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Higher Education Partnerships Programme:

Enhancing the sustainability of technology transfer and research management in higher education institutions through strategic UK – Malaysia university partnerships





Scoping Report: Enhancing the sustainability of Technology Transfer and Research Management in Higher Education Institutions through strategic UK – Malaysia University Partnerships

Report commissioned by: The British Council in Malaysia www.britishcouncil.my

Contact:

Prabha Sundram, Head Education, Malaysia Prabha.Sundram@britishcouncil.org.my

Report author: Dan King www.research-consulting.com

Contact: dan.king@research-consulting.com

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Executive Summary

Context and background to the project

In 2015, the Malaysia Education Blueprint 2015-2025 (Higher Education)^a set out a vision for the development of higher education in Malaysia, building on the already strong growth in the previous decade.

Innovation Ecosystem is one the 10 Shifts identified in the Blueprint, with three associated strategies:

- 1. prioritising strategic research areas of national importance;
- 2. facilitating greater private investment and involvement; and
- developing supporting services such as technology transfer offices to enable the commercialisation of products and solutions.

In response to the challenges identified in this, and subsequent reports, the British Council proposed to undertake a scoping study to strengthen the linkages in technology transfer activities and to enhance the capacity of technology transfer offices (TTOs) in Malaysian Higher Education Institutions (HEIs) using the best practice and models of UK HEIs. This study was carried out through the British Council's Higher Education Partnerships Programme with the Ministry of Education Malaysia.

Undertaking a scoping study and partnership development

Research Consulting, working with technology transfer practitioners from the University of Nottingham, has been appointed by the British Council to undertake the scoping study on technology transfer in the UK and Malaysian HEIs.

A project steering group was established with representatives from the British Council and Ministry of Education Malaysia in October 2018. A workshop with Malaysian stakeholders was held in Malaysia (Kuala Lumpur and Putrajaya) on 26 and 27 November 2018. The workshop enabled direct discussions with leaders in the Ministry of Education, Innovation and Technology Managers Association (ITMA) and a wider group of organisations, stakeholders and universities. In December 2018, the British Council issued a call for partnerships, seeking expressions of interest from UK universities with the aim of developing a small number of partnerships between universities in the UK and Malaysia, to share good practice and expertise in technology transfer. A total of 18 proposals were received from this call, and a selection was invited to participate in a partnership workshop in Malaysia on 14 and 15 February 2019.

Partnership opportunity areas to develop technology transfer in Malaysia

The scoping report identified a number of areas of partnership potential for UK-Malaysia universities and organisations. These are grouped into four areas:

- Experience/inexperience in doing technology transfer;
- Governance and institutional issues in managing and delivering technology transfer;
- Industry engagement overall levels of engagement and how this affects technology transfer; and
- Funding and policies supporting technology transfer.

The report's recommendations for potential partnership actions and opportunities are summarised below.

Experience/inexperience in doing technology transfer

- 1. Practical technology transfer, secondments and partnering to engage UK and Malaysian TTOs in working on commercialisation projects, due diligence and business case / opportunity reviews. Short visits, placements and on-line.
- Investigation of the benefits and challenges in developing shared models and structures to balance experience, deal flow and partnerships. Alignment to other areas of Knowledge Exchange that support the overall outcome objectives for research commercialisation – consultancy, for example.





- Building technology transfer collaboration on existing university-to-university relationships and looking at areas in common, i.e. research strengths, existing university collaborations and industry partners. Some technology transfer projects may have exploitation opportunities in UK and Malaysia that can support a joint approach to areas like market assessment or implementation, allowing TTOs to work on real shared projects.
- 4. How the UK's university campus institutions, which have similar technology transfer challenges, play a role in supporting collaborations, and the development of technology transfer in Malaysia generally.
- 5. Review capacity building approaches for technology transfer staff in the UK, and how they would apply in the Malaysian context.

Governance and institutional issues in managing and delivering technology transfer

- Partnering between ITMA and equivalent UK organisations and leaders, e.g. PraxisAuril and National Centre for Universities and Business (NCUB), to support ITMA in driving the development of suitable practical guidance for universities and industry in Malaysia backed by government ministries, business and university leadership.
- 7. Identify Malaysian research and knowledge exchange leaders who can help to develop, implement and champion practical guidance.
- 8. Building technology transfer elements into existing partnership activities involving senior university leaders. For example, identifying the UK/Malaysia senior visits which should include technology transfer on the agenda.

Industry engagement – overall levels of engagement and how this affects technology transfer

- Projects and approaches to engaging industry, corporates, investors, and small and medium-sized enterprises (SMEs) – models and approaches used in the UK.
- 10. Identifying corporates with strong UK and Malaysia connections, as a catalyst to collaborations.
- 11. Enhancing industry engagement within existing funding streams, informed by approaches and experience in the UK, for example, PhD placements into industry, joint industry supervision of relevant PhDs.

Funding and policies supporting technology transfer

12. In this area, partnership opportunities for university-to-university activity are limited but examples and case studies from the UK may be of benefit to the Ministry of Education Malaysia in furthering its science, technology and innovation policy. Interventions in the UK, for example in developing PhD placements into industry and research users' organisations, may be of significant value.



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1. Introduction



The Malaysia Education Blueprint 2015-2025 (Higher Education) and focus on the Innovation Ecosystem

In 2015, the Malaysia Education Blueprint 2015-2025 (Higher Education)^a set out a vision for the development of higher education in Malaysia, building on the already strong growth in the previous decade.

Innovation Ecosystem is one the 10 Shifts identified in the Blueprint, with three associated strategies:

- 1. be focused by prioritising a few strategic research areas of national importance;
- 2. facilitating greater private investment and involvement; and
- be supportive through services such as technology transfer offices that enable the commercialisation of products and solutions.
- Malaysia needs to move from academia operating in insolation, to the quadruple helix of academia, industry, government, and local communities coming together in partnership for the incubation, development, and commercialisation of ideas. ...
 The commercialisation of ideas and industry research partnerships to propel innovation is a necessity. In addition to that, a sustainable funding model with clear outcomes, incentives, and support for those who need it most is critical.

Malaysia Education Blueprint (Higher Education) 2015-2025

A project to undertake a scoping study and development of partnership opportunities

As part of its Higher Education Partnerships Programme, the British Council, working with the Ministry of Education Malaysia, has appointed Research Consulting, working with technology transfer practitioners from the University of Nottingham, to:

1. undertake a scoping study on technology transfer in the UK and Malaysian Higher Education Institutions (HEIs), and

 to develop plans to facilitate mutually beneficial higher education partnership activities between selected UK and Malaysian HEIs in enhancing the capacity of technology transfer offices (TTOs) in Malaysian HEIs using the best practice and models of UK HEIs, as well as to strengthen the linkages in the area of technology transfer and broader internalisation activities.

The project commenced in October 2018. A project steering group was established with representatives from the British Council and Ministry of Education Malaysia.

Workshop to generate understanding of Malaysia's technology transfer practices and challenges

Following initial desk research, supported by the British Council, a workshop with key Malaysian stakeholders was held in Malaysia (Kuala Lumpur and Putrajaya) on 26 and 27 November 2018.

The workshop enabled direct discussions with leaders in the Ministry of Education, Innovation and Technology Managers Association (ITMA) and a wider group of organisations, stakeholders and universities.

Details of the workshop, attendees and agenda are in Appendices 1 to 4.



The open call for partnerships

In December 2018, the British Council issued a call for partnerships, seeking expressions of interest from UK universities. The aim was to develop a small number of partnerships between universities in the UK and Malaysia to share good practice and expertise in technology transfer. Partnerships may develop to undertake a range of activities in support of the overall aim, including:

- shared experience of technology transfer, models and approaches;
- people exchange and mobility (staff, technology transfer officers, and potentially students);
- the development of links with industry partners of mutual interest and potential;
- mechanisms to support better international uptake of emergent technologies from the UK and Malaysia; and
- sectoral or thematic approaches that support technology transfer collaborations, based on strengths and assets within the UK and Malaysia.

At the deadline, 18 proposals were received including 17 from universities and 1 from a UK Research Organisation (company).

A partnership workshop, building on the expressions of interest to the call and the scoping study, was held on 14 and 15 February 2019. Appendices 5 and 6 provide further details.

This scoping report provided input to the workshop and an approach to partnership development.

2. Definitions and Terminology



Developing a common language

The project is focused on technology transfer. To ensure consistency in language, we have used three terms in delivering this project and this report:

- technology transfer
- knowledge exchange
- industry engagement

Technology transfer is one way of achieving impact from research outcomes. In the UK and Malaysia, 'technology transfer' is defined against a set of focused activities:

- patenting of intellectual property from research;
- creation of spin-out companies; and
- licensing of intellectual property (mainly patents) to industry.

A useful overview note on Technology Transfer in the UK was developed by several of the leading UK universities' Technology Transfer Offices (TTOs) in 2015.^b

It should be recognised that effective technology transfer sits within a wider spectrum of activities and actions that support the translation of research to industry (or other users of research, for example public healthcare providers).

Generally, these are termed **'knowledge exchange'** in the UK, although in common with Malaysia, other terms are routinely used. Knowledge exchange activities include: academic consultancy, undertaking contract research for industry, industry-university secondments and staff exchanges, and programmes to address employee skills.

Definitions

Definitions used in this report: technology transfer, knowledge exchange and industry engagement

The **definitions** of terms used in the report are as follows:

- **Technology Transfer (TT):** The processes of spinning out new companies based on university intellectual property (IP) and licensing IP to existing companies.
- **Knowledge Exchange:** Knowledge exchange (KE) is a process which brings together academic staff, users of research and wider groups and communities to exchange ideas, evidence and expertise.
- Industry engagement: Is related to both of the above. It is an underpinning activity of crucial importance in realising successful knowledge exchange and technology transfer endeavours. It is a wider consideration than just research however, it can equally relate to teaching activities and employability activities in support of onward employment of students. The extent and quality of a university's industry engagement is a critical success factor for both technology transfer and knowledge exchange. The term should be viewed broadly, and seen as inclusive of other 'research users' which can include publicly funded organisations, in particular those delivering healthcare services. Activities to maximise and encourage industry engagement can be held at organisational, department, research group and individual levels.

Knowledge Exchange

Activities contributing to knowledge exchange include:

- R&D partnerships with industry, including collaborative research and industry funding of research;
- Consultancy by academics for industry;
- Networking and the development of innovation clusters to build effective relationships;
- Research commercialisation, including technology transfer;
- Innovation Parks managed by universities; and
- Recruitment and placement of people with specialist R&D skills (e.g. PhD students).
- ^b "UK University Technology Transfer: behind the headlines", 2015. A note from the UK's leading university technology transfer professionals
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The latest national policy and good practice review in the UK is the 2016 McMillan Review of Technology Transfer^c which notes that 'technology transfer is just one route to impact, and universities should take the route appropriate to the specific technology in any particular case. National policy should continue to be focused around all forms of knowledge exchange'. This builds on a series of government reviews of business–university relationships, dating back to 2003.

Industry engagement and university-business relationships are now essential in research areas, not least in terms of accessing government funding for R&D projects and PhDs. Within the UK, the sustained importance of this is recognised in the number of high-level government reviews, and the development of a support ecosystem that recognises this.

Figure 1: An illustration of services delivered by technology transfer offices [source: Malaysia Education Blueprint 2015-2025 (Higher Education)].

Illustrative services offered by Technology Transfer Offices to drive the commercialisation of R&D outputs

1	IP Sourcing	 Source and assess technology from universities to meet the needs of industry; and Source market knowledge and access customers. 	
2	IP Strategy	 Provide advice on how to protect inventions; and Develop an appropriate IP protection strategy. 	
3	Proof of concept	 Conduct market research to identify potential markets and assess market needs and the competition; Construct a proof of concept strategy to demonstrate the performance and commercial potential; and Working with inventors and partners to determine right commercialization strategy. 	
4a	Licencing	 Identify potential licensees who have a business need for the technology; and Negotiate all the terms, conditions and fee structure. 	

SOURCE: R.Graham (2014) MIT Skolteck Initiative; Imperial Innovations



c Report to the UK higher education sector and HEFCE by the McMillan Group, "University Knowledge Exchange (KE) Framework: good practice in technology transfer", 2016

3. Engagement with Malaysian Stakeholders

The November 2018 workshop agenda

In November 2018, a workshop was held with key stakeholders in Malaysia.

The workshop was structured as a two-day activity, with the majority of participants attending on day 2. The structure was:

- Day 1 AM meetings between the consultants and Malaysia project steering group, comprising the British Council and representatives from the Ministry of Education.
- Day 1 PM a focused session including representatives from other ministries and key organisations, including ITMA and Academy of Sciences Malaysia.
- Day 2 a larger session involving ~ 50 individuals as representatives of public and private universities in Malaysia, projects and initiatives supporting technology transfer including ITMA, and government ministries and agencies supporting actions linked to technology transfer.

During the workshop, presentations were received from a number of stakeholder organisations including:

- Academy of Sciences Malaysia (day 1)
- Innovation and Technology Managers Association
 (ITMA) (days 1 and 2)
- PlaTCOM Ventures, a technology commercialisation platform for Malaysia focusing on SME innovation (day 2)
- Collaborative Research in Engineering, Science and Technology (CREST), an industry-led brokerage and engagement vehicle for collaborative R&D, talent development and commercialisation, focusing on the electrical and electronic engineering sector (day 2)
- Existing initiatives for technology transfer training, focusing on academics and entrepreneurial training, led by the Malaysian Industry-Government Group for High Technology (MIGHT). A third cohort visited the UK in January 2019

Day 2 of the workshop also featured a number of breakout sessions, and feedback from these sessions have been incorporated into the following section on challenges. The breakout sessions covered four questions, which the participants considered and shared their views with the wider group. The questions were:

Key question	Sub-questions to consider
How well are universities doing in technology transfer?	 What are the examples of successful technology transfer? What are the barriers experienced by universities? Are universities working with the R&D 'active' and R&D 'capable' companies? How can they find them? Should they focus on sectors or clusters of businesses? Who 'owns' the relationship? How can universities use existing resources to support technology transfer? How can universities help businesses to find the right academics to work with?
How to improve industry engagement in R&D?	Recognising the wider value of industry engagement in shaping applied research and underpinning technology transfer.
The role of other stakeholder institutions and agencies	 What is the business view of innovation? Actions to develop a Malaysian ecosystem that encourages innovation. How can local activities, like Innovation Parks or business clusters contribute? What measures or activities can support greater networking between business and academia? Who are the industry champions in Malaysia for R&D and innovation? How can they influence others more effectively?
Partnership opportunities and suggestions	 Participants were invited to identify three key messages or ideas for the project team to work on that indicate where or how UK / Malaysia partnerships can support technology transfer



Input from key groups, projects and initiatives

During the workshop, presentations were received from a number of stakeholder organisations including:

- Academy of Sciences Malaysia (day 1)
- Innovation and Technology Managers Association (ITMA) (days 1 and 2)
- PlaTCOM Ventures, a technology commercialisation platform for Malaysia, focusing on SME innovation (day 2)
- CREST, an industry-led brokerage and engagement vehicle for collaborative R&D, talent development and commercialisation, focusing on the electrical and electronic engineering sector (day 2)

Innovation and Technology Managers Association (ITMA)

Established in 2014, ITMA comprises members from 19 universities, with additional members from related companies and agencies. ITMA is the equivalent to PraxisAuril in the UK, and as such, it is a key organisation in shaping good practice, policy and the development of technology transfer professionals.

It also represents a vehicle for sustained UK-Malaysia engagement around technology transfer, particularly where opportunities or issues are 'sector wide' (as opposed to university-university partnerships).

Working with similar organisations in other countries, PraxisAuril was one of four founding organisations which, in 2010, championed the development of international recognition standards for technology transfer professionals, through the international Alliance of Technology Transfer Professionals (ATTP) (see Appendix 8, "RTTP"). Since May 2019, ITMA has been an Alliance Association of ATTP.

PlaTCOM Ventures

PlaTCOM Ventures Sdn Bhd is the national technology commercialisation platform of Malaysia, supporting the exploitation of research and IP. 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 the SME Master Plan 2012-2020. By 2020, its objectives are to:

- 1. help a minimum of 300 Malaysian SMEs to commercialise their innovations;
- 2. facilitate a minimum of 250 licence deals; and
- 3. become a self-sustainable entity.

The presentation identified that PlaTCOM Ventures initiatives contributed significantly to improving the rate of technology transfer through intellectual property licensing from universities, research institutions and SMEs since its establishment in 2014. Of the 190 licence deals facilitated, 56% came from universities in Malaysia, predominantly the five research universities.

The facilitation process and shared services approach managed by PlaTCOM Ventures is not present in this form in the UK, and the model offers some value to UK institutions as set against the issue of shared services development identified in multiple UK reviews, but yet to be realised effectively.

Collaborative Research in Engineering, Science and Technology Centre (CREST)

CREST is an initiative focused on industry-academia collaboration and established in 2011. It represents an interesting, and seemingly unique (to Malaysia) model that draws together a sectoral approach, focused on companies in Malaysia's electrical and electronic industries.

It focuses on three activity elements: collaborative R&D grants, talent development and commercialisation. It comprises 20 universities (public, private and overseas), 18 multi-national corporate members and almost 50 local smaller companies.

Corporates include companies with UK R&D presence and university-linked activity, e.g. Dyson (which has a manufacturing site in Malaysia), Agilent and Intel. The CREST model is distinctive when viewed against UK measures in this area, although it has similarities with the UK's Catapult Centre network. CREST directly addresses the weaknesses in Malaysia's innovation ecosystem – company engagement in R&D, and university-business engagement. To date, CREST has supported 123 R&D projects, nurturing over 20 technology start-ups.



4. Key challenges in developing Technology Transfer in Malaysia

Challenges and gaps exist in four main areas

Desk research and inputs from the workshop held in November 2018, have identified a number of areas where gaps and challenges exist in Malaysia in relation to technology transfer.

The scoping report groups these together into four themes:

- 1. (In)experience in doing technology transfer;
- 2. Governance within universities, linked to the wider regulatory (ministerial) environment;
- 3. Industry engagement; and
- 4. Funding and policy support for technology transfer.

In light of these challenges, the potential areas for UK-Malaysia collaboration or partnerships have been identified.

(In)experience in doing technology transfer

There is a relative lack of experience in technology transfer, and individuals with responsibility for this area typically (i) expect the responsibility to be limited to a few years, and (ii) have limited resources to draw on to support a strong pipeline of activity. The key challenge at both the national level and for individual institutions, is to grow experience and capacity in technology transfer. The challenge is both short term (achieving results and outcomes, engaging businesses in productive collaborations) and longer term (building a cadre of professionals with experience in technology transfer, increasing business demand and absorptive capacity for innovation). Existing support via the British Council for training in technology transfer is noted.

In addition to experience within individual technology transfer offices, *institutional experience* of technology transfer is also a factor that influences a university's ability to engage successfully in technology transfer (governance and decision making at senior levels). This is discussed further in the section on governance.

- Most individuals assigned technology transfer responsibilities have this as a temporary role and expect to move on in a few years. Overall levels of experience will therefore remain low (i.e. under ~5 years) and the investment into training will diminish over time. Further, the development of personal contacts and networks, considered essential to effective partnership work, are hampered in this environment.
- How can the funding environment underpin longer term 'professional' roles for technology transfer and knowledge exchange – including the emergence of leadership roles within institutions for professional growth and development? What scope is there for such individuals to move between industry and academia?
- PlaTCOM Ventures, as a centralised expertise in technology transfer, represents an interesting model that has value to the UK as a potential model for shared services. The shared services approaches to technology transfer developed in Malaysia may successfully address issues in a way that the UK has not been able to thus far. There may be scope for the development of a training environment aligned to PlaTCOM Ventures to give rapid experience to new entrants and PhD students.
- Alignment to other forms of knowledge exchange. It is notable that not all research commercialisation is delivered through technology transfer. How can Malaysian universities create support structures that maximise the outcome by utilising the best pathway for that project or opportunity? This is linked to the development and realisation of Key Performance Indicators (KPIs) around technology transfer and knowledge exchange.
- Engage PhD students in innovation-led approaches how do the growing number of PhD students in Malaysia engage in innovation, with industry and R&D during their PhD studies? Doctoral training in the UK has developed significantly in recent years, particularly around the engagement with industry and facilitation of placements for PhD students.
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- 1. Practical technology transfer, secondments and partnering to engage UK and Malaysian TTOs in working on commercialisation projects, due diligence and business case / opportunity reviews. Short visits, placements and on-line.
- 2. Investigation of the benefits and challenges in developing shared models and structures to balance experience, deal flow and partnerships. Alignment to other areas of Knowledge Exchange that support the overall outcome objectives for research commercialisation consultancy, for example.
- 3. Building technology transfer collaborations on existing university-to-university relationships and looking at areas in common: research strengths, existing university collaborations and industry partners. Some technology transfer projects may have exploitation opportunities for the UK and Malaysia that support a joint approach to areas like market assessment or implementation, allowing TTOs to work on real shared projects.
- 4. How the UK's university campus institutions, which have similar technology transfer challenges, play a role in supporting collaborations, and the development of technology transfer in Malaysia generally.
- 5. Review capacity building approaches for technology transfer staff in the UK, and how they would apply to the Malaysian context.

Governance

Throughout the workshop, a number of issues emerged around governance. Technology transfer is a complicated activity, with risks and many regulatory / governance issues. Upfront financial commitments are needed, for example to fund a patent application or to invest in a spin-out company. Equally, there are considerations including legal ones, as to how far a university's financial or resource support should continue once a company has been formed or a technology licensed. The potential for individual financial reward for academics from technology transfer is also captured in UK university policies but remains a difficult issue to manage.

This can be considered as *institutional experience* of technology transfer and is a critical factor that influences a university's ability to engage successfully in technology transfer (governance, decision making at senior levels, understanding of risks etc.). A report recently released in the UK examined technology transfer through a major survey of practitioners.^d

University central leadership and management are viewed as among the strongest positive influences on the overall level of commercialisation. However, their influence on the specific phases of commercialisation depends on the policies and support functions that the universities provide as a result of the strategic direction and allocation of resources, not least because of the demands on academic time to fulfil teaching and research functions.

In the UK, years of practice have laid down many established guides and practices that provide assurance to senior leaders.

^d Report by RSM Pacec Ltd. for the Department for Business, Energy and Industrial Strategy (BEIS), "Research into issues around the commercialisation of university IP", 2018



Some evidence from the November workshop indicates that R&D-related contracts/agreements in general present difficulties for university governance and approval^e. General R&D agreements are beyond the scope of this work but are known to be an issue for the management of university-business interactions. Partnership actions may consider how ITMA can facilitate developments that benefit all universities and industry partners, for example through approaches like the *'Lambert Agreements'* – a suite of R&D template agreements for use between industry and universities developed to ease partnering on R&D, including on intellectual property ownership and exploitation rights. A decision guide helps universities and companies to select the right agreement type for the circumstances.

- Guidance on practice, freedoms and limitations for university leaders to provide the confidence on appropriate measures, risks and approaches in Malaysia. Aimed at Vice-Chancellors, Deputy Vice-Chancellors, Financial Directors, Heads of Institutions, etc., they also provide a resource for TTOs to draw upon when briefing senior colleagues. It is common for UK TTOs to need the support and approval of non-TTO senior staff for key decisions in technology transfer practices, and the workshops identified similar issues in Malaysia.
- Instigating the development of Malaysia-specific practice guides, building on the advisory note development by several of the UK's leading TTOs, and in the 'Practical Guide' advisory notes produced periodically by PraxisAuril^f.

- Continue to develop examples and case studies demonstrating success from technology transfers and industry engagement. These must operate at multiple levels, for government, for university leadership, for individual academics and for industry. The videos in development by the Ministry of Education Malaysia is one approach. A review of most UK university websites will see strong evidence (and celebration) of their links to industry – for research, for student employment and for innovation. Equally, the National Centre for Universities and Business drives new case studies exemplifying business-university successes.
- A further consideration is the extent to which business and innovation leaders are present on the Boards of universities in Malaysia.
- Whilst TTOs focus on the filing of new patents, of equal importance (financially and for resources) is the dropping of patents and intellectual property when the commercial opportunity is not compelling. This remains a difficult issue for universities in the UK (for example, when academic inventors feel it should not be dropped in spite of a lack of commercial progress), and was raised as a concern in the workshop. The UK experience and approaches may help Malaysian TTOs to manage their growing intellectual property portfolios. This is linked to governance and the importance of senior leaders understanding and backing the TTO position.

- e The management of legal agreements relating to R&D remains challenging in the UK and Australia. A recent benchmarking work by Research Consulting identified some of the issues.
- ^f For example (i) in 2016, PraxisUnico and AURIL, working with legal firms, produced a "national advisory note for Universities and Government Agencies on State Aid in R&D&I", addressing the practical interpretation of EU laws and practices in areas like technology transfer, and (ii) the 2013 "IP Best Practice in UK-China Technology Transfer" guidance, supported by the UK Intellectual Property Office, British Embassy Beijing and UKTI.
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- 6. Partnering between ITMA and equivalent UK organisations and leaders, e.g. PraxisAuril and NCUB, to support ITMA in driving the development of suitable practical guidance for universities and industry in Malaysia backed by government, ministries, business and university leadership.
- 7. Identify the Malaysian research and knowledge exchange leaders who can help to develop, implement and champion practical guidance.
- 8. Building technology transfer elements into *existing* partnership activities involving senior university leaders. For example, identifying the UK/Malaysia senior visits which should include technology transfer on the agenda.

Industry engagement: an underpinning role in shaping research for applications of commercial value

Industry engagement is a recognised challenge in several of Malaysia's recent reviews and policy documents. It is important to successful technology transfer, but it also a wider issue influencing other factors.

An academic with strong industry connections is likely to produce research outcomes that are better informed by market needs or challenges, even where that research is early stage. This in turn may be more easily directed into technology transfer outcomes.

Industry engagement is an area where sustained focus and resources have been applied in the UK, underpinning many aspects of university activity.

- Developing a national forum or platform for research and business leaders to discuss innovation, and to visibly champion this area. Examples include the National Centre for Universities and Business (NCUB) in the UK which also generates many case studies evidencing the value of partnership. The influence of business leaders with strong R&D credentials on policy and practice is evident in other ways, for example, the recent PraxisAuril blog sought the views of corporates like GSK, Siemens and Rolls-Royce on what they seek from university collaborations.
- Experience in industry engagement and successful collaboration with industry in R&D appeared to be limited to certain 'hot spots' of activity or funded projects. The importance of sectoral and multi-disciplinary research themes for effective industry engagement was noted. Models like CREST address this in focused areas, and examples of sector-focused university activity were given (e.g. agri-tech). How can improvements be scaled up across Malaysia? What lessons can be learned from UK approaches and structures, and does CREST present a model for the UK to learn from? Are there sectors of significant scale or location where a CREST-like model might be expanded?
- How to address industry engagement with academics, researchers and PhD students? There is a perceived need to find and introduce more industry engagement through a variety of mechanisms. The UK's experience suggests opportunities in a range of approaches, including:
 - o The role of PhD placements into industry;
 - o Supporting more academics in engaging the industry and providing the incentives to do so;
 - o The role of other activities in developing industry partnerships, placements, employability;
 - o Joining up 'business facing' activities in universities to ensure a simple, coherent offer to industry.
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- Funding is an important element in driving business demand for R&D. It incentivises industry engagement, within existing funding streams and in new funding streams.
- ITMA could network more broadly with organisations like PlaTCOM Ventures and CREST to ensure approaches to industry engagement are scaled and shared, and to increase opportunities for business networking amongst its members. The value of in-country placements/secondments to build professional experience might also be considered.
- Working with small businesses (SMEs) requires different approaches to the engagement. The UK is widely recognised as having strong SME-university engagement practices⁹. Models like the Nottingham Trent University's Innovation Community Lab use student recruitment to drive innovation in clusters of local SMEs.

- 9. Projects and approaches to engaging industry, corporates, investors and SMEs models and approaches used in the UK.
- 10. Identifying corporates with strong UK and Malaysia connections, as a catalyst to collaborations.
- 11. Enhance industry engagement within existing funding streams, informed by approaches and experience in the UK, for example PhD placements into industry, joint industry supervision of relevant PhDs.



Funding and Policy

• The performance of the UK in technology transfer is a product of a policy and funding environment that has been consistent and is supportive of a wide range of pathways to knowledge exchange and to incentivise business R&D. There is a wealth of evidence, reviews and case study information that sets out the development of the UK's approach to technology transfer, with its strengths and weaknesses. This is outlined in Appendix 8.



9 The OECD 2017 scoreboard ranked the UK 1st for "SMEs collaborating on innovation with higher education or research institutions, 2012-2014".

- A consistent issue arising in UK reviews, raised by the industry, is the need for simplicity in how the funding and support available from government is presented to industry (Witty^h, Dowlingⁱ). Certain UK funding streams have been long standing and are highly valued by industry including the Knowledge Transfer Partnership (KTP) scheme which routinely engages companies in R&D which have previously never done so.
- What is the balance and mix of funding that best supports technology transfer, within the wider research and innovation environment?
 - How to sustain technology transfer roles and to build experience and capability at a national level, as well as delivering institutional needs. Structures at national and university-level.
 - o How to address the challenges of early stage funding, proof of concept and commercial launch.
 - o Lessons from UK experiences in funding for technology transfer.
- Encouraging more private sector investment into R&D, and the likely need for government to incentivise through tax and (part) grant funding schemes. UK schemes like the Patent Box might be considered.
 Stimulating business demand for R&D (and technology transfer) is a core element of the UK's Industrial Strategy, and recent reviews have examined this in specific relation to technology transfer^j.
- Ensuring incentives and rewards for knowledge exchange, alongside existing academic esteem and performance indicators like publications.
- The role of small grant schemes to incentivise the industry, and SMEs in particular, to 'open up about their issues' so universities can work on them.^k

12. In this area, partnership opportunities for university-to-university activity are limited but examples and case studies from the UK may be of benefit to the Ministry of Education Malaysia in furthering its science, technology and innovation policy. Interventions in the UK, for example in developing PhD placements into industry and research users' organisations, may be of significant value.

- ^h Sir Andrew Witty's Review of Universities and Growth, "Encouraging a British Invention Revolution", 2013
- ⁱ Professor Ann Dowling, President of the Royal Academy of Engineering, "The Dowling Review of Business-University Research Collaborations", 2015
- J House of Commons Science and Technology Committee 2016-17, "Managing intellectual property and technology transfer", HC 755, 2017
- ^k In the UK, other pathways including EPSRC's approach of industry co-funding PhDs are used to address the same point – getting industry to consider and articulate their longer-term R&D and innovation challenges.
- 17 Higher Education Partnerships Programme: Enhancing the sustainability of technology transfer and research management in higher education institutions through strategic UK – Malaysia university partnerships

5. Conclusion



Many of the issues which Malaysian universities face in developing technology transfer are common with those currently or previously experienced in the UK. This includes a backdrop of (perceived) low business demand for R&D and collaboration.

In Malaysia, the key issues are anticipated to be the overall levels of industry engagement, across academics, researchers and professional staff. This provides a challenging landscape from which to continue to build.

The opportunities for partnerships based solely on technology transfer with individual universities may be limited, in view of the limited resources of UK TTOs. That said, opportunities linked to staff exchange, and technologies with UK/Malaysia market relevance may provide live cases for TTOs in the UK and Malaysia to work collaboratively.

The more productive area may be the wider initiatives that support networking and the development of good practice in Malaysia. Equally, a number of university governance and advisory measures may be needed to ensure that technology transfer can be effectively delivered by TTOs in Malaysia. Existing structures in Malaysia - PlaTCOM Ventures and CREST, for example - have some uniqueness and value to the UK as examples of shared/collaborative approaches to technology transfer and knowledge exchange.

Next Steps

The scoping report was shared with the British Council team in advance of the second partnership workshop, and was used as input in shaping the partnership workshop held on 14 and 15 February 2019.

Details of the February 2019 workshop, participants and notes of key outcomes are detailed in Appendices 5 and 6.

References



Useful links and references

This section draws together a number of references from within the report that may be particularly helpful to the development of technology transfer in Malaysia. It includes reviews and examples of good practice, links to case studies and policy reviews.

Reviews and Reports – Technology Transfer

- 1. House of Commons Science and Technology Committee 2016-17, "Managing intellectual property and technology transfer", HC 755, published March 2017
- 2. Report by RSM Pacec Ltd. for the Department for Business, Energy and Industrial Strategy (BEIS), "Research into issues around the commercialisation of university IP", published February 2018
- "IP Best Practice in UK-China Technology Transfer" a practical guide by PraxisUnico (now PraxisAuril) with the IPO, British Embassy Beijing and UKTI
- 4. Anderson & Law, "University Spinouts: An imperfect ecosystem". An in-depth look at the way in which private and public funding is affecting the success of UK spinouts, 2018
- 5. Report to the UK higher education sector and HEFCE by the McMillan Group, "University Knowledge Exchange (KE) Framework: good practice in technology transfer", 2016
- HM Treasury, "Getting smart about intellectual property and other intangibles in the public sector: Budget 2018", October 2018

Reviews and Reports – university-business interactions, industry engagement and related areas

- 7. Sir Andrew Witty's Review of Universities and Growth, "Encouraging a British Invention Revolution", October 2013
- 8. Professor Ann Dowling, President of the Royal Academy of Engineering, "The Dowling Review of Business-University Research Collaborations", July 2015
- 9. Sir Richard Lambert, "Lambert Review of Business-University Collaboration", HM Treasury December 2003
- 10. Technopolis, "Assessing the economic returns of engineering research and postgraduate training in the UK", March 2015
- 11. Royal Academy of Engineering, "Increasing R&D investment: business perspectives", 2018
- 12. National Centre for Universities and Business (NCUB), "State of the Relationship Reports (2014-2018)", annual reports summarising university-business collaboration across the UK

Examples and Case Studies

- 13. PraxisAuril Blog, "Approach, Facilities and Complementary Expertise what industry looks for in an academic partner", July 2018
- 14. National Centre for Universities and Business (NCUB), "Success Stories from university-industry partnerships". A series of case studies and examples, illustrating industry engagement



Appendix 1 – Project Steering Group 2018



Professor Dr. Raha Abdul Rahim	Director, Higher Education Excellence Planning Division, Department of Higher Education, Ministry of Education Malaysia
Prabha Sundram	Senior Programme Manager, Education, British Council
Dr. Syamimi Shamsuddin	Senior Principal Assistant Director, Research Management Section, Department of Higher Education, Ministry of Education Malaysia
Siti Fazlina Mohd Sani	Senior Assistant Director, Special Fund and Coordination Section, Institutions of Higher Education Research Excellence Division, Department of Higher Education, Ministry of Education Malaysia
Asyraf Saedon	Programme Manager, Education, British Council
Syauqi Azman	Education and Society Programme Officer, British Council
Dr. Dan King	Consultant on behalf of the British Council, Director, Research Consulting Ltd.

Appendix 2 – Stakeholders Engagement Workshop - Participant List (26-27 November 2018)

Professor Dr. Raha Abdul Rahim	Director, Higher Education Excellence Planning Division, Department of Higher Education, Ministry of Education Malaysia
Siti Fazlina Mohd Sani	Senior Assistant Director, Special Fund and Coordination Section, Institutions of Higher Education Research Excellence Division, Department of Higher Education, Ministry of Education Malaysia.
Dr. Syamimi Shamsuddin	Senior Principal Assistant Director, Research Management Section, Department of Higher Education, Ministry of Education Malaysia
Farahin Fazira Mohd Munim	Assistant Director, R&D Management Unit, Institutions of Higher Education Excellence Planning Division, Department of Higher Education, Ministry of Education
Professor Dr. Samsilah Roslan	Director, Putra Science Park, Universiti Putra Malaysia President, Innovation and Technology Managers Association Malaysia (ITMA)
Professor. Ir. Dr. Sivarao Subramonian	Vice President, Innovation and Technology Managers Association Malaysia (ITMA)
Dr. Zahira Mohd Ishan	Assistant Secretary, Innovation and Technology Managers Association Malaysia (ITMA)
Professor Dr. Khairiah Badri	Exco Member, Innovation and Technology Managers Association Malaysia (ITMA)
Chin Fung Wei	Vice President, Marketing and Industry Development, CREST
Dr. Nor Azmi Alias	Senior Vice President, Research Management, CREST
Dr. Viraj Perera	CEO, PlaTCOM Ventures Sdn Bhd
Lofty Abdul Karim	Vice President, PlaTCOM Ventures Sdn Bhd
Michelle Lim Woodliffe	Assistant Vice President, Technology Commercialisation Specialist, PlaTCOM Ventures Sdn Bhd
Biruntha Mooruthi	Vice President, Commercialisation Specialist, PlaTCOM Ventures Sdn Bhd
Associate Professor Dr. Anthony Ho Siong Hock	Pro Vice Chancellor – Research and Enterprise, Taylor's University
Associate Professor Dr. Edwin Chung Chin Yau	Director, Knowledge Transfer and Commercialisation, Taylor's University
Murali Prasad	Founder, SIZZLESCIENCE
Ahmad Razif Mohamad	Manager, Malaysian Industry-Government Group for High Technology (MIGHT)
Dr. Nor Azlina Arrifin	Secretary, Division of Transfer of Technology and R&D Commercialisation, Ministry of Energy, Science, Technology, Environment & Climate Change
S. Siva Kumar	Deputy Secretary, Division of Transfer of Technology and R&D Commercialisation, Ministry of Energy, Science, Technology, Environment & Climate Change
Nur Sharliza Mohd Rapi'ain	Principal Assistant Secretary, Division of Transfer of Technology and R&D Commercialisation, Ministry of Energy, Science, Technology, Environment & Climate Change



Nor Raiha Che Hasan	Science Officer, Division of Transfer of Technology and R&D Commercialisation, Ministry of Energy, Science, Technology, Environment & Climate Change
Muhamad Baihaqi Ibrahim	Science Officer, Division of Transfer of Technology and R&D Commercialisation, Ministry of Energy, Science, Technology, Environment & Climate Change
Dato' Saiful Anuar Lebai Hussen	Secretary General, Ministry of Economic Affairs
Professor Datuk Dr. Halimaton Hamdan	Council Member, Academy of Sciences Malaysia
Associate Professor Dr. Razamin Ramli	Director, Innovation and Commercialisation Centre, Universiti Utara Malaysia.
Professor Ir. Dr. Fatimah Ibrahim	Deputy Director, UM Centre for Innovation and Commercialisation, University of Malaya
Professor Dr. Rofina Yasmin Dato' Othman	Director, UM Centre for Innovation and Commercialisation, University of Malaya
Professor Dr. Mohd Shahir Shamsir Omar	Director, Innovation and Commercialisation Centre, Universiti Teknologi Malaysia
Dr. Abang Azlan Mohamad	Deputy Director, Innovation and Commercialisation, Universiti Malaysia Sarawak
Associate Professor Dr. Nik Hisyamuddin Muhd Nor	Director, Innovation and Commercialisation Centre, Universiti Tun Hussein Onn Malaysia
Associate Professor Dr. Mustafa Man	Deputy Director, Research Management and Innovation Centre, Universiti Malaysia Terengganu
Professor Dr. Rosni Bakar	Director, Centre for Entrepreneurship Development, Commercialisation & Intellectual Property Management, Universiti Malaysia Perlis
Dr. Zulkifly Mohd Zaki	Deputy Director, Innovation, Product Development & Commercialisation Research Management Centre, Universiti Sains Islam Malaysia
Associate Professor Dr. Azizi Miskon	Director, Research and Innovation Management Centre, Universiti Pertahanan Nasional Malaysia
Dr. Ching Yew Beh	Business Engagement and Innovation Services, University of Nottingham Malaysia
Professor Lynne Jack	Director of Research, Heriot-Watt University Malaysia
Zareena Omar	Interim Registrar/ Head of Academic Services, University of Reading Malaysia
Dr. Olivia Tan Swee Leng	Director, Collaboration & Innovation Centre, Multimedia University
Sarah Deverall	Director Malaysia, British Council
Prabha Sundram	Deputy Director, Education and Society, British Council
Kuek Yen Sim	Senior Programme Manager, Newton Fund and Science, British Council
Asyraf Saedon	Programme Manager, Education, British Council
Syauqi Azman	Education and Society Programme Officer, British Council
Dr. Dan King	Consultant on behalf of the British Council, Director, Research Consulting Ltd.
Dr. George Rice	Head of Commercialisation, University of Nottingham (UK)
Anita Pathma	Head of Research Support Office, University of Nottingham Malaysia

Appendix 3 – Framework for discussions and issues



The following slides were used as the framework for discussions with stakeholders on technology transfer in Malaysia.

The Research I	ase in Malaysia: structure
and funding.	

An overview of the research base in Malaysia and individual universities

Individual skills requirements in researchers, PhDs and support staff: gaps, strengths and weaknesses

Understanding the people skills and experience issue

The wider eco-system for R&D&I

Understanding the wider environment that facilitates successful technology transfer

Technology Transfer

Issues specific to technology transfer and commercialising research

Outcomes from Technology Transfer (and Research) What are the important outcomes?

- Government policy and funding
- An overview of the research base in Malaysia and individual universities
- What are the strategies or priorities that shape the direction of the research base?
- How are these aligned to national and industrial challenges?
- What is the extent of industry / universities network and communications in research?
- The co-creation of research with industry challenges and focus
- Academics and Researchers how extensive are links to industry and end users at the level of the academic or research group?
- What incentivises academics to commercialise their research?
- How is great research communicated to industry?
- How are the training environment for PhD students engaged with industry or end users of research?
- Technology Transfer and Business Engagement Staff do they exist in universities?
- Case studies that others can learn from?
- What is stimulating business demand for R&D&I?
- Can universities access other private sector actors to support TT: investors, patent agents, non-executive directors and legal
- Assets for R&D environments, reserves, populations, industries,
- How is research with commercial potential currently identified and developed?
- How is the potential value of that research identified or evaluated?
- How is it communicated to industry partners who may be interested?
- What are the barriers or factors that delay or prevent this?
- What activities are undertaken? How are they resourced?
- What are the outcomes that are wanted?
- For researchers and the research base
- For industry
- For the Malaysian economy







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Appendix 4 – Stakeholders Engagement Workshop (26-27 November 2018)

Day 1 - Policy

Date 26 November 2018 (Monday) Venue Department of Higher Education, Ministry of Education Malavsia

Objective To define the scope of the policy recommendations, ownership and decision-making process and governance process in technology transfer and research management as well as industry engagement in HEIs.

Invited Participants:

- Ministry of Education Malaysia
- Ministry of Energy, Science, Technology, Environment & Climate Change
 - Division of Transfer of Technology and R&D Commercialisation
 - Academy of Sciences Malaysia
- Ministry of Economic Affairs
- Innovation and Technology Managers Δ Association Malaysia



Day 2 - Universities & Implementing Agencies

Date Venue

27 November 2018 (Tuesdav)

Pullman Putrajaya – Putra Meeting Room 4 & 5 Objective To validate the draft scoping study of the Higher Education Partnerships Programme: Enhancing the sustainability of Technology Transfer and Research Management in Higher Education Institutions through strategic UK-Malaysia University Partnerships, & developing a capacity-building strategy and consequent sustainable implementation plan that make use of techniques such as (but not necessarily limited to) secondments, coaching, mentoring, workshops, courses, training materials, social media and other forms of exchanging and transferring best practice.

Invited Participants:

- Malaysian Public and Private Higher Education Institutions
- 2. Malaysian Industry-Government Group for High Technology (MIGHT)
- 3. PlaTCOM Ventures Sdn Bhd
- 4. Malaysia Innovation Agency
- Malaysia Innovation Foundation
- 6. Malaysia Digital Economy Corporation
- Collaborative Research in Engineering, Science and Technology Centre (CREST)
- 8. Other technology transfer related organisations and institutions

Appendix 5 - Strategic UK -Malaysia Partnerships Workshop - Participant List (14-15 February 2019)

Peter Collier	Intellectual Property and Commercialisation Manager - MICRA Project, Cranfield University
Professor Raymond Lee	Associate Dean (Global Engagement) and Professor of Biomechanics, Faculty of Technology, University of Portsmouth
Dr. Andrew Hamilton	Institute for Sensors, Signals & Communications, Technology and Innovation Centre, University of Strathclyde
Dr. Geraint Lewis	Head of Enterprise Services, Newcastle University
Tasneem Gohir	Head of Knowledge Transfer and Impact, Research Support Office, Royal Veterinary College
Professor Fiona Tomley	Professor of Experimental Parasitology, Department of Pathobiology and Population Sciences, Royal Veterinary College
Dr. Steven Hoo	Assistant Professor, School of Engineering & Physical Sciences, Heriot-Watt University
Dr. Chia Ping Lee	Assistant Professor, School of Engineering & Physical Sciences, Heriot-Watt University
Dr Khalik Mohamad Sabil	Associate Head, School of Energy, Geoscience, Infrastructure & Society, Dr. Khalik Heriot-Watt University
Fawwaz Fauzi	HR Wallingford
Dr. Rhian Hayward	Chief Executive Officer, Aberystwyth Innovation and Enterprise Campus, Aberystwyth University
Maryann Vargis	SEA & SA International Officer, Aberystwyth University
Dr. Brian More	Intellectual Property Commercialisation Director, Coventry University
Dr. Kogila Balakrishnan	Director, Client and Development (East Asia), University of Warwick
Professor Ir. Dr. Fatimah Ibrahim	Director, UM Centre for Innovation & Commercialisation (UMCIC), University of Malaya
Dr. Lee Ching Shya	Industry Liaison Officer, UMCIC, University of Malaya
Dr. Wan Safwani Wan Kamarul Zaman	Coordinator Business & Development, UMCIC, University of Malaya
Abdul Naem Suhaime	Project Officer, UMCIC, University of Malaya
Wan Aminatul Afna Wan Mohamad Rawi	Assistant Registrar, UMCIC, University of Malaya
Professor Dr. Khairiah Badri	Director, Centre for Collaborative Innovation, Universiti Kebangsaan Malaysia
Professor Dr. Sheila Nathan	Lecturer, School of Biosciences & Biotechnology, Universiti Kebangsaan Malaysia
Professor Dr. Samsilah Roslan	Director, Putra Science Park, Universiti Putra Malaysia President, Innovation and Technology Managers Association Malaysia (ITMA)
Associate Professor Dr. Noor Azurati Ahmad @ Salleh	Deputy Director, Innovation and Commercialisation Centre, UTMKL, Universiti Teknologi Malaysia
Dr. Mimi Aminah Wan Nordin	Deputy Director (Innovation and Commercialisation), Research Management Centre, International Islamic University Malaysia
Professor Dr. Nooritawati Md. Tahir	Director, Research Innovation Business Unit, Universiti Teknologi MARA
Professor Dr. Razamin Ramli	Director, Innovation & Commercialisation Centre, Universiti Utara Malaysia
Mohd Azri Md. Nadzir	Social Research Officer, Universiti Utara Malaysia

Associate Professor Dr. Tajul Shuhaizam Said	Director, Research and Innovation Centre, Universiti Pendidikan Sultan Idris
Associate Professor Dr. Homathevi Rahman	Deputy Director (Innovation), Centre for Research and Innovation, Universiti Malaysia Sabah
Associate Professor Dr. Nik Hisyamuddin Muhd Nor	Director, Innovation and Commercialisation Centre, Universiti Tun Hussein Onn Malaysia
Associate Professor Dr. Mustafa Man	Deputy Director, Research Management and Innovation Centre, Universiti Malaysia Terengganu
Professor Ir. Dr. Sivarao Subramonian	Director, Commercialisation Centre, Universiti Teknikal Malaysia Melaka
Mohd Nizam Abdul Rashid	Assistant Registrar, Technology Transfer Office, Department of Research and Innovation, Universiti Malaysia Pahang
Hardyana Mohd Saman	Assistant Registrar, Technology Transfer Office, Department of Research and Innovation, Universiti Malaysia Pahang
Muhammad Izmer Yusuf	Deputy Director, Centre for Entrepreneurship Development, Commercialisation & Intellectual Property Management, Universiti Malaysia Perlis
Dr. Nur Zazarina Ramly	Faculty of Science & Technology, Universiti Sains Islam Malaysia
Dr. Mohd Hafiz Jamaludin	Director, Consultancy, Intellectual Property and Commercialisation Office, Universiti Malaysia Kelantan
Associate Professor Dr. Saiful Bahri Mohamed	Director, Research Management, Innovation and Commercialisation Centre, Universiti Sultan Zainal Abidin
Associate Professor Dr. Azizi Miskon	Director, Research and Innovation Management Centre, Universiti Pertahanan Nasional Malaysia
Dr. Olivia Tan Swee Leng	Director, Collaboration and Innovation Centre, Multimedia University
Muhammad Syazwan Amarjit Abdullah	Senior Director, Technology Transfer Office, Universiti Teknologi Petronas
Associate Professor Dr. Fairuz Abdullah	Head of Intellectual Property and Commercialisation Unit, Universiti Tenaga Nasional
Noor Hanison Mohd Zain	Manager, Intellectual Property and Commercialisation, Universiti Tenaga Nasional
Dr. Marayati Marsadek	Department of Electrical Power Engineering, Universiti Tenaga Nasional
Dr. Goh Hock Guan	Head of Department & Assistant Professor, Department of Computer and Communication Technology, Universiti Tunku Abdul Rahman
Karen Lau	Senior Manager, Sunway Innovation Labs (iLabs), Sunway University
Professor Deborah Hall	Vice-Provost (Research and Knowledge Exchange), Nottingham University Malaysia
Professor Dr. Raha Abdul Rahim	Director, Higher Education Excellence Planning Division, Department of Higher Education, Ministry of Education Malaysia
Dr. Syamimi Shamsuddin	Senior Principal Assistant Director, Research Management Section, Department of Higher Education, Ministry of Education Malaysia
Siti Fazlina Mohd Sania	Assistant Director, R&D Management Unit, Institutions of Higher Education Excellence Planning Division, Department of Higher Education, Ministry of Education Malaysia
Sarah Deverall	Director Malaysia, British Council
Prabha Sundram	Senior Programme Manager, Education, British Council
Kuek Yen Sim	Senior Programme Manager, Newton Fund and Science, British Council
Asyraf Saedon	Programme Manager, Education, British Council
Rowena Lim	Education and Society Programme Manager, British Council
Syauqi Azman	Education and Society Programme Officer, British Council
Dr. Dan King	Consultant on behalf of the British Council, Director, Research Consulting Ltd.
Dr. George Rice	Head of Commercialisation, University of Nottingham (UK)

Appendix 6 – Strategic UK -Malaysia Partnerships Workshop (14-15 February 2019)



Day 1 Agenda

- **9:20** Scene Setting: UK-Malaysia Partnerships Programme for Sustainability of Technology Transfer
- 9:30 Technology Transfer: Malaysian Perspectives
- **10:15** Exploring gaps, challenges and opportunities in technology transfer
- 10:30 The Call: introduction to the 10 UK universities
- 14:00 Case studies in Technology Transfer
- 16:30 Day 1 wrap-up and Overview of Day 2 sessions and approach

Day 2 Agenda

Identify Partners Session
Funding opportunities
Parallel Session: building the partnerships
Presentation: sharing of outcomes with wider groups
Summary and close





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Appendix 7 – Technology Transfer in Malaysia

Background – changes to higher education in Malaysia

Malaysia Education Blueprint 2015-2025

The Blueprint sets out Malaysia's aspiration to make innovation a major driver of national economic growth. It noted that whilst research output is improving, for example in the volume of publications and international ranking of universities, other areas such as the number of patents and engagement levels with industry and community, are still not as intensive or widespread as desired.

Developing the innovation ecosystem

Following the Blueprint, the Ministry of Education Malaysia facilitated the development of innovation ecosystems in selected strategic areas that are critical to the nation's economic growth. These ecosystems support both university-driven and demand-driven research, development, and commercialisation models, with significant improvements on a wide range of research measures.

Figure 2: Visualisation of the innovation ecosystem [source: Malaysia Education Blueprint 2015-2025 (Higher Education)]



One of the main challenges cited is the lack of connectivity between industry and academia

There is an identified need for Malaysian universities to play a bigger role in supporting innovation and commercialisation, i.e. to venture beyond the traditional functions of teaching, research and publication to intensify their role as a solution provider for other stakeholders, and as a developer of skilled research talent and a driver of commercialisation. However, there are many national and operational obstacles that impede the progression of research and development to commercialisation and entrepreneurship.

Malaysia does not yet have a national science, technology and innovation policy in place¹, and the coordination of funding, policy and actions to realise the economic benefits from research, development and innovation sits across a number of ministries^m. As a result, it is reported that the direct impact of science, technology and innovation to economic growth in Malaysia has not been well translated.¹

A number of initiatives have been instigated including the establishment of five research universities, and actions focused on technology transfer, to address this.

The Ministry of Education: a crucial role in leading innovation ecosystem

The Ministry of Education was identified in the Blueprint as having a crucial role in facilitating the development of innovation ecosystems featuring university-driven and (importantly) demand-driven research (Figure 2).

The Ministry of Education is the largest funding agency in the innovation landscape, accounting for 42% of the RM881 million budget in 2013ⁿ (but notably covering the entire value chain from 'pre-R&D, R&D to pre-commercialisation'). The Ministry of Science, Technology and Innovation (MOSTI), at 36%, was the second most significant funding agency. It should be noted that the functions of MOSTI are now undertaken by the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC).

- ^m 14 relevant ministries are cited in the Blueprint, 23 in Science Outlook 2017
- ⁿ Equivalent to about £167 million
- **29 Higher Education Partnerships Programme:** Enhancing the sustainability of technology transfer and research management in higher education institutions through strategic UK Malaysia university partnerships

Academy of Sciences Malaysia, "Science Outlook", 2017



Building industry demand for R&D

A focus on industry demand for R&D is important. The proportion of R&D funded by the government in Malaysia has been high, with 41% of the gross domestic expenditure on R&D financed by eight government Ministries in 2013.^a

The Science Outlook 2015° reported that industry participation alongside Institutions of Higher Learning (IHLs) was low, as reflected in Malaysia's low business sector R&D expenditure per GDP at 0.7% in 2012 (compared to 1.4% in Singapore, 2.3% in Taiwan and 3.1% in South Korea).

The majority of Malaysia's researchers are found in universities, in contrast to the high performing economies whose researchers are mostly in Business Enterprises.

Science Outlook 2017, Academy of Sciences Malaysia

Malaysia is ranked 26th in the Universitas 21 2018 ranking

The Universitas 21 2018 ranking of national HE^p systems, ranked Malaysia 26th out of the 50 national HE systems examined.

PhD completions per 100k population were about one quarter of those in the UK, but comparable to Japan and above other ASEAN nations.

'Innovation capability' is Malaysia's weakest pillar

The World Economic Forum's 2018 Global Competitiveness Report suggests that the challenge for Malaysia in innovation remains, despite positive progress in other areas of competitiveness^q.

Malaysia ranks 25th overall on this index, but of the 12 indicators, *'innovation capability'* is the weakest in performance terms and is only on par with the wider East Asia and Pacific Average (whereas other indicators for Malaysia exceed this benchmark). However, the report notes that in 77 of the 140 economies studied, *'innovation capability'* is the weakest pillar, indicating that this is a challenging area to improve. By comparison, the UK ranks 8th, with *'innovation capability'* scoring 79/100.

The Ministry (of Education) will also work collaboratively with other agencies and higher learning institutions (HLIs) to create a supportive environment for both university-driven and demand-driven research.

Malaysia Education Blueprint 2015-2025 (Higher Education)

Innovation and technology transfer

Development of technology transfer offices in Malaysian universities

Most Malaysian HEIs have established a TTO to contribute to the commercialisation process of knowledge generated by the universities and to catalyse industry involvement, with the scope of these activities extending from patenting and licensing to collaborative research and company creation.

A main challenge is the lack of connectivity between industry and academia

There is, however, a capacity gap within the TTOs, and possibly the wider governance structures in Malaysian HEIs that may impede the operations and roles of the TTOs, and subsequently the sustainability of technology transfer within Malaysian HEIs.

This may be due to several factors, both internal and external, including but not limited to the management of the offices, legal environment, degree of institutional autonomy, communication and government support for technology transfer.

One of the main challenges cited is the lack of connectivity between industry and academia, which will influence the ability of these TTOs to deliver outcomes.

- Academy of Sciences Malaysia, "Science Outlook", 2015
- Universitas 21 Ranking of National HE Systems, May 2018
- Klaus Schwab, World Economic Forum, "The Global Competitiveness Report", 2018. ISBN-13: 978-92-95044-76-0





Emerging incentives

Initiatives emerging from the Blueprint include incentivising HEIs to establish supporting systems for the commercialisation of ideas, such as technology transfer offices, mechanisms for the co-utilisation of infrastructure, enhanced data monitoring systems, and talent development programmes.

Funding for technology transfer and innovation

MESTECC and grants for R&D & Innovation activity

A number of grant schemes explicitly support business and university-led innovation, including:

- Smart Fund up to RM1,000,000 for applied R&D in strategic priorities, supporting TRL4 R&D for business or social benefit.
- Enterprise Innovation Fund aims to increase the participation of SMEs or individuals in technological innovation of new or existing products, processes or services. Funding is up to RM500,000.
- Facilitation Fund a fund addressing the funding gap between R&D and commercialisation ('valley of death'), up to RM500,000.

A further fund - International Collaboration Fund - is for cooperation in science, technology and innovation in joint R&D activities in five priority technology areas. The fund provides up to RM500,000 for 24 months. This fund may be a viable pathway for emerging partnerships to explore.



Appendix 8 – Technology Transfer in the UK

The development of Technology Transfer in the UK

UK Technology Transfer Offices have evolved since the mid-1980s

Technology transfer in the UK has matured considerably in the last decade, and on many measures, it is one of the best performing globally. The technology transfer offices and ecosystems have evolved considerably since the 1980s.

There are valuable lessons for the development of Malaysian technology transfer and industry engagement, during this period of its development. However, it is important to note that models that are currently successful for the UK may not be the most suited to implementation in Malaysia's research system.

UK universities have been in a position to commercialise their own intellectual property for around 30 years, leading to an often-quoted statement that the UK is approximately 10 years behind the maturity of the US Technology Transfer system. Most of the UK Technology Transfer offices, mainly in research intensive universities, were initially created in the 1990s.

Although UK TTOs are relatively mature, it remains the case that perceived mismatches between research and innovation performance exist^r. These drive periodic reviews of technology transfer and benchmarking between countries, typically the US, UK and Japan (BEIS/PACEC, 2018).

Before TTOs: centralised commercialisation of publicly-funded R&D

Before the mid-1980s, the commercialisation of research from universities and other government organisations, was centralised and managed by the British Technology Group (BTG).

BTG was, for example, responsible for the licensing of the technology around magnetic resonance imaging (MRI), a type of scan that uses strong magnetic fields and radio waves to produce detailed images of the insides of the body. This included intellectual property from the University of Nottingham's Nobel Laureate, Professor Sir Peter Mansfield. The intellectual property was bundled with other inventions by BTG to form the package of intellectual property that underpinned the commercial success of this technology.

Whilst the UK has now moved from a fully-centralised approach to a fully devolved approach, this may not be right for other countries and innovation ecosystems.

In the UK, universities with less research typically do not have TTO support. A mixed model, where some centralised provision is retained to assist those for whom an experienced technology transfer team is not viable, may offer advantages.

There are advantages and disadvantages to each approach:

- Centralised models allow the development of experienced teams and a strong deal flow, and an ability to maintain key relationships with industry and investors. But there is significant difficulty in reaching out to encourage disclosures from the many individual academics and researchers in universities.
- Devolved models are located close to those undertaking the research and developing the intellectual property, greatly assisting in the identification and disclosure of intellectual property. But unless the research and intellectual property flow are significant, developing an experienced and well-connected TTO to ensure successful commercialisation, is very difficult.

r NCUB Blog, "Making sense of data and politics on research impact", November 2018





The emergence of Technology Transfer Offices in universities

The major catalyst for change in university management of technology transfer came in 1985, when the UK government announced that BTG would no longer have the exclusive right to commercialise inventions from university research and resulting from Research Council funding^s. Through the late 1980s and 1990s, the more research-intensive UK universities developed technology transfer functions that have continued to mature, develop and evolve.

Imperial Innovations Ltd., one of the first university TTOs founded in 1986, now has a team of 26 people and is the technology commercialisation partner for Imperial College London whose annual research grant and contract income is £360 million. In other institutions, the technology transfer function is a team within the university's wider research and knowledge exchange support, e.g. University of Sheffield.

Technology transfer is one of the primary mechanisms for the commercialisation of research outcomes, and focus on leveraging value from patents and other forms of Intellectual Property through **licence deals** and the creation of venture capital-backed **spin-out companies**.

The UK's approach to technology transfer is one that has evolved significantly over time. Approaches, resources, funding and the policy environment have all contributed to this evolution. It is not perfect, but on most measures it is now one of the most successful globally.

There is a clear alignment between the volume of research activity undertaken and the volume of output or KPIs associated with technology transfer

Within the UK, there are over 160 universities, and it should be noted that many of these do not have established technology transfer offices. There is a clear alignment between the volume of research activity undertaken and the volume of output or KPIs associated with technology transfer (McMillan, 2016). Full function TTOs tend only to be found where annual research incomes exceed £20-£30 million, and would include:

- Specialist intellectual property and legal expertise;
- Resources to identify and nurture research outcomes with commercial opportunity;
- Commercial development expertise, networked with investors, partner organisations and research users;
- Access to, or management of, internal funding (on a grant basis) to support initial commercial development work (e.g. proof of concept, business case development); and/or
- Access to, or management of, institutional investment funding, to invest and subsequently co-invest with downstream investors in spin-out companies.

Professional status of technology transfer officers

Within the UK, the role of the technology transfer professional is now well established, as is the understanding of the wider network of professionals with whom technology transfer officers routinely engage, i.e. patent agents, lawyers, investors etc.

PraxisAuril supports networking between technology transfer officers as well as within this wider network. PraxisAuril is a founding member of the Alliance of Technology Transfer Professionals which has spearheaded international professional recognition for knowledge exchange practitioners - Recognised Technology Transfer Professional (RTTP). ATTP alliance associations exist in Japan, the US, South Africa, Europe and Australasia. From May 2019, ITMA became an Alliance Association of ATTP.

There are currently over 450 individuals listed as RTTPs, with few in Asia outside of Japan, Singapore and China.

S Anderson & Law for PraxisAuril, "University Spin-outs: an imperfect system", 2018



Case Study: University of Birmingham and Viatem

The University of Birmingham Enterprise announced the formation of a new spin-out company, Viatem Ltd., to develop and exploit the therapeutic potential of PEPITEM (Peptide Inhibitor of Trans-Endothelial Migration). The announcement coincided with the presentation of new research showing that synthetic PEPITEM can prevent or delay the onset of rheumatoid arthritis in animal models of the disease and restore the regulation of white blood cell migration in human tissues.

Dr. James Wilkie, CEO of University of Birmingham Enterprise, commented: 'Despite substantial innovation over the last few decades, there are still significant unmet needs in rheumatoid arthritis treatment. We are delighted to be commercialising this novel therapeutic target which is supported by a robust and increasing body of evidence.' The university has licensed the technology to the newly formed spin-out company Viatem Ltd. The university is a shareholder in the company which has received funding from Innovate UK, West Midlands Academic Health Science Network and University of Birmingham's Enterprising Birmingham Fund. Viatem is located in the BioHub Birmingham®, the university's bio-incubator based in the Birmingham Research Park.

Institutions with smaller research volumes (~£5-£10 million per annum), may have *individuals* responsible for technology transfer, who work with in-house legal, finance and industry engagement teams to bring additional expertise. But for UK universities with lower levels of research income or whose research is predominantly in arts or social sciences, providing experienced in-house support for technology transfer is typically not possible or justified by the likely deal flow.

Creating structures suitable for smaller institutions to undertake effective technology transfer was an issue discussed in the evidence given to the House of Commons Science and Technology Committee in 2017^t.

Student-led enterprise

It should be noted that many institutions which have smaller research incomes, often have strong *student* enterprise activities and support infrastructure (i.e. assisting undergraduate or recent graduates to start businesses). For example, the University of Derby is a teaching intensive UK university with 200 research active academic staff, 320 PhD students and a research income of £3 million per annum⁴. Whilst it has negligible technology transfer activity (measured in patents, income from intellectual property or spin-out companies), it prioritises *student enterprise* and creates around 100 businesses a year⁴.

Such universities make significant contributions to the innovation and start-up ecosystem outside the usual parameters defining technology transfer.



- t House of Commons Science and Technology Committee, Tenth Report of Session 2016-17, "Managing intellectual property and technology transfer", 2017
- u University of Derby, "Annual Accounts 2017"
- Based on the HESA's HE-BCIS returns for newly registered companies in the period 2014-15 to 2016-17.
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Technology Transfer Offices in the UK

Maturity of TTOs in the UK and access to seed funding

Technology transfer within the UK operates within a well-developed environment, where experienced individuals operate in mature structures for governance and operations. These in turn are underpinned by (relatively) stable funding streams.

Full function TTOs, tend only to be found in research intensive universities, would typically constitute the following expertise and functions:

- Legal and patent process advice and competence, coupled with an understanding of the commercial context for agreements;
- Technical understanding of the patenting process and commercial value;
- Ability to understand and investigate intellectual property emerging from research in terms of market value and commercial propositions;
- Financial capability to manage income flows in and out; and
- Networking and business development capacity to work with investors, patent agents, industry partners, legal advisors and non-executive directors.

Such TTOs may be established as external vehicles (e.g. Imperial Innovations or Warwick Ventures) or embedded within the Research and Knowledge Exchange teams of the university. Neither approach currently dominates.

One of the important enabling tools for TTOs is access to small scale grant funding - £3,000 to £15,000 - to enable projects and opportunities to be progressed quickly. Such funds are routinely deployed by universities and may be sourced from a number of areas, including the Higher Education Innovation Fund (HEIF) and individual Research Councils (as Impact Acceleration Accounts).

The 2016 McMillan review (University Knowledge Exchange Framework)

Technology Transfer metrics, compared across the UK and US, illustrated that the number of patents created per unit of research income was similar. In this context, the existence of a patent represents a research outcome that is both patentable and might have some commercial value. Technology Transfer Offices work with researchers to build commercial plans around these established patent positions, with both the UK and US using the same principles in identifying routes to market for the intellectual property that take into account technology maturity, current market dynamics, investment availability alongside personal motivations and aspirations of the individual researchers involved.

When creating spin-outs, UK TTOs frequently lead on, or facilitate, a number of points of negotiation:

- Investment by the university into the spin-out as an initial investor, and following that with investment in subsequent investment rounds;
- The arrangements through which the academic contributes time to the development of the company whilst balancing duties within the university, sometimes facilitated through consultancy agreements; and
- The split of future revenues or income from the sale of shares in the company between the university, department and individual academic (personal).

These are complex issues and difficult to negotiate. They must also work around wider regulations on university governance, legal and commercial considerations.



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A Technology Transfer profile of a typical research intensive UK university

A 'typical' research-intensive UK university such as one of the Russell Group members, may have the following profile (Figure 3) in terms of technology transfer.

What this illustrates is the relative scale of difference between the inputs (research income and staff) set against what might be expected as outcomes from technology transfer.

Figure 3: Technology transfer metrics for a 'typical' research intensive UK university

A typical intensive UK university in numbers		
£100m	Research income from grants and contracts	
2,000	Research active staff (academic and researchers)	
120+	New inventions per year	
20+	New patents per year	
15	License patents per year	
>1 to 5	New companies per year	

Collaborations and networking in Technology Transfer

There have been to date relatively limited levels of collaboration between universities

Despite recognition in policy reviews on the issues for universities in managing technology transfer (e.g. Lambert 2003^w, McMillan 2016, House of Commons Science & Technology Committee 2017), there have been to date relatively limited levels of collaboration between universities in terms of shared services or shared approaches for supporting technology transfer. Universities with smaller research incomes have tended to use private sector consultancy support for specific technology transfer opportunities if/when they arise.

More common are project-level collaborations, where aspects of technology transfer are supported through a joint project, most commonly these involve the provision of grant or investment funding. The notable ones are:

- The 1999/2004 University Challenge Seed Funds (UCSF): £60 million investment funding for technology transfer in research intensive universities, creating university-linked seed investment funds; and
- The 2017 £100 million Connecting Capability Fund, which sought to create collaborations for research commercialisation and technology transfer.

University Challenge Seed Funds – locallymanaged investment funds for university intellectual property

In 1999, the UK Government [via what was then the Office for Science and Technology (OST)] launched a scheme to provide the leading research universities with access to seed funding for investment into technologies that could develop into strong commercial propositions. A total £60 million was made available over the period 1999-2004, supporting 20 seed funds. With only two exceptions (Imperial and Oxford), they were all collaborative with between two and six universities. A number of these were awarded on a collaborative basis, and were subsequently increased through access to other funding programmes. Typically they had the following characteristics:

- Collaborative between four and five universities, with a combined research income of ~£100 million;
- An initial funding award of ~£4-5 million, with 20% contributed by the universities;
- An advisory board comprising independent individuals with strong credentials and experience in early stage technology development;

 Sir Richard Lambert, "Lambert Review of Business-University Collaboration", HM Treasury, 2003





- A professional, FSA-regulated Fund Manager, was often appointed to make investment decisions.
 Typically, these were venture capital companies who also manage later stage funds; and
- Investment from the fund into projects ranged from £15,000 to £250,000.

In 2005, the UCSF was reviewed by SQW Ltd., as part of a wider review of government support for knowledge transfer^x.

By 2003, 59 spin-outs had been reported, building on 134 patent applications. Aside from the directly supported spin-outs and technologies, the original scheme had a number of legacies and benefits, including better TTO-investor relationships and TTO understanding of the investment landscape from the perspective of investors. Several TTOs were able to augment the initial funding to sustain the flow of investment funding.

Research England launches the Connecting Capability Fund seeking to improve collaboration in research commercialisation

Following the McMillan Review in 2016, Research England (formerly the Higher Education Funding Council for England or HEFCE) launched a £100 million competition to support greater collaboration in research commercialisation – the Connecting Capability Fund (CCF).

In April 2018, Research England announced £67 million in 14 collaborative projects between universities and with other partners to drive forward world-class university commercialisation. The collaborative projects funded from this programme have recently started, and include projects that are regional and national collaborations, and sector-based approaches:

- MICRA, a collaboration of the eight most researchintensive universities in the Midlands, supporting the development of the largest UK formal technology transfer office collaboration to increase impact, through the Midlands Innovation alliance led by University of Birmingham
- Technology networks in the space sector, led by University of Leicester

- Building the bio-economy sector across Yorkshire, Humberside and Teesside through a collaboration led by University of York
- Drawing on the strengths of London's specialist HE institutes in a project led by the Royal Veterinary College, to counter infectious diseases and resistance to antimicrobials through portable devices.

It is too soon to assess the impact of these projects on successful research commercialisation, and how collaboration contributes to impact. As a significant investment, the scheme will undoubtedly be reviewed by Research England in due course.

The new (CCF) projects show the extraordinary potential of universities to deliver not only national but regional and local value. Universities are unique in having the reach to support technological and commercial development right across the UK's industrial base. They are also deeply embedded in their local economies and communities, but with international networks to draw in talent, partners and investment.

The Connecting Capability Fund is a great showcase of how higher education can change the prospects of communities and places.

Professor Trevor McMillan, Vice-Chancellor of Keele University, and Chair of the CCF steering group

SQW Ltd. for the Office of Science and Technology, "Interim evaluation of knowledge transfer programmes funded by the Office of Science and Technology through the Science Budget", 2005



Case Study: The Set Squared partnership

The Set Squared partnership is notable within the UK as being a sustained, multi-faceted collaboration. It regularly features as a case study in policy reviews. It was catalysed from the award of seed funding in 2001 under the UCSF, and developed into a wider collaborative platform that has been sustained. In this regard, it is notable in the UK and an interesting model for technology transfer collaborations. It is a collaboration between the five leading research-led UK universities of Bath, Bristol, Exeter, Southampton and Surrey.

It now runs a varied programme supporting entrepreneurs, scale up, research collaboration and investor engagement. Since 2002, it reports that it has helped secure over £1.5 billion in investment, with SET Squared-supported start-ups in the south of England raising £218 million in 2017. A number of case studies exemplify their work.

Case Study: iCURe - Innovation to commercialisation of university research

Innovation to commercialisation of university research (ICURe) is a new UK collaborative programme piloted by Innovate UK for technology transfer in the UK. The approach is scalable and has transferable features for Malaysia.

The initial pilot by the Set Squared partnership (involving four universities), has expanded to two other collaborative pilots led by the University of Warwick and Queens University Belfast.

- I thought I knew my target market for my technology. But this programme has helped our team gain real feedback from potential customers and is dramatically changing the way we view our approach to research commercialisation.
- SET Squared ICURe Pilot Programme participant

ICURe is a programme of commercialisation support for teams of academic researchers wishing to explore the commercial potential of their research. It aims to improve commercial awareness amongst academic personnel, to develop and enhance the entrepreneurial skills of early career researchers, and to strengthen links between academic and industrial communities. ICURe ensures that the academic community is primed for the demands of research translation and as such, contributes to bridging the gaps between research, innovation and commercialisation.

ICURe focuses on training early career researchers to find the right route to commercialisation, and will help them to develop the necessary business skills, connections and expertise to pursue their ideas. A key step in the programme is for the Early Career Researcher 'Entrepreneurial Lead' to spend approximately three months intensively testing the business model by having meaningful conversations with at least 100 prospective customers, regulators, suppliers, partners and competitors to validate the commercial potential of their research.





Professional development and networking, strongly supported by PraxisAuril (the UK's equivalent of ITMA)

Although shared services are very uncommon in the UK outside of certain projects, there is however, significant networking and support for individuals involved in technology transfer. This is principally via PraxisAuril, which offers a growing suite of training programmes including the fundamentals of technology transfer, licensing, new venture creation, managing university consultancy business and software commercialisation.

Following a number of mergers of UK networking and professional organisations, PraxisAuril now represents a community of 173 member organisations and 5,000 knowledge exchange professionals.

Surveys of this community have been undertaken by Research Consulting for PraxisAuril,^y and illustrate the contemporary issues facing professionals in this area within the UK.

Notable findings include the changing skills set required, with greater emphasis on partnership building and relationship management with external organisations. Responses to this survey came from individuals with a range of experience in the field, with over half having had more than six years of experience in the field.

The relative experience levels of UK and Malaysian technology transfer officers is worth examination. Experience in technology transfer takes time to build, and the profile of the technology transfer experience of Malaysian professionals may be examined as a proxy measure of maturity.

UK universities have put in place intellectual property (IP) frameworks and have available good practice materials and a strong community of practices with international links in PraxisAuril. This is an environment which supports continuous improvement of standards of practice. International standards and recognition for technology transfer professionals

In addition, PraxisAuril is a founding member of the Alliance of Technology Transfer Professionals (ATTP), and champions individual members to seek and acquire the Registered Technology Transfer Professional (RTTP) status.

RTTP is the International Standard for the Professional Competence & Experience of Knowledge Exchange and Technology Transfer practitioners working in universities, industry and government labs based on a track record of real world achievement.

There are now over 400 members worldwide, including the UK (45), Thailand (3) and Singapore (12).

The emergence of university-investor partnership deals

From around 2002, private sector investors have begun to see commercial value in deals undertaken directly with leading research intensive universities. They provide access to investment funds and their expertise in return for preferential access and a stake in the emerging intellectual property.

Key actors include the companies IP2IPO and IP Group.

IP2IPO's deal with Oxford University's Chemistry Department was one of the first of its type in the UK. Subsequent deals were concluded with Southampton University (2002), King's College London (2003) and York University (2006).

The IP Group has links to ~33 universities in the US, UK and Australasia, including 18 UK universities, including Nottingham, Southampton and Oxford.

McMillan Review 2016

^y Research Consulting for PraxisAuril, "The State of the Knowledge Exchange and Commercialisation Profession", 2017.



The UK policy landscape for technology transfer

There has been sustained, and largely consistent, policy support for research commercialisation in the UK since before 2000.

In economic terms, this has been set within the wider perspective of the contribution to *innovation* and, latterly, business *productivity*. Both are core to the UK Government's Industrial Strategy.

A focus of multiple government reviews since 2000 has been the development of an effective interface between industry and academia, within which technology transfer plays an important contributory element.

This has led to the creation of sustained funding streams which have acted as critical enablers for technology transfer and wider industry engagement.

Lambert's 2003 review of business-university interactions was particularly significant in shaping subsequent actions and policy in this area. Importantly, it noted the challenges for both the universities and UK industry, a scenario shared with Malaysia's own assessments of current strengths and weaknesses.

The biggest challenge identified in this Review lies on the demand side. Compared with other countries, British business is not research intensive, and its record of investment in R&D in recent years has been unimpressive. UK business research is concentrated in a narrow range of industrial sectors, and in a small number of large companies.

Richard Lambert, Lambert Review of Business-University Collaboration, 2003

In 2015, Professor Ann Dowling led a government review of business-university research collaborations. The review's recommendations were broad and included specific references to the development of academics' connections with industry at the earliest stages of their career, including PhD study. PhD student engagement with industry (and hence exposure to innovation) now receives significant encouragement and incentives. It is built into strategies and operations at university and funding agency levels, through a variety of mechanisms including short-term placements and schemes such as the Industrial CASE scheme – which encourages companies to co-fund a PhD project based on an R&D challenge relevant to their needs.

Strong, trusting relationships between people in business and academia form the foundation for successful collaboration. These relationships require mutual understanding and a common vision for the benefits that can be derived from the collaboration.

Dowling Review, 2015

Figure 4: Key success factors in university-business interactions (Source: Dowling Review, 2015)

Rank	Key success factor
1	Strong and trusting personal relationships
2	Shared vision, goals and objectives defined, setting in place clear expectations
3	Mutual understanding between partners
4	Ability of - and oppotunities for - staff to work across institutional boundaries
5	Collaboration brings about mutual benefits
6	Funding available
7	Processes for agreeing contracts and IP are in place
8	Clear and effective communication between partners
9	Organisational support, including senior management buy-in and championing
10	Willingness to devote time and resources from both parties





Through dialogues with academics, business and others, Dowling identified the key success factors for business-university collaborations (Figure 4). Whilst funding was noted to be important, the development of personal relationships, shared understanding and the willingness to devote time and resources emerged as significant elements.

In 2016, the McMillan Review reported on an examination of Technology Transfer in the UK, as part of a wider examination of knowledge exchange.^z Importantly, the review recognised that whilst the UK was operating at world class standards in technology transfer, universities, technologies and places vary. The review recognised two important aspects of technology transfer in the UK:

- 1. That "universities that do more research do more technology transfers", and
- 2. That "effective technology transfer usually incurs a net cost for universities".
- Senior university leadership is essential for good technology transfer, in part because the governance of technology transfer raises challenges.

McMillan Review 2016

Other reviews and evidence include the Wilson Review of business-university collaboration (2012)^{aa}, and Witty Review of Universities and Growth (2013).

These many reviews consistently stress the importance of the relatively small but flexible Higher Education Innovation Fund (HEIF) as a key enabler for universities to effectively realise their strategies for knowledge exchange, technology transfer and industry engagement.

HEIF is a predictable and stable funding stream into universities for knowledge exchange. In gross terms, it is not a large funding stream – it represents a small percentage of all science and R&D funding from the UK Trade & Investment department (UKTI). Allocations to universities from HEIF are made on a performance basis, whereby performance in a range of Knowledge Exchange metrics determines the funding. Leading universities receive ~£3 million per annum from HEIF, typically investing the funds into:



- knowledge exchange staff, supplementing the university's own funds for teams in this area.
- internal schemes to support ongoing or new initiatives for industry engagement and knowledge exchange.
 Small grant schemes to seed projects are common.

Institutions set out their strategy for investing the HEIF funds, with the last strategies submitted in 2016. The value of HEIF has been consistently demonstrated in reviews of business-university interaction, and the government has recognised this with increases to the budget. In 2018/19, the budget is £210 million.

Other reviews have looked more widely at the opportunity for better exploitation of intangible assets in the public sector. The review commissioned by HM Treasury in 2018^{bb} identified five key barriers to realising the full value of knowledge assets (KA) in the public sector:

- Identification of KA assets;
- Insight to develop, protect and exploit their KAs;
- Infrastructure for support/management of KAs;
- Incentives for organisations and individuals; and
- Investment organisational budget systems enabling the investment needed to generate value from these KAs.

Given the challenges identified by stakeholders in Malaysia, lessons from the implementation and development of HEIF in the UK may have particular value for the development of technology transfer and knowledge exchange in Malaysia.

HEFCE (now Research England under the Knowledge Exchange Framework), "Good Practice in Technology Transfer", 2016

- ^{aa} Department for Business, Innovation & Skills, "Business-university collaboration: the Wilson review", 2012
- ^{bb} "Getting smart about intellectual property and other intangibles in the public sector", HM Treasury, 2018
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Policy and metrics: incentives and reward for technology transfer

UK-wide metrics relating to technology transfer, set within a wider framework of understanding university knowledge exchange performance, were introduced in 1999 (initially on a voluntary basis). The returns, now managed by the Higher Education Statistics Agency (HESA) as the Higher Education - Business and Community Interaction Survey (HE-BCIS), form a national dataset covering a range of performance measures including:

- research funded directly by industry or other partners;
- the formation of spin-out companies and student businesses (turnover, employees, investment);
- technology licences;
- income resulting from intellectual property-led commercialisation; and
- consultancy and training services delivered to organisations as commercial work.

From ~2008, the returned HE-BCIS metrics were used to allocate funding to universities for knowledge exchange capacity (under HEIF) – performance in the financial elements of HE-BCIS determined the level of funding to that university.

The Research Excellence Framework

The Research Excellence Framework (REF) is a further policy change that had a positive impact on the perceived importance of technology transfer. REF is a major resource allocation process that assesses the quality of research in UK HEIs and subsequently uses the outcome to determine funding into universities via Research England. In 2014, part of the assessment process, and 20% of subsequent funding, was allocated based on evidence of 'impact' realised from research. Research England "quality-related research (QR)" funding, where allocation is influenced by REF, totals £1.4 billion for 2019-20. A second REF exercise is planned for 2021.

The UK funding landscape relevant to Technology Transfer

In comparing support and systems for technology transfer, the relative scale and focus of underpinning *research* funding should be considered, as broadly speaking, the levels of technology transfer are a factor of overall research funding (McMillan, 2016).

UK Research and Innovation, the umbrella organisation for the funding agencies that are the primary public funding for universities in the UK, has an annual budget of ± 6.5 billion.

UK Research and Innovation brings together the seven Research Councils, Innovate UK and Research England (the latter formed in 2018 from a predecessor HEFCE). From this, ~3,900 research and business grants are allocated each year, funding 151 universities.

Figure 5: An overview of the UK's Research and Innovation investment (source: UKRI)



UK Research and Innovation 2018/19 allocation, by council



For technology transfer, the most relevant parts of this funding environment are:

- Research England, for HEIF and initiatives such as the Connecting Capability Fund; and developing knowledge exchange frameworks.
- The three Research Councils covering science, engineering and medicine (EPSRC, BBSRC, MRC), accounting for over £2 billion in research funding, often in collaboration with business.
- Innovate UK, whose budget has grown significantly in recent years. Innovate UK works with people, companies and partner organisations to find and drive the science and technology innovations that will grow the UK economy, working with companies to de-risk, enable and support innovation.

Within this wider landscape, the funding developments and interventions that have allowed the UK's technology transfer to develop include:

Name	What / when
Higher Education Innovation Fund (Research England)	A sustained funding stream that supports staff for knowledge exchange and technology transfers. It has been in existence since 1999, and since 2008, it has operated on a stable performance-based algorithm allocation (prior to this, it was allocated competitively). In 2018-19, the HEIF budget is £210 million and is worth ~£3 million p.a. for the ~25 HEIs receiving the highest levels of support.
Impact Acceleration Accounts (IAAs): [Engineering and Physical Sciences Research Council (EPSRC); Biotechnology and Biological Sciences Research Council (BBSRC); Economic & Social Research Council (ESRC)]	 Devolved funding from the Research Councils (individual RCs have their own schemes) to support research commercialisation and impact projects in the most research active universities for that Research Council. EPSRC currently funds 33 IAAs across the UK, with a total investment since 2012 of more than £150 million. BBSRC has funded 14 organisations with a three-year IAA award from April 2018, totalling £4.5 million.
Medical Research Council Translational Funding	 The Medical Research Council (MRC) operates a number of translational funding schemes which seek to devolve funding into universities to support technology transfer and related activity. These include: 'Confidence in Concept' (provides responsive and flexible funding to support preliminary work aimed at assembling the data to support an application for a translational project grant) 'Proximity to Discovery' (an industry engagement fund) Developmental Pathway Funding Scheme (DPFS) supports academically-led projects whose goals are to improve prevention, diagnosis, prognosis, or treatment of significant health needs, or that focus on developing research tools that increase the efficiency of developing interventions. Projects supported by the scheme have up to four clearly defined milestones, outcomes and future plans
Innovate UK	The creation of the Technology Strategy Board, which later became Innovate UK, was a significant milestone in the UK's R&D&I ecosystem. It is an additional agency supporting business-led R&D through funding for R&D projects and networking. Funding from Innovate UK plays a key role in supporting the commercial development of technologies being licensed or spun out of universities. The 2018/19 budget is ~£800 million.

About the British Council

The British Council is the UK's international organisation for cultural relations and educational opportunities. We work with over 100 countries in the fields of arts and culture, English language, education and civil society. Last year we reached over 80 million people directly and 791 million people overall including online, broadcasts and publications. We make a positive contribution to the countries we work with – changing lives by creating opportunities, building connections and engendering trust. Founded in 1934 we are a UK charity governed by Royal Charter and a UK public body. We receive 15 per cent core funding grant from the UK government. www.britishcouncil.org

The British Council has been working with Malaysia since 1948.

About the Department of Higher Education, Ministry of Higher Education Malaysia

MoHE is one of the Ministry of Malaysia whose integral role is to increase student's achievement through an efficient education system that includes creating a higher education ecosystem. The Department of Higher Education (DOHE) is a department under the Ministry of Higher Education (MoHE) overseeing higher education matters in Malaysia. Higher education institutions under the purview of DOHE are Public Universities (UA) and Private Higher Educational Institutions (PHEIS). These institutions are the main components in the national education ecosystem and training to generate first-rate thinkers, scholars, masters, skilled and semi-skilled manpower in accordance with their respective roles. DOHE is the key department responsible in developing policy and programmes in pushing the Malaysian higher education excellence. DOHE is also responsible in strategising and realising the initiative to strengthen Malaysia's research capacity through various programmes. Since 2007, DOHE has introduced programmes to develop and strengthen research foundation in Malaysia. DOHE is now pursuing international collaboration to intensify research and innovation.



About Research Consulting and the University of Nottingham

This project has been led by Research Consulting Ltd., working with advisors and technology transfer specialists from the University of Nottingham.

Research Consulting is a UK-based consultancy specialising in research management, knowledge exchange and publication. The company focuses on enabling knowledge exchange, demonstrating impact and supporting commercialisation. Clients include universities in the UK and Australia, HEFCE (now Research England), EPSRC, ESRC, PraxisAuril (the leading UK sector body for technology transfer), Hong Kong Research Grants Council, European Commission and Department for International Development (UK Government).

Dr. Dan King is a Director in Research Consulting, and leads the work in research development, partnerships and knowledge exchange. He has held senior partnership and knowledge exchange roles at the University of Nottingham (2001-2017) and Nottingham Trent University (2017-2018), managing teams delivering **partnerships, industry engagement** and **technology transfer activity**. He is familiar with the range and application of UK funding streams supporting industry engagement and technology transfer.

The University of Nottingham has extensive experience in technology transfer and UK-Malaysia engagement. Both in the UK and Malaysia, the university is one of the leading research intensive universities and is strong in technology transfer and business partnerships. The university also has a campus in Ningbo, China (UNNC) and is developing technology transfer capacity in both University of Nottingham Malaysia (UNM) and UNNC. It has a portfolio of spin-out companies, technologies licensed to industry and extensive industry partnerships (from corporate to SMEs).

The university has pioneered a number of approaches to technology and regularly contributes to the policy and practice of technology transfer and knowledge exchange. **Professor Deborah Hall** is Vice-Provost (Research and Knowledge Exchange) of University of Nottingham Malaysia (UNM). She is responsible for embedding good practice in research governance at UNM including implementing policies and procedures for research contracting, national and international dual/joint PhD programmes, Intellectual Property management, and commercialisation of research outcomes such as setting up spin-out companies.

Dr. George Rice is Head of Commercialisation and part of the Technology Transfer Office (part of the Research & Innovation) at UNUK. His role focuses on the commercialisation of technologies from the engineering and physical sciences area. He has been a Non-Executive Director in a number of spin-out companies, and worked closely with national sector organisations in training delivery for technology transfer. He is experienced in the development of technology transfer in China, and more recently Malaysia.







MINISTRY OF HIGHER EDUCATION

Higher Education Partnerships Programme:

Enhancing the sustainability of technology transfer and research management in higher education institutions through strategic UK – Malaysia university partnerships

Scoping Report October 2019