invention Revolution: Sir Andrew Witty's Review of Universities and Growth** (2013). Review of strengths in UK Innovation and analysis of barriers and enablers.
4. **The Dowling Review of Business-University Research Collaborations** (2015). Professor Ann Dowling, President of the Royal Academy of Engineering.
5. **University Knowledge Exchange (KE) Framework: good practice in technology transfer** (2016). Report to the UK higher education sector and HEFCE by the McMillan group.
6. **Success stories** in U-I collaborations - examples collated by the National Centre for Business and Universities (NCUB).
7. **Good practice observations from industry:** PraxisAuril December 2018. Observations from industry on the importance and approaches to successful U-I collaboration.

A wider set of reading and reference materials and sources is listed below.

8. **The Changing State of Knowledge Exchange UK Academic Interactions with External Organisations 2005-2015** updates the analysis of the largest ever survey of UK academic engagement with external organisations, which was undertaken by the Centre for Business Research in 2008/9 and which covered the period 2005-2008. This original web-based survey attracted over 22,000 responses and the latest survey has received 18,177 responses - these are the two largest research and knowledge exchange surveys ever completed of a national Higher Education System.
9. **IPO Intellectual Asset management** – Advice handbook for HEIs (UK-centric but broadly applicable worldwide).
10. **SET²** World-leading Spin-off support and incubation collaboration.
11. **ICURe** (Innovation to commercialisation of university research). Training and boot camp for (new) academic entrepreneurs. A recent development and approach to technology transfer being pioneered in the UK.
12. **Valley of death** – UK Parliamentary inquiry in to availability of investment for commercialisation of research output.
13. **Wellings Review of Intellectual Property and Research Benefits 2008** Commissioned to advise on medium to long term planning for University impact strategy.

APPENDIX 4

REGIONAL HIGHER EDUCATION POLICY FORUM ON UNIVERSITY LINKS FOR INDUSTRY ENGAGEMENT

March 7, 2019, Conrad Hotel, Manila

The forum brought together representatives from across EA and the UK representing academia, government/policy makers and industry to share examples of success and discuss the challenges faced in further developing and embedding U-I. Following presentation and Q&A sessions with the main speakers, delegates were assigned groups and asked to discuss their own experience and objectives which were captured by the British Council. This summary focusses on output from the workshop and recommendations for next steps – the main summary of the forum presentations and discussion was produced by the British Council.

Workshop 1
What successful policies or models of partnership have been implemented in your country to achieve university-industry partnership? What enablers facilitate it and what barriers hinder it?

Workshop 2
What do you want to do next to enhance U-I partnerships? What do you need from and what can you offer to:

- Government?
- Industry partners?
- UK partner?

KEY THEMES FROM DISCUSSION

- Leadership is vital – both from Government/policy-makers and senior managers in HEIs
- Resources are needed
  - from Government this is funding, but also co-ordination of metrics/ policy
  - from University leadership it is building time for U-I in to workloads and recognizing/ rewarding it alongside Teaching and Research
- Academics need new skills – training in enterprise/entrepreneurship
- Dedicated U-I staff for relationship management/contracting/admin
- Academics need to build trust with industry – conferences and networking are useful, examples of co-location (i.e. industry presence on research parks) can be very powerful
- Significant differences in context between EA nations – further comparative study was suggested
- For some, student-centric U-I (placements, employability) was more important that technology transfer

SUCCESSFUL MODELS	COMMENT/RECOMMENDATION
UK's Knowledge Transfer Partner-ships (KTP) which links university to industry where a graduate is recruited for a specific project and overseen by an academic. Costs are shared between Government and employer.	This model can be easily adapted to fit EA nations – Innovate UK (who run the UK scheme) would doubt-less be supportive. It will require commitment of resource from Government as well as publicity to stimulate demand. Universities may need to adapt processes (i.e. staff resource management) also.

SUCCESSFUL MODELS	COMMENT/RECOMMENDATION
Shift towards down-streaming of research results and commercialization of research outputs	Where HEIs and public funders signal the importance of impact in the assessment of research quality academics will be able to further 'push' their work out in to the economy and society. Care should be taken not to be limited by the 'linear model' of research being done in isolation with commercial opportunities only sought at the end; evidence from the UK suggests developing strategic relationships between HE and industry streamlines the uptake of research results (i.e. as academics consider industry needs from the outset of their research). Data from extensive surveys of academic staff in the UK show that primary motivations for academics are to underpin/ enhance their research and teaching. In-come generation from commercialization is a much lower priority[35].
Ministries' involvement in developing collaborative ecosystem	The innovation ecosystem is complex and usually spans boundaries of several government departments (i.e. education/science to trade/industry but also health, environment etc). Clear signals from the top that departments should be joined up in their policies is important as well as clear and complementary lines of accountability (to avoid overlap and excessive administrative burden).
Development of practical solutions and network dialogues	The UK has developed strong professional networks to highlight the value of U-I (PraxisAuril, NCUB etc). These serve both to develop and disseminate good professional practice as well as to highlight policy issues (both opportunities and threats). In some cases, they can be seen as more bipartisan than funders or HE managers. Profes-sional accreditation also helps to embed U-I such as through the ATTP network. The British Council can play a role bringing the right people together to establish a U-I network in EA with only a modest in-vestment of resource.

35 The Changing State of Knowledge Exchange. NCUB. **http://www.ncub.co.uk/reports/national-survey-of-academics.html**

REGIONAL HIGHER EDUCATION POLICY FORUM ON UNIVERSITY LINKS FOR INDUSTRY ENGAGEMENT

SUCCESSFUL MODELS	COMMENT/RECOMMENDATION
Individual efforts through academic collaboration (EA)	Many U-I relationships begin from two (or more) individuals coming together through shared interest/ opportunity. The chances of developing these relationships can be enhanced when academics are given time (and resource) to attend networking events/conferences outside of their usual academic orbit (as well as encouraging industry to be more involved in academic events). However, building relationships can be very time consuming and they are not without risk (e.g. to HEI's reputation in the event of unsuccessful projects) so HEIs should provide centralized professional support to academ-ics managing these relationships.
Emphasis on patent-ing of inventions	An emphasis on patenting can yield some positive results – especially in the early phase if there has been a backlog of potentially useful research but experience in Europe and the US shows that an over-emphasis on patenting can be to the detriment of the far greater economic and social benefits that flow from stronger U-I relationships. Patenting is a very small proportion of the valuable U-I activity in the UK.

BARRIER	RECOMMENDATION
Budget and funding	Budget and funding are always going to be a concern to some extent. It is important to have reasonable expectations that U-I will not, on the whole, be a profit-making activity but will, once embedded be self-sustaining for the most part. The UK experience of a substantial return on investment is due in large part to the significant sums already invested in research and teaching that can be unlocked by dedicated U-I policy and funding. Similar is true for HEIs in terms of resource management; developing U-I will require an investment of time and resource but the benefits returned are far broader than income generation (i.e. more relevant research and more employable graduates).

BARRIER	RECOMMENDATION
Funding goes to national universities	National differences in the make-up of HE sectors are common across the world and it is not unreasonable perhaps that Governments would assume to capitalise on their past investment in public HEIs. However, there are established models of matched-funding and co-investment that can be tailored to particular national contexts. Private HEIs may benefit from being pro-active in approaching their public peers to develop mutually beneficial partnerships that may draw public support where they can demonstrate they are addressing policy goals.
IP (only for developing countries)	The potential for loss (or leakage) of IP is a reasonable concern but UK experience is that it can be paralysing (especially where little trust has been developed between partners). The UK developed a series of model contract (Lambert Agreements) to act as a useful starting point to take some of the risk from initial IP negotiations. HEI staff with professional qualifi-cation can also potentially help as they will be guided by the HEI's desire to develop relationships rather than a potentially more short-term approach taken by external legal specialists. Since the majority of HEIs already have partnerships with UK/other HEIs in teaching and research activities it may be useful to build on this and ask for advice on IP management. The UK IPO developed guidance for Universities[36] that provides helpful advice and could be adapted further for EA economies.
Research-focused rather than partnership-focused behaviour of researchers	University leadership need not only to signal the importance of U-I alongside teaching and research but also provide resource and acknowledge contributions. Most UK HEIs now see the recruitment and progression policies specifically highlighting U-I. Hence academics will see that their next promotion may come as much from their U-I activity as from T or R. UK partner HEIs are likely to be happy to share generic information in this regard and development of professional networks in EA will also promote the development and sharing of good practice.

36 Intellectual asset management for universities. **https://www.gov.uk/government/publications/intellectual-asset-management-for-universities**

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BARRIER	RECOMMENDATION
Researchers' lack of entrepreneurial skills	Professional training and accreditation can be provided in partnership with networks such as PraxisAuril[37] (who are part of the global Alliance of Technology Transfer Professionals which already has some members in EA). Provision of enterprise and entrepreneurship training (with consideration of local legal context) is perhaps less of a barrier than academics finding or being allocated the time and resource to undergo training.
Inability of academic to make informed contact with industry and to do anything outside of their duties	As above, both Government and University leadership can play a role in providing resources to free up academic time for networking and business engagement. However, stimulating demand from business is less easy even if matched public funding is available. Many UK HEIs report success in starting small via programmes like KTPs. At the other end of the spectrum, the UK has seen success in developing large scale projects where HEIs and Industry may begin with distinctive roles but build relationships over the course of the joint working (for example the Biomedical Catalyst[38] in the UK or successive rounds of Framework funding from the EU[39]).

ENABLER	RECOMMENDATION
Behaviour change of researchers on public engagement	Public engagement should be developed hand in hand with U-I as the two share much in common in terms of developing the value of impact as well as challenges for time/resource management. UK policy recognises public engagement alongside U-I although there are still challenges around developing appropriate low-burden metrics. Early career researchers in particular have been seen to actively develop public engagement as a route to enhance their research and teaching profile. The UK has set up a national Centre for Public Engagement[40] to further embed and disseminate good practice and the model could be adapted for EA.

37 PraxisAuril. **https://www.praxisauril.org.uk/**
38 **https://mrc.ukri.org/funding/science-areas/translation/biomedical-catalyst/**
39 **https://ec.europa.eu/programmes/horizon2020/en**
40 National Co-ordinating Centre for Public Engagement **https://www.publicengagement.ac.uk/**

ENABLER	RECOMMENDATION
Technology transfer to the university	The UK has a long history of investing in University-based research so much of the policy has been focussed on transferring technology out of HEIs in to the economy. However, the German economy is structured differently leading to the creation of the Fraunhofers as a way of linking Universities and private sector research/ innovation capacity which has been very successful. This model has been adapted for the UK under the Catapult Centres which are focussed on bringing together partners interested in specific innovation areas such as advanced manufacturing and renewable energy. This model may be useful in building on current success.
Industry to match technology centres	Catapult centres (as above) would also capitalise on this success along with sustained support from Government in the form of policy and funding.
Development of internship programs for students	Students are – and always will be – the primary mechanism for transferring knowledge from the research base to the economy. Internships can build relationships and enhance employability and it is recommended that senior leadership of HEIs put structures in place to capitalise on the existing activity.
Trust to facilitate working together and sharing of resources	There are no short cuts to building trust between individuals/organisations but there are pitfalls that can be avoided. Professional enterprise training for academics and a practical approach to IPR are essential. UK HEIs employ specialist staff to manage and de-risk these r elationships – especially in the early period (many of these staff are supported from the dedicated public funding for U-I).
Dialogues for industry and academe to speak the same language	As above, networking, training and experience are needed on both sides; strategic relationships do not develop overnight but mutual benefits will reinforce trust and develop demand for further working. Dialogue may be held at the national level for strategic sectors and at the local level in terms of engaging with SMEs and the wider public depending on specific national structures. The UK has a network of Local Economic Partnerships made up from business and HE leaders.

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NEED	RECOMMENDATION
Funding	The case for public funding needs to be made on the basis of U-I meeting national needs and is best articulated through comprehensive and robust data from which progress can be demonstrated. Universities can allocate core funds to U-I and may be able to use a more qualitative approach based on their specific strategy and goals. External partners will pay a market rate for interactions they see as valuable, but this will most likely need 'pump-priming' by a combination of internal/public funding in the early years. HEIs should be proactive in developing dialogue with government to demonstrate how increased investment will lead to a strong return across the economy and society.
Policies to facilitate collaboration	Government needs to consult on and communicate priorities and provide support to establish collaboration. Leadership within the HEI has a similar role to develop, implement and evaluate policies that fit with their mission alongside teaching and research. In the UK HEIs publish their 5-year strategies for U-I sends a strong message to both academics and funders of their commitment to U-I and the outcomes they expect.
Evaluation tools for the university and industry to evaluate each other for mutual benefits	The UK process to develop useful metrics has been challenging; in short, the better one is able to evaluate the impact of a specific project/collaboration the further one is from being able to compare projects or develop and overall 'score' for success. While income generation is not a goal of U-I in the UK, many metrics rely on income as a proxy for impact on the basis that organization (public and private) tend to spend money rationally and that currency units are more directly comparable than, for example, patents vs hours of consultancy.
Regional mediator to raise the global sense of wider regional partnership	The British Council would be well placed to work with national agencies and institutions in this regard – drawing on expertise and experience from the region and the UK.

NEED	RECOMMENDATION
Technological investment like online/ virtual study course that can be expanded to other regions to address very limited physical movement	This challenge is perhaps a good example of where Government, Industry and HE will need to come together to implement the infrastructure they need for future challenges. There are already a number of examples of where HEIs have developed innovative solutions to these issues but scaling up does tend to require substantial investment – perhaps the UK Research Partnership Investment Fund (UKRPIF) would be a useful model to consider where large scale capital projects are funded jointly from Government and Industry to meet such challenges[41].
Standard framework Implementation link U-I together	The UK has probably the broadest policy framework in terms of activities and disciplines that could readily be adapted for specific national contexts in EA. However, this will always be a challenging problem given the vast range of ways in which academia can interact with the wider economy to say nothing of the fact that the nature of innovation is to do things differently. A combination of metrics and narrative will be essential as well as clear articulation of objectives from Government and a willingness by all parties to engage over the long term. If frameworks are implemented too early, they are likely to stifle the very interaction they are designed to support (although it is acknowledged that political will and stability are needed for this type of medium to long term planning).

41 UK Research Partnership Investment Fund. Research England. **https://re.ukri.org/research/uk-research-partnership-investment-fund/**