



**Asia-Pacific
Economic Cooperation**

Researcher Mobility Workshop Report

Researcher mobility among APEC economies

**APEC Human Resources Development
Working Group**

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This report was written by Dr Sarah Richardson and Dr Julie McMillan from the Tertiary Education Research Programme at the Australian Council for Educational Research and Dr Ren Yi from the Higher Degree Research Office at Macquarie University. It was prepared for the Australian Government Department of Education and Training to contribute to the APEC Researcher Mobility Workshop in Jakarta in December 2015 and to report discussions at the workshop. The views expressed in this document are not necessarily the views of the Australian Government Department of Education and Training.

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Produced by
Dr Sarah Richardson, Dr Julie McMillan, Dr Ren Yi
Australian Council for Educational Research
Private Bag 55
Camberwell Victoria 3124
Australia
Tel: (61) 3 9277 5555

Higher Degree Research Office Macquarie University
Level 3, Research HUB
C5C East, Macquarie University
NSW 2109
Australia
Tel: (61) 2 9850 6198

For
Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 68919 600
Email: infor@apec.org
Website: www.apec.org

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Executive summary

There is growing acknowledgement around the world that contemporary research is increasingly – and needs to be – international. In a globalised world common problems can only be solved through the sharing of expertise and pooling of resources. At the same time, research developments are critical in stimulating economic growth in knowledge economies. Ensuring that researchers can access best practice through international research collaboration is essential in facilitating innovation.

Policies and structures can go a long way to supporting increased international research collaboration. Online communication technologies have become a vital part of researcher mobility, enabling researchers to unite in conducting collaborative research across the world. It is inevitable that policy makers may regard communication developments as taking the place of physical researcher mobility and hence reducing the cost involved.

Research indicates, however, that face-to-face interaction remains vital in successful research collaborations, particularly at the early stage of projects and when multi-disciplinary approaches are required¹. This is due to the role of face-to-face interaction in creating trust between researchers. Thus, international research collaborations are fundamentally premised on researcher mobility and, hence, researcher mobility lies at the core of efforts to enhance the quality, impact and capacity of research to inform innovation in all APEC economies.

This report has been written for the APEC Researcher Mobility Workshop, held in Jakarta in December 2015. Chapters 1 to 7 were prepared to stimulate consideration of the issues surrounding researcher mobility. They provide an overview of pertinent literature, case studies, data sets and policy of relevance to the topics that were discussed at the workshop. Chapter 8 provides a report on discussions at the workshop and identifies recommendations made by workshop participants.

Policy context for researcher mobility

Increasing attention is being paid by policy makers towards the conditions of knowledge creation and usage. Facilitating research mobility requires policy makers to understand the dynamics of research mobility and the factors which need to be overcome to enable this to occur.

- **Global initiatives** - multi-lateral approaches to global challenges through research have become commonplace and international mandates enable them to stimulate coordinated responses.
- **Regional initiatives** – efforts to integrate research and to support researcher mobility within APEC economies include those among ASEAN members and specific activities such as the Asia-Pacific Network for Global Change Research.
- **Economy initiatives** – many APEC economies have policies to encourage researcher mobility through the removal of barriers and the creation of contexts which support innovation.
- **University networks and disciplines** – groups such as Universitas 21 and the Worldwide Universities Network collaborate on a range of activities to enhance research collaboration.
- **Policy directions** – There is a need for additional policy making on aspects such as sharing research infrastructure, establishing centres of excellence, building research capacity in emerging economies and regional data collection on research activity, output, quality and impact.

Regional and global trends in researcher mobility

There are numerous global data sets which include information on elements of researcher mobility but a lack of clear definitions and the political motivation to collect data on researchers means that there is a lack of rigorous evidence on the impact of researcher mobility.

- **Highly skilled migrants** – the highly skilled tend to be more globally mobile than others with global emigration rates of 2.4 per cent overall and 5.4 per cent for the tertiary educated population.
- **‘Scientist’ mobility** – the movement and foreign exposure of ‘scientists’ (as major data sets tend to refer to them) is common in many economies, despite wide variations in patterns of mobility.

- **Co-authoring patterns** – the proportion of research papers with international co-authors has risen in nearly all APEC economies, for example accounting for 66 per cent of all journal articles from Hong Kong, China in 2014, and internationally co-authored papers have higher rates of citation.
- **Expenditure on research** – the amount of money spent on research varies considerably between APEC economies, from more than 4 per cent of GDP to less than 0.1 per cent of GDP.
- **Research expenditure sources** - The source of expenditure on research varies between APEC economies from more than 75 per cent from industry to more than 75 per cent from government.
- **Duration of mobility** – short term and long term mobility are correlated and the greater the duration, the greater the likelihood of international collaboration in research.

Researcher mobility throughout the career

Researchers move through a number of key career stages, from research students to early career researchers to mid- and late-career researchers. Mobility, its drivers and the barriers which prevent it from occurring vary according to career stage, requiring different policy responses.

- **Brain circulation** – concerns about brain drain persist but are accompanied by a growing acknowledgement of the value of researcher mobility for both sending and receiving economies.
- **Research student mobility** – the international movement of research students is becoming increasingly common, this varies by discipline and economy. It is driven by the quality of training available, the possibility to work with lead researchers and the availability of facilities.
- **Early career mobility** – post-doctoral researchers are perhaps the most internationally mobile of all researchers, often moving from one short term contract to another. This is driven by career and funding opportunities and the possibility of enhancing research skills.
- **Mid and late career research mobility** – once more advanced in their careers, the international mobility and collaborations of researchers tends to be based on connections made earlier in their careers. It is frequently driven by a desire to be autonomous in research. Mid- and late-career researchers tend to have established careers and family ties which limit mobility to short periods.
- **Benefits of mobility** – there is evidence that mobility has an extremely positive impact on research innovation, research output and research career development.
- **Barriers to mobility** – the greatest barriers to mobility include a lack of opportunities and funding, visa restrictions, family and community ties, language skills and salary differentials.

Academia-industry research collaborations

Using research to fuel innovation is increasingly regarded as important in stimulating economic growth. Encouraging collaboration between university researchers and their colleagues in industry and government is important in enabling research to be leveraged to stimulate economic development.

- **Industry investment in research** – the proportion of expenditure on research which comes from industry varies from more than 75 per cent to less than 25 per cent across APEC economies. Up to three-quarters of researchers in some economies are in the business sector.
- **Innovation performance** – the APEC economies of Korea, the USA and Japan are regarded as having the highest levels of innovation, with innovation growth rates highest in China and Korea. Openness of research systems are critical in stimulating innovation.
- **Geographical proximity** – the closeness in the location of industry and academic partners appears to be critical in the likelihood that they will collaborate. Local collaborations tend to lead to international collaborations if partners already have international relationships.
- **Lack of commercial focus** – many research students receive little training in research aspects critical for academia-industry partnerships such as intellectual property rights and entrepreneurship and this can limit mobility of researchers between academic and industry.
- **Encouraging academia-industry collaboration** – methods to facilitate greater engagement between universities and industry include the promotion of opportunities and sharing of good practice, as well as rewards for universities that demonstrate strong industry collaboration.

Inter-institutional research collaborations

Higher education institutions play an important role in researcher mobility through encouraging and rewarding mobility of researchers and developing relationships with institutions in other countries.

- **International outlook** – the engagement of universities with international partners is increasingly important in institutional reputation, with many young universities building their position with an explicit focus on international collaborations.
- **Relationship management** – ensuring that relationships between institutions are well managed is critical and incorporates clarity in goals and scope and stakeholder authorisation.
- **Research centres** – when institutions establish research centres this tends to encourage collaborative behaviour among researchers, enabling them to engage in large-scale research projects and drawing in colleagues from around the world, particularly if social ties are strong.
- **Collaborative ties** – the likelihood of ongoing inter-institutional collaborations is strengthened by institutions engaging in diverse forms of engagement with other institutions.
- **Challenges in institutional collaboration** – institutional relationships can be complex and particular challenges include mismatched expectations and capabilities and bureaucracy.

Ensuring integrity in researcher mobility

As research becomes increasingly international, and researchers move from one research environment to another, it is ever more important to govern research relationships to ensure research integrity.

- **Research integrity variations** – there is diversity in how research integrity is governed, implemented and policed among APEC economies.
- **Research governance** – the professionalisation of research is very unevenly distributed among APEC economies, with greatest activity in the more advanced economies. Global bodies focus on good-practice dissemination and the commonalities faced by researchers.
- **Reciprocity in researcher mobility** – multi-directional flows of researchers are important in optimising research achievements around the world and in assisting emerging economies to build their research capacity, with a need for APEC economies to be good global citizens in research.
- **Research integrity** – research integrity covers all elements of research and incorporates a need for appropriate management.
- **Research ethics** - governance of research ethics can vary significantly, even among similar cultures and economies. Respect for cultural traditions is balanced with protection of research subjects.

Recommendations to enhance researcher mobility among APEC economies

At the APEC Researcher Mobility Workshop held in December 2015 in Jakarta, participants from 12 APEC economies discussed all of the issues raised above and made the following recommendations:

- **Researcher mobility data** - APEC economies consider and agree on a minimum data set for recording the mobility of researchers and aim to share this information across the region.
- **The economic impact of researcher mobility** - APEC economies could undertake further research to examine the economic and social impact of researcher mobility.
- **Priority research** - APEC economies consider and agree to priority fields of research which reflect the shared interests and common challenges faced across the region.
- **Expert researchers** - APEC economies consider the need for information on expert researchers in priority fields of research to be shared between economies.
- **Research Integrity** - APEC economies consider and agree to activity focused on the issue of research quality and integrity. APEC members continue to examine the issue of research ethics and aim to develop guiding principles for integrity matters to provide consistency and transparency across the region.

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Acronyms

ACER	Australian Council for Educational Research
ACO	Academic Careers Observatory
APEC	Asia-Pacific Economic Cooperation
APN	Asia-Pacific Network
APRU	Association of Pacific Rim Universities
ARC	Australian Research Council
ARMS	Australasian Research Management Society
ASEAN	Association of South East Asian Nations
AUN	ASEAN University Network
CARA	Canadian Association of Research Administrators
CGIAR	Consultative Group on International Agricultural Research
CISEPO	Canadian International Scientific Exchange Programme
ECR	Early Career Researcher
ERC	European Research Council
ERIA	Economic Research Institute for ASEAN and East Asia
EU	European Union
GDP	Gross Domestic Product
GERD	Proportion of GDP spent on research and development
HEI	Higher Education Institution
HDR	Higher Degree Research (Students)
INORMS	International Network of Research Management Societies
ICT	Information and Communication Technology
IPCC	Intergovernmental Panel on Climate Change
IRU	Innovative Research Universities
MQ	Macquarie University
NCURA	National Council of University Research Administrators
OECD	Organisation for Economic Cooperation and Development
POSTECH	Pohang University of Science and Technology
R&D	Research and Development
SAME	Scheme for Academic Mobility and Exchange
SEED-Net	Southeast Asia Engineering Education Development Network
SRA	Society of Research Administrators
STEM	Science, Technology, Engineering and Mathematics
UIS	UNESCO Institute of Statistics
UK	United Kingdom
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organisation
US(A)	United States
WUN	Worldwide Universities Network

‘Our research is so complex that the resources of a single region of the world are no longer enough - both intellectually and economically, it must be a global effort’. Fabiola Gianotti

1. Introduction

In 2015 more and more economies are looking to the knowledge sector to generate innovation and economic growth. Unlike other economic sectors, the knowledge sector is one which is reliant on a workforce educated to the highest possible level. Innovation, research developments and technological breakthroughs are fuelled by highly-skilled employees. As APEC Leaders declared in 2012:

‘Education is the pre-eminent source of economic development in the 21st century, creating more and higher quality jobs and bolstering productivity growth. Education is also a fundamental component of economic activity. Cooperation in the education sectors of APEC economies fosters innovative growth as students, researchers and education providers build scientific, technological and linguistic communities’².

A strong research workforce is important in fuelling innovation but it is no longer enough. In a globalised world common problems are best tackled through the sharing of expertise and pooling of resources. Moreover, access to best practice through international research collaboration is necessary in stimulating local economic growth.

1.1 The role of researcher mobility in stimulating APEC collaboration

Diplomatic cooperation can help stimulate international research collaboration, but in reality most collaboration arises from people-to-people links between experts with shared research interests. Thus, efforts to stimulate researchers to work with their peers in other economies are increasingly important.

Researcher mobility is a critical element in sustaining economic development. Outbound

researchers gain new skills, knowledge and the opportunity to build networks with researchers in other economies, together enhancing their capacity to contribute to, and lead, advanced research. Inbound researchers add research capacity to an economy and bring in new technologies and ways of doing things. Their presence enables local researchers, including those who may not be able to be mobile themselves, to build connections with researchers in other economies and expand their collaborative activities.

As this discussion paper makes clear, both inbound and outbound researcher mobility is of great value in enhancing the quality of research, expanding the impact of research outputs and facilitating global research collaborations to solve common problems. In the context of APEC this is of particular significance due to the focus placed on openness and cooperation. The APEC Mission Statement states:

‘We are united in our drive to build a dynamic and harmonious Asia-Pacific community by championing free and open trade and investment, promoting and accelerating regional economic integration, encouraging economic and technical cooperation, enhancing human security, and facilitating a favourable and sustainable business environment. Our initiatives turn policy goals into concrete results and agreements into tangible benefits’³.

Researcher mobility plays an important role in ensuring that tangible benefits of cooperation across APEC economies are gained by all economies through encouraging technical cooperation, and regional integration. With an emphasis on brain circulation, studies have found that researcher mobility contributes to a global enhancement of innovation, bringing institutions into collaborative networks and opening them up to new ideas and approaches.

‘The impact on any one university in the region as a result of this circulation is complex and includes, but is not limited to,

- *the development of knowledge and innovation networks within and between countries in the Asia-Pacific region,*
- *the development of hubs or centres of innovation in specific fields,*
- *the transfer of global best practices throughout both the core and periphery of the region [and]*
- *the development of ‘co-collaborators’ for future innovative research and development (and therefore, linkages between HEIs in various settings that would otherwise not develop)’⁴.*

1.2 Policy context for researcher mobility

The challenges facing policy makers around the world are universal in scope. Climate change, energy supply, food security, natural disasters, and disease control are some of the most pressing issues. Solving them requires collective efforts which are coordinated across regions and economies.

‘Tackling global challenges required targeted, decisive action ... Science, technology and innovation play a central role in understanding the interaction of the relevant environmental, technological and social factors ... and in developing solutions’⁵.

Around the world there are clear signs that research is becoming increasingly international, and this is certainly true in the APEC region, with low cost telecommunications and air travel enabling researchers to collaborate and share research infrastructure. These positive outcomes should be recognised and celebrated. But they should not distract us from the fact that the majority of researchers do not collaborate with colleagues in other economies and are not mobile.

Due to the important role that knowledge plays in laying the foundation for innovation,

increasing attention is being paid by policy makers towards the conditions of knowledge creation and usage. There is increasing realisation at a range of policy levels - the global, regional and domestic level, as well as within the academic structures of discipline and institution - that researcher mobility is a valuable means of enhancing research capacity and output, and that international collaborations enable efficiencies in research.

Facilitating researcher mobility requires policy makers to understand the dynamics of research mobility and the factors which need to be overcome to enable this to occur⁶. Numerous barriers work to deter researcher mobility. Three major sets of barriers tend to be referred to⁷:

Box 1: Barriers to researcher mobility

- *Legal and administrative* – including visas and taxation;
- *Social and cultural* – including access to information about mobility opportunities, language skills, accommodation and family responsibilities; and
- *Recognition and parity* – including fears that career options may be derailed by mobility and the large variation in salaries across economies.

Some of these barriers are clearly more easily addressed by policy makers than others. And while some can be solved by policy makers in individual economies, others demand a regional or multi-lateral approach.

1.3 Patterns of researcher mobility

Contemporary patterns of researcher mobility can be attributed to a number of key driving factors.

- First, globalisation and the subsequent **cross-border organisation of research and innovation**, in which researchers around the world are increasingly contributing to a global knowledge bank rather than working in isolation⁸.

- Second, the increasing demand for hugely **expensive research infrastructure** to enable scientific advances, requiring resource sharing and research clusters. Initiatives such as the Large Hadron Collider are illustrative of this pattern.
- Third, the **internationalisation of the higher education sector**, characterised by ever-growing ranks of mobile students. Researchers who experienced mobility during their undergraduate studies appear to be more likely to engage in mobility as they build their researcher identities⁹.
- Fourth, the shift of many economies from reliance on primary production, industry and services to **increased focus on knowledge economies**. This development has inevitably led to a global shortage of highly-skilled knowledge workers, ensuring that they are in high demand.

There are estimated to be around seven million researchers worldwide¹⁰. A proportion of researchers have always moved from economy to economy. Tracking these movements over time has yielded indications that researcher mobility achieves significant benefits, not only for individual researchers but also for sending and receiving economies.

‘Collaborating internationally or spending time on a research visit abroad can be very beneficial to a researcher’s career and can give researchers access to expertise, facilities and research environments that significantly broaden their experience and networks’¹¹.

There is certainly evidence of an increase in researcher mobility worldwide. Precise figures on researcher mobility are difficult as common categories in international statistics are ‘tertiary educated population’ – which does not distinguish those who are researchers and those who are not - and ‘migration’ - which takes into account long-term mobility rather than short term mobility.

Bearing these limitations in mind, there are indications that the more highly skilled and educated people are, the more likely they are to be mobile, with global emigration rates of 2.4 per cent overall and 5.4 per cent for the tertiary

educated population¹².

Mobility rates do differ significantly across APEC economies but in 2010 it was estimated that more than 10 per cent of the tertiary educated population had emigrated in six APEC economies – Brunei Darussalam; Hong Kong, China; New Zealand; Papua New Guinea; the Philippines and Viet Nam – and between 5 and 10 per cent had emigrated in a further seven APEC economies¹³.

More targeted data from the APEC economies of Australia; Canada; Japan and the USA suggests that the patterns for researcher mobility are quite complex. In Australia and Canada more than 60 per cent of scientists have international experience and more than 40 per cent of scientists are from another country. In Japan, almost 40 per cent of scientists have international experience but just 5 per cent are from another country¹⁴. And in the United States just 19.2 per cent of scientists have international experience but almost 40 per cent of scientists are from another country.

The proportions of international students in advanced research programmes also varies significantly, comprising around one-third of research students in economies such as New Zealand, Australia and the United States¹⁵. The OECD estimates that even taking the variations between economies into account the proportion of research students who are international is around twice the proportion of undergraduate students who are international¹⁶.

Despite showing diversity between economies, these patterns do indicate that researcher mobility is relatively common. This is important because there is evidence that mobility is an important factor in enabling researchers to enhance their research performance¹⁷. For researchers perhaps the best measure of research performance is publications, and there is evidence that academic publications are becoming increasingly international in terms of authorship.

International co-authorship is an important measure of researcher mobility because there is significant evidence that the relationships which researchers build with colleagues in other economies when they are mobile are vital in

stimulating international cooperation on research, and hence publications. Data from 2014 suggests that in nine APEC economies more than a half of all research publications

involved co-authors from other countries¹⁸, with more than 17 per cent of research publications in all APEC economies including international co-authors.

Figure 1: Proportion of research publications with international co-authors by region¹⁹

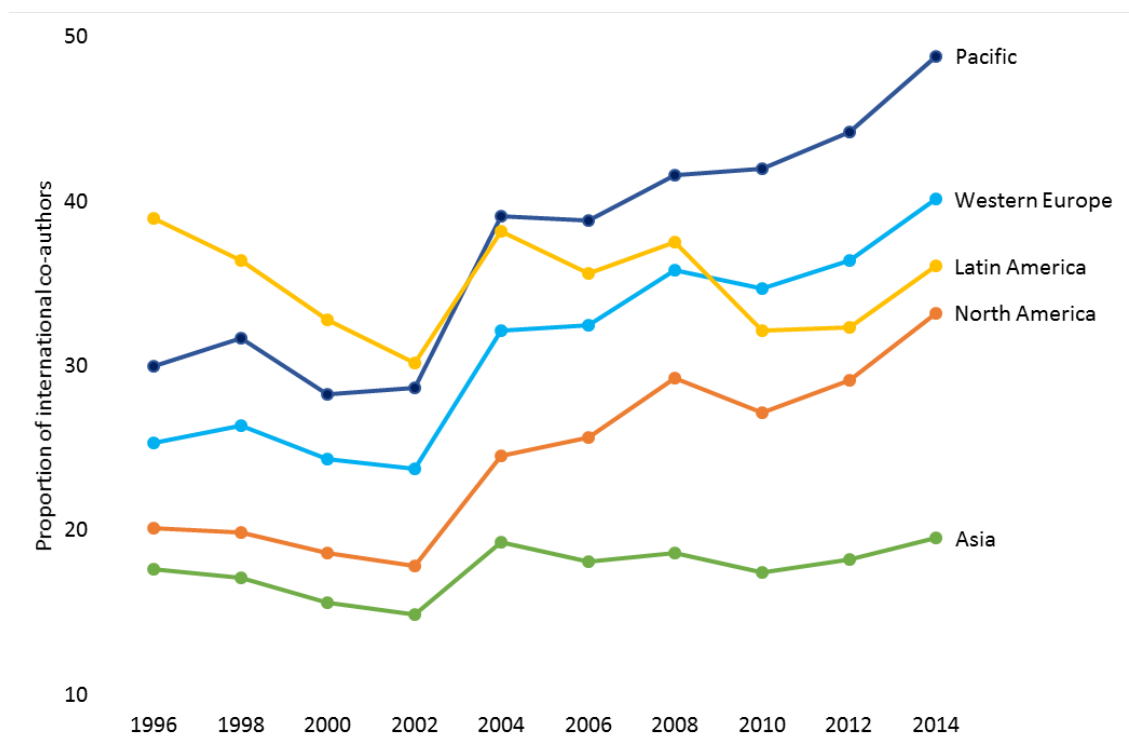


Figure 1 uses data from the Scopus database to show the proportion of research publications from five regions of the world which have international co-authors, over a period between 1996 and 2014. The Pacific has had the highest proportion of co-authorship since 2004, overtaking Western Europe, with Asia recording the lowest proportion of international co-authorship. In all areas, however, an upward trend is evident.

An analysis of 25 million research papers published between 1981 and 2012 has shown that the proportion of papers written by authors from only one economy is falling, with growth coming from collaborative publications written by authors from more than one economy²⁰. Papers that are written collaboratively are also cited more often than single economy ones and this benefit extends to all papers written by researchers at institutions with a great deal of international collaboration.

Despite the benefit of researcher mobility, however, many researchers are not mobile.

For example a recent study from the EU has found that a third of researchers have never been mobile and less than half of researchers have been mobile for three months or more at any point in their careers²¹. This suggests the need to consider the push and pull factors which impact on researcher mobility at all stages of their careers and to determine strategies to encourage greater researcher mobility.

Beyond a focus on physical movement of individual researchers, any investigation of researcher mobility also needs to consider the broader issues it raises. Four key themes are of particular importance.

- **Mechanisms to support researcher mobility**, including initiatives at the institutional, disciplinary, economy, regional and global level, are essential in ensuring

researchers are able to be mobile. This incorporates the need for mechanisms that target all stages of researcher careers, from research students to early, mid and later career researchers.

- **Institutional partnerships** bring together higher education institutions in different parts of the world to cooperate on research endeavours. These set a context for sustained researcher mobility and collaboration but must be carefully managed to ensure equity of benefits for all.
- **Partnerships with industry** are of fundamental importance in stimulating economic growth, enabling research expertise to be applied to the industrial and commercial sectors. This is essential if the value of research excellence is to be optimised for the benefit of broader society, particularly in underpinning innovation. Such commercialisation of research requires a policy context which encourages research-industry collaboration and the willingness of different sectors to engage with each other.
- **Research integrity and research ethics** are defined differently in different economies, varying from highly rigorous oversight to a more laissez-faire approach. This can lead to complexities in collaborative research activities and suggests a need to address how different understandings can work together.

This workshop will consider all of these issues within the context of Asia-Pacific cooperation, investigating whether regional approaches could be used to stimulate researcher mobility and greater collaboration with industry.

2. Regional and global trends in researcher mobility

Higher education data collections reflect political priorities. Undergraduate student enrolment, retention and outcomes are closely tracked, at domestic, regional and global levels. This reflects the focus of many governments on opening up opportunities for young people to gain a higher education. Similarly, there is extensive data available on undergraduate student mobility, reflecting policy makers' interest in internationalisation.

Much less attention is paid to research students,

Presentations by experts from a range of APEC economies will enable participants to gain valuable insights into varied approaches to research mobility and commercialisation which they can then apply in their own contexts.

This discussion paper has been prepared to stimulate consideration of the critical issues surrounding researcher mobility in advance of the workshop. It provides an overview of pertinent literature, case studies, data sets and policy documents of relevance to the topics that will be discussed at the workshop. The discussion paper aims to provide an accessible and well-informed synopsis of essential factors that affect researcher mobility and research commercialisation.

The workshop comes at an important moment in the evolution of research. There are suggestions that research is now in a 'fourth age'. Having progressed from the individual to the institutional to the national, research is now defined by the international and it could be argued that 'institutions that do not form international collaborations risk progressive disenfranchisement'²².

If, as has been suggested, "research collaboration has become the norm in every field of scientific and technical research"²³, then leveraging collaborations to bring APEC economies closer together requires a focus on their fundamental components, particularly ensuring that universities and researchers have what they need to develop sustainable partnerships. And a major component of this is encouraging the mobility of researchers²⁴.

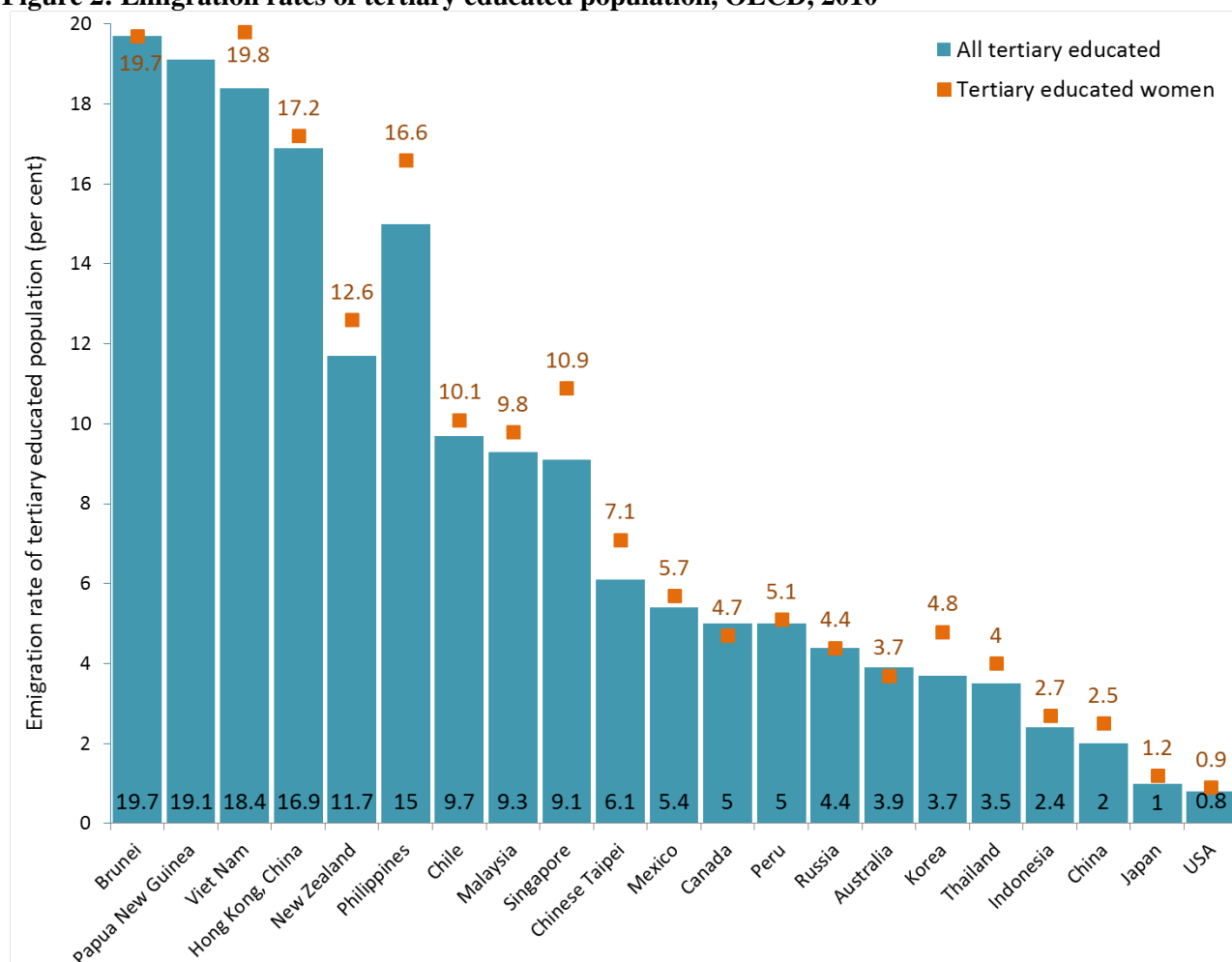
researcher mobility or research collaborations to the extent that the OECD acknowledges that 'quantitative evidence on the impact of mobility patterns is not readily available'²⁵. Instead, identifying trends in researcher mobility requires extrapolation from rather generalised data sets.

The first is the mobility of highly skilled migrants, a group which tends to be defined as anyone who has completed a tertiary education. Researchers form part of this group but are

rarely distinguishable other than in small studies. Moreover, ‘mobility’ is conflated with ‘migration’, making it impossible to determine

the length of time away and likely omitting shorter-term mobility.

Figure 2: Emigration rates of tertiary educated population, OECD, 2010²⁶



Bearing these limitations in mind, there are indications that the more highly skilled and educated people are, the more likely they are to be mobile, with global emigration rates of 2.4 per cent overall and 5.4 per cent for the tertiary educated population²⁷. Highly skilled women also appear to have higher emigration rates than their male peers, as illustrated in **Figure 2**.

While there is a pronounced lack of rigorous, comparable data on researcher mobility among APEC economies, a number of the more prominent economies are commonly referred to in studies on researcher mobility. For example, one study looked at the mobility patterns of researchers in the fields of biology, chemistry, materials and earth and environmental sciences

in sixteen countries, including the APEC economies of Australia, Canada, Japan and the United States²⁸.

Table 1 shows the proportion of the researcher workforce which is foreign, the proportion of researchers who are overseas, the proportion of researchers with international experience and the return rate for mobile researchers in four APEC economies. It is noteworthy that Japan has contrasting patterns of researcher mobility in comparison with the three other economies. The same study suggested that mobile researchers perform at a higher level than their non-mobile peers and argued that this is directly caused by their mobility²⁹.

Table 1: Researcher mobility, Franzoni et al., 2012³⁰

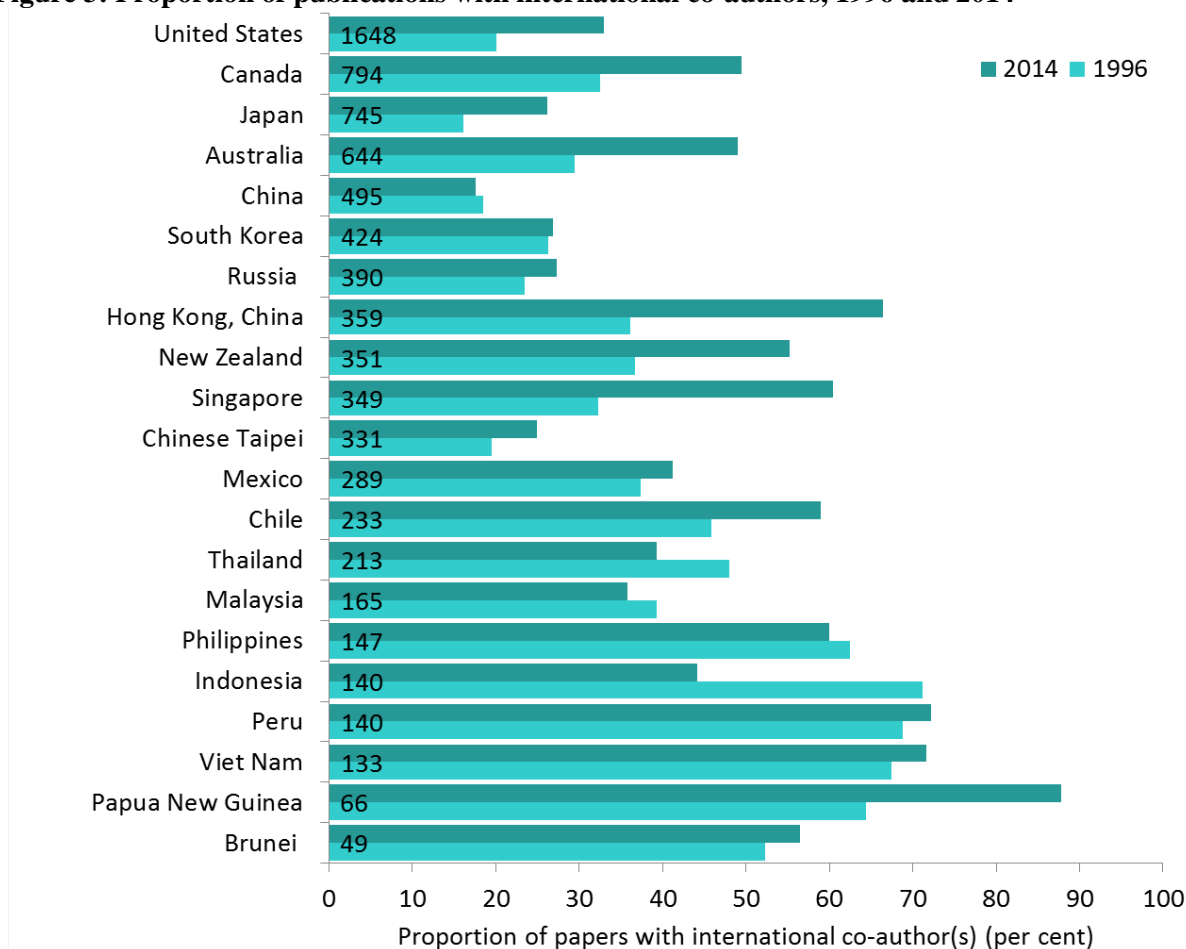
Economy	Proportion of researchers which is foreign (%)	Researchers currently overseas (%)	Researchers with international experience (%)	Return rate for mobile researchers (%)
Australia	44.5	18.3	62.9	70.8
Canada	46.9	23.7	66.8	64.4
Japan	5.0	3.1	39.5	92.0
United States	38.4	5.0	19.2	74.2

Research publications, citations and impact are the main measures of research productivity and thus give us a second insight into researcher mobility. Using data from Scopus, SCImago utilises the Google PageRank algorithm to show publication patterns around the world between 1996 and 2014³¹.

economy in 1996 and 2014. Economies are ordered by their h-index (where h represents the number of papers which have been cited that many times). The h-index is shown at the base of each bar, ranging from 1,648 in the United States to just 49 in Brunei Darussalam.

Figure 3 shows the proportion of papers with international co-authors from each APEC

Figure 3: Proportion of publications with international co-authors, 1996 and 2014³²



It is interesting to note that economies with the lowest h-indexes, such as Viet Nam and Peru, had some of the highest rates of international co-authorship of papers in 1996, and that these high rates continue to 2014 (although there has been a significant fall in Indonesia). It is equally interesting to note that in nearly all economies the rates of international co-authorship have risen between 1996 and 2014.

In some economies this rise has been extremely large. For example in Hong Kong, China the rate of international co-authorship of papers has risen from 36.1 per cent to 66.4 per cent. The overall pattern suggests the increasing role of international collaboration in research.

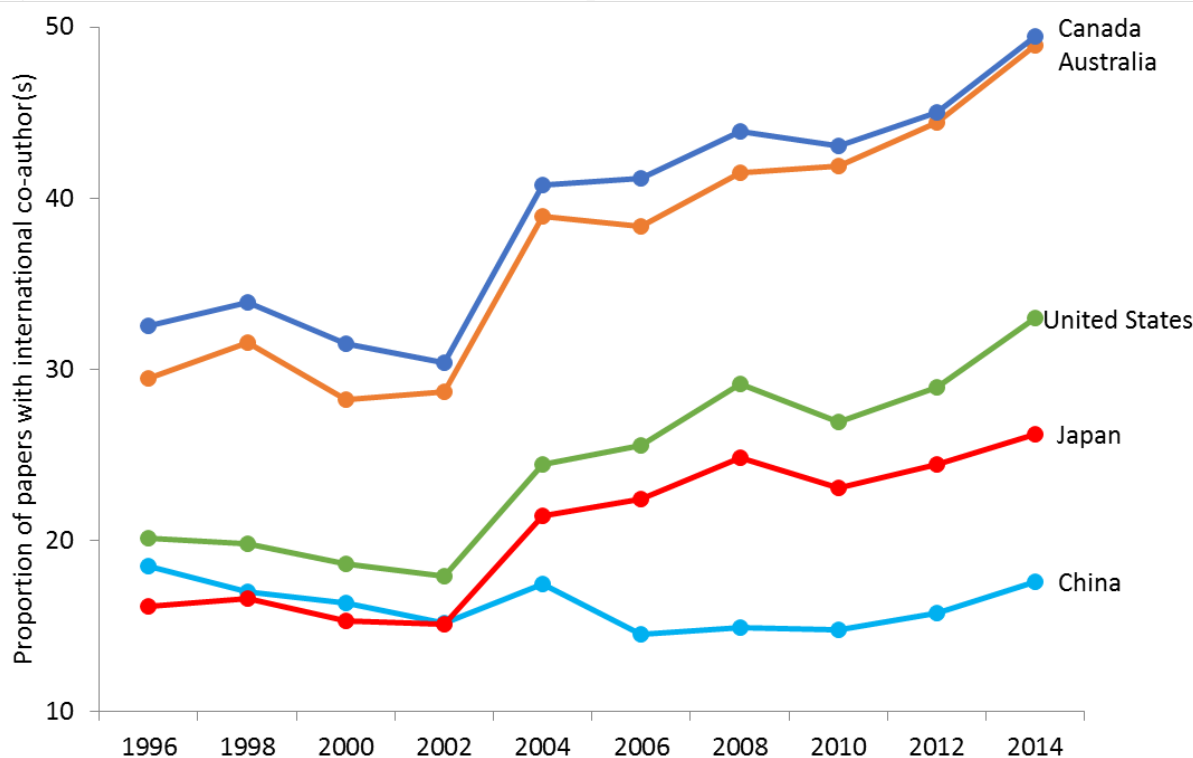
It is important to note that researchers in five APEC economies – Australia; Canada; China; Japan; the United States - produced a total of 1.3 million papers in 2014, compared to a total of 280,000 from all the other APEC economies combined. This means that the increases in international co-authorship in these economies (an average of 11.7 per cent between 1996 and

2014) is particularly important in shaping the overall trend towards greater international collaboration on publications, and hence reflects an increase in collaborative research.

Figure 4 shows changes in the proportion of papers written with an international co-author between 1996 and 2014 for the top five APEC economies in terms of publication output. There are clearly large increases in the proportion of international publications in Australia, Canada, Japan and the USA. It is also interesting that patterns in the relative proportion of papers with international-co-authors are relatively stable with the highest proportions in Canada over the entire period, closely followed by Australia.

The pattern for China is anomalous in comparison with the other four economies, showing a drop in rates of international-co-publications between 2004 and 2014, although this trend now appears to be upward, with the rate for 2014 of 17.6 per cent slightly above the rate of 17.4 per cent in 2004.

Figure 4: Patterns of international co-authorship, 1996-2014³³



In a recent analysis of 1.25 million journal articles, international collaboration was found

to have a strong and positive effect on citations and the status of journals that articles are

published in³⁴. Thus it could be suggested that international research collaboration lead to “greater scientific visibility, quality and impact”³⁵. Moreover, it has found that this is true for researchers at both established and newer institutions. For example at MIT the number of citations per paper increased by 4.12 for each 10 per cent increase in the rate of collaboration³⁶.

The OECD also has more detailed data on researcher mobility but this is only available for three APEC economies. The lack of systematic data on researcher mobility held by agencies who collect data from around the globe, in particular the OECD and UNESCO, has led the Royal Society to state that this situation needs to be remedied:

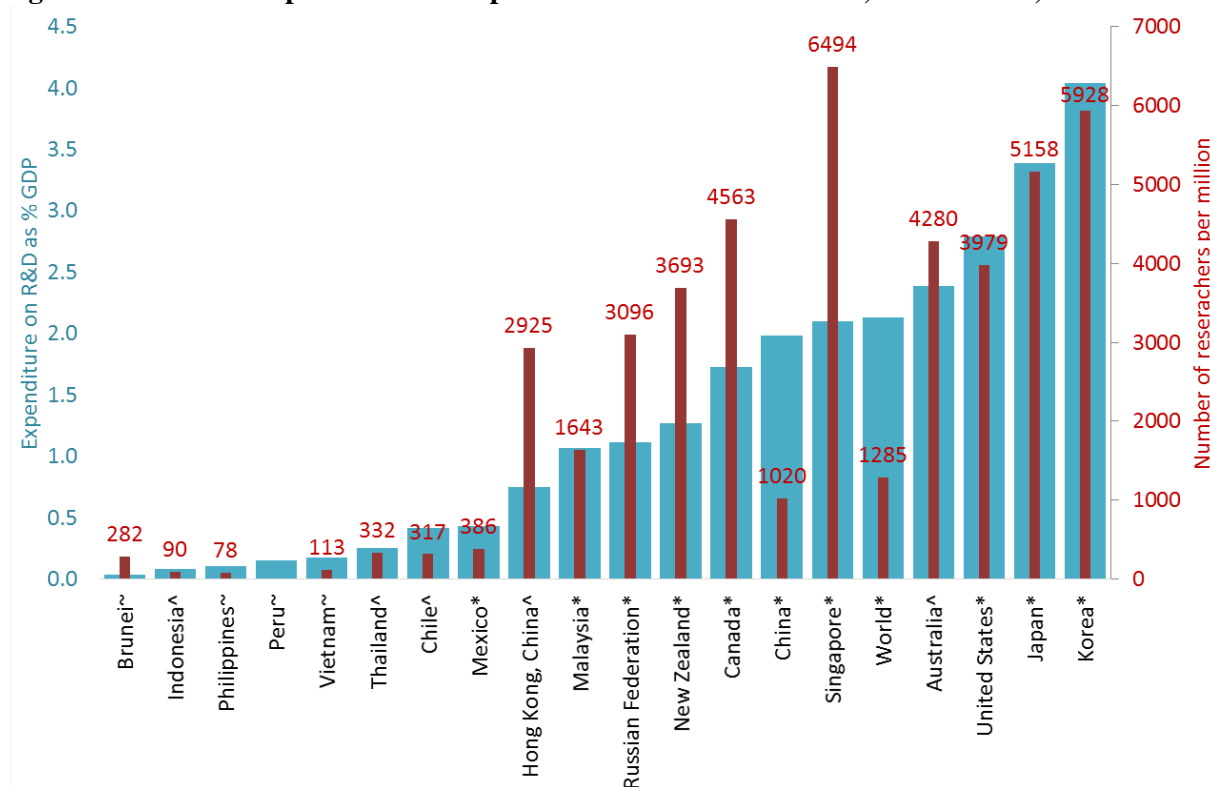
‘There is a specific lack of data on the flow and migration of talented scientists and their diaspora networks. UNESCO, OECD and others should investigate ways of capturing this information as a priority, which would enable policy makers to better understand,

nurture and oversee global science for the benefit of society as a whole’³⁷.

The third source of data which can be used is that relating to the research and development (R&D) workforce. The most recently available comparative World Bank data on R&D expenditure as a proportion of GDP shows variations from 4.04 per cent in Korea to 0.04 per cent in Brunei Darussalam (although up-to-date figures are not available for all economies). When compared to data on the number of researchers per million, a correlation emerges, as **Figure 5** indicates.

Korea and Japan, with the first and second greatest proportion of GDP spent on R&D, have the second and third largest number of researchers per million, at more than 5000. In contrast, economies such as Brunei Darussalam; Indonesia; the Philippines; Viet Nam; and Thailand have the lowest proportions of GDP spent on researchers and also the lowest numbers of researchers per million, falling as low as 78 in the Philippines.

Figure 5: Researchers per million & expenditure on R&D as % GDP, World Bank, 2012³⁸



Key: *2011-2012, ^2009-2010, ~2002-2007

No data for Papua New Guinea or Chinese Taipei is available. No researcher data for Peru is available

Six APEC economies have relatively large numbers of researchers as compared to percentage of GDP spent on R&D. This may indicate problems sustaining the current research workforce in future years. Singapore stands out, with 2.1 per cent of GDP spent on R&D but 6494 researchers per million. In contrast, China reflects overall world patterns of a much smaller number of researchers per million than the proportion of GDP spent on research, with 2 per cent of GDP spent on R&D but only 1,020 researchers per million. This could be considered to suggest that the R&D workforce in China is likely to grow substantially in the future.

The fourth source of data on researcher mobility comes from studies of specific groups of researchers. For example, a study by *Nature* looked at the prevalence of, and attitudes toward, mobility among 2,300 of their readers around the world, the majority of whom were researchers with PhDs in the fields of natural sciences and engineering³⁹.

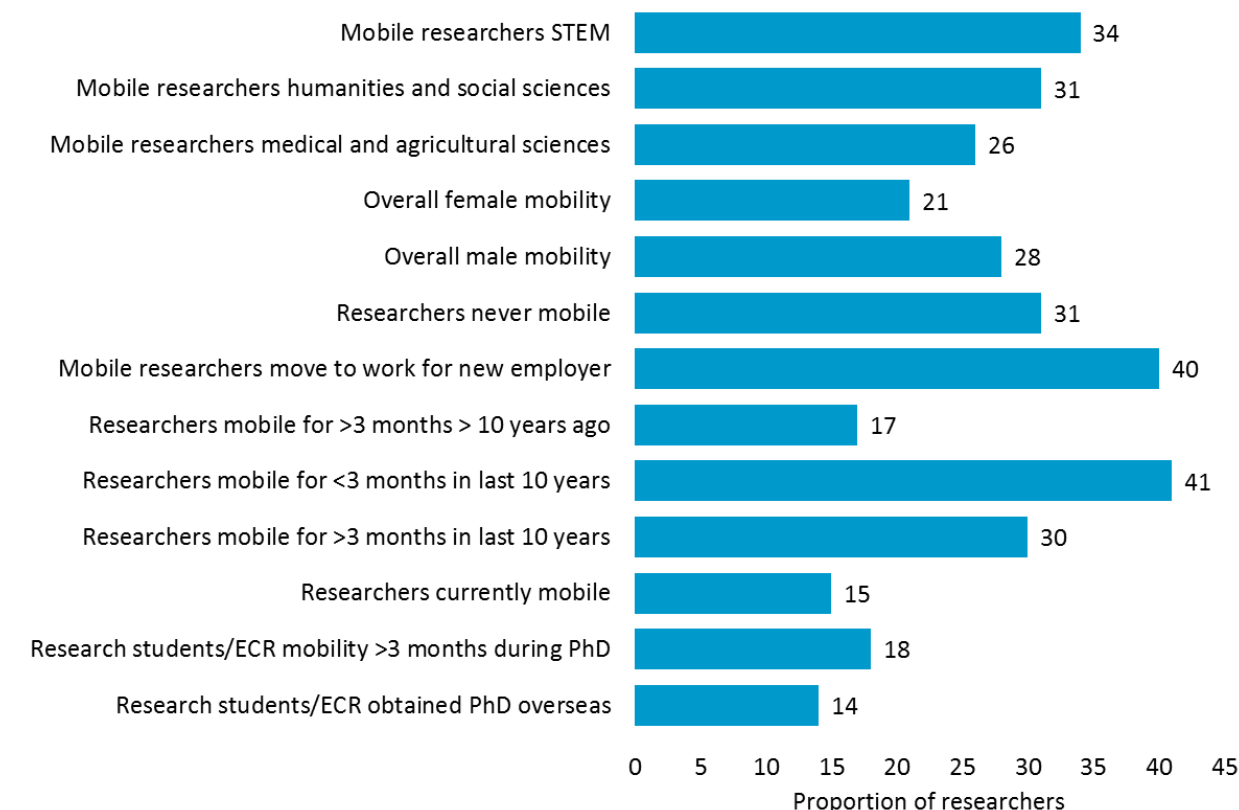
The study found that:

- 36.4 per cent researchers reported that they were living outside their home economy;

- early career researchers were much more mobile than their more-experienced colleagues;
- 40 per cent of those who had done their PhD 16 years ago reporting that they had no interest in mobility;
- Common motivations for mobility were to get a new job, to gain overseas experience, to work in a prestigious institution and to work in an environment relevant to their field of research;
- More than three-quarters of respondents were open to further mobility in the future, with the strongest driver ‘an increased quality of life’, followed by the availability of research funding and the ability to secure a more senior position; and
- A significant factor in deterring mobility were concerns about limits being placed on researcher autonomy.

Another study of researchers, this time from the European Commission, incorporated a survey of 10,000 researchers currently working in Europe, 4,000 researchers working outside Europe, an analysis of research work in 45 economies (including eight APEC economies)⁴⁰. The key findings are shown in **Figure 6**.

Figure 6: Key findings from European Commission MORE2 study



The study suggests that long-term and short-term mobility are highly correlated and that the greater the duration of mobility the more likely researchers are to engage in international collaboration, with relationships stemming from the mobility experience⁴¹. Similarly, collaboration with industry arises mainly among researchers who have experience working in industry⁴². The EU emphasis is reinforced by the OECD which emphasises that mobility of skilled graduates has increased in line with the evolution of globalisation and that this “plays an important role in shaping skilled labour forces”⁴³.

In the Asia-Pacific region there are significant imbalances in the distribution of research expertise and the capacity to innovate. This is due to a number of factors, not least the capacity of emerging economies to attract skilled workers in a competitive market. But the imbalances are also a consequence of contrasts in policy contexts, with governments in some economies placing considerably more emphasis on research and innovation than in others. Researcher mobility has an important role to play in establishing a climate of trust.

Overall, this section has shown that there is a substantial amount of researcher mobility among APEC economies and that international collaboration is an increasingly common characteristic of research activities. These patterns reflect the increasingly global nature of research and the need for economies to enable inward and outward mobility of researchers in order to play a role in international efforts to solve global problems.

In the APEC context, there is enormous scope for economies to build on the researcher mobility that exists to enhance collaboration, helping to fulfil the APEC goals of regional integration and technical cooperation. Achieving this calls on greater cooperation between APEC economies to share good practice and develop joint projects to support researcher mobility. It also calls on economies, regional groups, institutions and disciplines to develop policies and initiatives to encourage and support researcher mobility.

3. Initiatives to support researcher mobility

3.1 Global initiatives

Global initiatives to encourage research mobility are perhaps most apparent in multi-lateral approaches to addressing global challenges. Faced with common challenges which are beyond the scope of individual economies to solve, high level policy commitments across multiple economies can help establish a context in which researcher mobility is favoured.

Global bodies such as the United Nations are able to facilitate processes in which global, regional, domestic and private actors agree to adopt collaborative approaches to critical issues⁴⁴. Examples might include the UN Convention on Climate Change and the Millennium Declaration.

The Intergovernmental Panel on Climate Change (IPCC) is an example of a global approach to research in order to address a challenging global problem, and one that has been successful in influencing policy. It was established in 1988 and works to review research findings related to climate change through the voluntary collaboration of researchers from around the world⁴⁵. The IPCC was awarded the Nobel Peace Prize in 2007. It is regarded as instrumental in raising the awareness of policy makers and citizens about climate change and steps that can be taken to mitigate, and adapt to, its consequences⁴⁶.

International agreements are powerful in their ability to gain sufficient traction to stimulate coherent and coordinated responses. Often a targeted group of actors will sign up to promote a particular approach and to frame responses which involve the bringing together of expertise from around the world in focused research to devise responses and solutions. As research from the OECD notes:

‘A firm mandate at the outset of an international collaboration effort facilitates recognition and trust. It is a key element of an effective foundation for international collaboration’⁴⁷.

Beyond this, it is ideal if policy makers in economies link global strategies to their own

political and research priorities, ensuring that they receive political and financial support. This also increases the likelihood that global commitments will generate international linkages for domestic researchers, facilitating their mobility. The latter point is critical as there is powerful evidence that policy makers are much more reluctant to fund international research projects than to fund domestic ones that link into global initiatives⁴⁸.

Box 2: Case Study of agricultural research in Indonesia and Peru

The **Consultative Group on International Agricultural Research (CGIAR)** is a strategic research group incorporating 15 research agencies worldwide, including APEC economies: Indonesia; Malaysia; Mexico; Peru; the Philippines and the United States.

Its research takes place in cooperation with domestic, private and multi-lateral agencies and private sector organisations. The focus is on the reduction of rural poverty; improved food security, improved nutrition and health and the improved management of natural resources⁴⁹.

Examples of research centres include the *Centre for International Forestry Research* in Bogor, Indonesia which conducts research on forest and landscape management and works in 30 countries⁵⁰.

Another is the *Centro Internacional de la Papa* based in Lima, Peru which undertakes research in root and tuber farming and capacity development in more than 20 countries⁵¹. It is estimated that each dollar invested in CGIAR generates nine dollars in increased productivity⁵².

A further critical element in ensuring that global approaches to researcher mobility are sustained and fruitful is the engagement of non-government actors. Private funding agencies such as the Bill and Melinda Gates Foundation can help ongoing funding of pure research, but the sustainability of research initiatives is further reinforced by the engagement of industry and business partners. This enables the

research to be used to stimulate innovation and commercial applications of research⁵³.

Research centres which are regarded of being of particular excellence have traditionally been focused on Europe and North America. But this is rapidly changing, as emerging economies gain a stronger place in the global research community. For example, Chinese researchers accounted for 17.4 per cent of research publications in 2014, up from just 2.5 per cent in 1996⁵⁴.

The emergence of research centres in other regions has resulted in ‘an increasingly multi-polar scientific world in which the distribution of scientific activity is concentrated in a number of widely dispersed hubs’⁵⁵. This context has a number of important implications for policy makers at the local, domestic, regional and international level. It is increasingly important that economies work together to facilitate international approaches to research which minimise inefficiencies and duplication. Examples are shown in Box 3⁵⁶.

Box 3: Methods to enhance internationally collaborative research

- Coordination between research funding agencies;
- Sharing the use of research infrastructure;
- Establishing global centres of excellence around challenging issues;
- Building research capacity in emerging economies;
- Open-access publication of key research journals;
- Global data collection on research activity, output, quality and impact; and
- Global data collection on researcher mobility.

Facilitating global collaboration on research, and the development of research capacity in emerging economies, is underlain by researcher mobility. This shapes skilled labour forces and also enables the diffusion of knowledge. Virtual collaboration facilitates ongoing cooperation between cross-national teams of researchers but physical mobility still has a critical role to play in the establishment of these relationships⁵⁷.

Contributing to a global research culture places significant imperatives on policy makers. It requires policies that facilitate researcher mobility, both outward and inward. It requires research environments and facilities that are attractive to researchers. It requires the recognition of foreign qualifications. And all of these policies need to work together in a coherent way⁵⁸.

3.2 Regional initiatives

Regional initiatives to integrate research and to support researcher mobility can be found around the world. In South-East Asia, ASEAN member economies (seven of which are also in APEC) have coordinated research over many years. This strategy has grown out of one of the goals of ASEAN to ‘provide assistance to each other in the form of training and research facilities in the educational, professional, technical and administrative spheres’⁵⁹.

Box 4: Case study of ASEAN Research Clusters

Under the auspices of the **Southeast Asian Ministers of Education Organisation Regional Centre for Higher Education and Development (SEAMEO RIHED)** strategies include four regional research collaborations around health & medicine, environment & biodiversity, agriculture & food and social science⁶⁰.

Each research cluster is led by two or three core economies and core universities (for example Malaysia; Thailand and Viet Nam lead the research collaboration on agriculture and food).

The objectives are to encourage research collaboration among ASEAN researchers, to investigate common problems, to increase the visibility and impact of ASEAN researchers and to support the development of common policy frameworks⁶¹.

In 2014, ASEAN and the EU gave a joint workshop on opportunities for ASEAN researchers in Europe, organised by EURAXESS Links ASEAN⁶². The workshop showcased research funding and mobility opportunities and included presentations from

some of the top research organisations in Europe such as the European Molecular Biology Organisation.

This event formally opened up opportunities for collaboration around research to researchers working in ASEAN. The involvement of EURAXESS is important as it is the main European portal for researchers to find research positions in European countries⁶³. These websites provide access to job opportunities, funding opportunities and events and users can sign up for a regular newsletter. To encourage the efficient use of resources the European Portal on Research Infrastructures Database provides information on research infrastructure across Europe which is open for use by external researchers⁶⁴, with the objective of making full use of infrastructure to fuel scientific innovation.

Regional coordination of research around APEC economies also takes place under the auspices of a number of agencies. An example is the Asia-Pacific Network for Global Change Research (APN) which receives funding from the Hyogo Prefectural Government and Ministry of the Environment in Japan, the Ministry for the Environment in New Zealand, the Ministry of Environment in Korea, and the National Science Foundation and US Global Change Research Program in the USA. The APN aims to facilitate research into natural systems and their importance for sustainable development⁶⁵. The agency does this through an explicit focus on regional cooperation, research capacity enhancement and input into policy decision-making.

The APN provides funding for research in its key areas of focus, particularly around climate change, ecology, environmental science and sustainable development. Two of the twenty-eight projects funded in 2013 were a study of global warming on the Indian Ocean with participation from researchers in China, Malaysia, Pakistan, Thailand and the USA⁶⁶ and a study of the impact of climate change on East Asian river basins with participation from researchers in Indonesia, Korea, Lao, the Philippines, Thailand and the USA⁶⁷.

While regional initiatives are of value there is some concern that they do not yield as much inter-regional collaboration as they could. An

example comes from ASEAN in the field of biotechnology. Biotechnology has been the main area for cooperation in science and technology among ASEAN members since 1983.

Bibliometric data shows that there was an increase in ASEAN output in the biotechnology field between 2004 and 2013, with a clear connection between R&D investment and output for each economy⁶⁸. Moreover, publications with international co-authors have also increased. Research partnerships among ASEAN members, however, remain very limited and most international co-authors come from outside South-East Asia. This suggests that more efforts are required to stimulate research collaboration among APEC economies.

Box 5: Case Study of the Economic Research Institute for ASEAN and East Asia

The **Economic Research Institute for ASEAN and East Asia (ERIA)** was established in 2007 with agreement from sixteen economies and works closely with the ASEAN secretariat. Its function is to undertake analytical research and capacity building, with research conducted in three key areas – economic integration, sustainable development and the reduction of differences in development⁶⁹.

Collaborative research projects include one focusing on the prevention of disaster in industrial parks, with researchers from Japan; Indonesia; the Philippines; Thailand and Viet Nam⁷⁰ and another on benchmarking biodiesel fuel standardization with researchers from Australia; China; India; Indonesia; Japan; Korea; Malaysia; New Zealand; the Philippines; Thailand and Viet Nam.

3.3 Economy initiatives

While much researcher mobility and research collaboration arises from people to people links it is enhanced by support from universities as well as the support of research funding agencies and governments. Universities are vital in providing a structure of pre-existing links with other institutions which provide ‘channels’ for

researchers to engage through. The political context in which universities sit is also critical. There are a number of ways in which researcher mobility and research collaboration with international partners fosters benefits for economies. Barlow summarises these as:

Box 6: Benefits of international research collaboration, Barlow⁷¹

- *Improving understanding between economies* – building trust between research communities and promoting shared values;
- *Resolving international disagreements* – providing a means to achieve agreement around controversial issues;
- *Coordinating shared responses to crisis* – creating networks of experts to provide rapid response and information exchange;
- *Collecting information about other economies* – finding out about new developments through relationships between researchers;
- *Generating strategic advantage* – working collaboratively to create technological advantages over other economies; and
- *Providing humanitarian assistance* – developing research capacity to enable emerging economies to solve pressing problems.

Research on policy around researcher mobility is somewhat limited but indications suggest a highly varied approach to domestic policy around researcher mobility⁷². In relation to researcher mobility a number of key policy areas are significant, from migration, to the recognition of foreign qualifications, to social services and to the funding of research.

The OECD reports that there is often a degree of incoherence between policies so that some encourage researcher mobility whereas others - in particular those which govern administration and legal concerns – can make mobility quite challenging. Overall, the OECD recommends removing barriers to short-term and circular mobility among researchers wherever possible, at the same time as ensuring that the context is supportive of research and innovation⁷³.

On the whole, incoming researcher mobility

tends to be subject to broad policy coverage whereas the OECD suggests that outgoing researcher mobility is less well targeted by policy makers, despite many economies having schemes to encourage their researchers to be outwardly mobile⁷⁴. Economies which are net recipients for skilled workers tend to use their migration system to encourage and facilitate mobility.

Despite the clear benefits of researcher mobility and international collaboration in research, these have not automatically formed a core part of government policy in the past. This suggests the need for policy considerations to include strategies to enable researcher mobility.

‘There is very little choice for governments; either they invest in policies that are premised on a higher degree of circulation or they run the risk of undermining the very developments that policy wants to foster, that is, a highly educated globally competent workforce’⁷⁵.

Regardless of differences between economies, all need to have policies which not only promote mobility but also demonstrate a nuanced understanding of the needs of researchers. For emerging economies with limited research infrastructure and resources it is important to collaborate in order to build capacity and to establish their own networks which can then tap into networks that exist in more established economies.

It appears that international collaborations are extremely important to research impact and commercialisation within economies⁷⁶. Indeed ‘migrants returning with cutting edge knowledge and networks abroad are considered important transmitters of technology and tacit knowledge’⁷⁷. This demands suitable responses from governments. Adams suggests that governments need to consider three key elements:

- ensuring conditions that attract top researchers with the skills to exploit knowledge;
- developing incentives for universities to engage in international partnerships; and

- encouraging collaborative relationships with research centres throughout the world which include the circulation of research staff in all directions⁷⁸.

Policy makers are increasingly being called on to ensure that policies respond to the increasingly global nature of research. The Royal Society recommends that appropriate policy responses should include the elements shown in Box 7.

Box 7: Policy responses that encourage researcher mobility, Royal Society⁷⁹

- Consistent and sustained research funding, regardless of economic downturns;
- Research strategies that emphasise, and reward, international collaboration;
- Contribution to global research efforts attempting to tackle common problems;
- Financial support for researcher mobility, such as mobility grants;
- Reduction in barriers to flows of researchers through alterations to visa conditions;
- Greater support for interdisciplinary and collaborative projects; and
- Policy making that is based on evidence, enabling researchers to inform policy.

Beyond attracting researchers from other parts of the world to base themselves in an economy, another policy around researcher mobility that has been successfully used is diaspora repatriation. In this case an economy implements specific policies to attract researchers from that economy who have moved overseas to return⁸⁰. Examples of APEC economies where this approach has been successfully implemented include China, Chinese Taipei and Korea. In these cases the returning expatriates have played a significant role in the evolution of knowledge-based economies and innovation⁸¹.

Achieving this outcome requires significant investment in infrastructure and institutions in order to attract expatriates away from highly attractive positions in other countries. It also

requires economies to be proactive. For example, several agencies from the government in Chinese Taipei established offices in Silicon Valley in order to connect with expatriates and to monitor technological advances. Producers from Chinese Taipei also entered into manufacturing partnerships through the connections of Chinese Taipei expatriates in the United States⁸².

Box 8: Case study of the Australian Research Council

In Australia the Australian Research Council (ARC) supports international research collaboration and researcher mobility in a number of ways in order to optimise the contribution of, and benefits for, Australia⁸³.

- The **Excellence in Research for Australia initiative** provides information on research excellence at Australian institutions and highlights areas which are emerging in importance, which may be useful to potential international collaborators.
- Under the **National Competitive Grants Programme** international collaboration is supported through research funding⁸⁴. There are more than 7,000 instances a year in which projects incorporate international collaboration, with a particular focus on the United States, China, New Zealand, Canada and European Countries. But this focus of collaboration is steadily becoming more diverse and in 2015 there are more than 200 instances in which projects involve collaboration with Japan, more than 100 with Singapore and around 60 each with Korea and Indonesia.
- The Australian Research Council also funds the inward mobility of researchers from around the world through a range of programmes⁸⁵. Researchers can access these through the research offices of Australian institutions. These include **Linkage Programmes** to facilitate cooperative approaches to research, ARC-funded Research Centres which bring together researchers from around the world to focus on key challenges, the **Discovery Programme** which funds fundamental research to power innovation (and

which includes international awards).

In Japan the Japan Society for the Promotion of Science supports researcher mobility in a number of ways including support for international joint research programmes and grants to support researcher mobility directly. Examples of initiatives include International Collaborations in Chemistry (ICC) which the Japan Society for the Promotion of Science facilitates in collaboration with the National Science Foundation in the United States. The programme involves researchers from both economies working together on chemistry research in order to find new synergies⁸⁶. The Japan Society for the Promotion of Science also promotes international research exchange between Japan and other economies, including seminars, research projects and the exchange of researchers⁸⁷.

The Australian Department of Education and Training administers the Endeavour Scholarships and Fellowships which are internationally competitive, merit-based scholarships that support citizens around the world to undertake study, research and professional development in Australia and for Australians to do the same overseas.

In addition, the Department of Industry, Innovation and Science has partnered with other economies to support scientific and research collaborations of mutual benefit, including through the Australia-China Science and Research Fund and the Australia-India Strategic Research. Further, the Australian Government National Health and Medical Research Council supports grants for Australian researchers to collaborate with international experts to solve global health problems. Many other economies have similar grants and opportunities available to support researcher mobility.

3.4 University network initiatives

Beyond global, regional, economy and disciplinary initiatives to support researcher mobility, networks of higher education institutions also work together to enhance researcher mobility. Support most commonly includes language, accommodation, visas,

insurance and employment assistance⁸⁸.

For example, Universitas 21 is a network of 27 research intensive higher education institutions in 17 countries, including the APEC economies of Australia; Canada; Chile; China; Hong Kong, China; Korea; Mexico, New Zealand; Singapore and the United States⁸⁹. Universitas 21 provides a number of schemes to support the mobility of research students and early career researchers. The Universitas 21 Early Career Researcher (ECR) Workshops are designed to enable ECRs at U21 universities to develop an international network of colleagues while expanding their skill set and understanding of research career development in their field. Numerous member universities offer travel scholarships to research students from other countries.

Box 9: Case study of the Inter-American Organisation for Higher Education

The **Inter-American Organization for Higher Education** (IOHE) encourages collaborative activities among its more than 300 member institutions⁹⁰. The College of the Americas (COLAM) is one of the IOHE programmes and provides training and research networks in order to promote networking and cooperation among institutions⁹¹.

COLAM also seeks to address common challenges in innovative ways using interdisciplinary approaches. COLAM provides online training and organises its activities around a number of core themes. These include social determinants of health; women, gender and development; and governance and human rights⁹².

A series of workshops targeted at early career researchers encourage the sharing of good practice and making links across member institutions, as well as enhancing collaborative research and faculty mobility⁹³. For example the 2013 workshop was on 'Innovative Technologies: From Research to Impact on Society' and was held at Tecnológico de Monterrey in Mexico.

Universitas 21 also offers a module in Global Ethics and Integrity which enables participants to consider good practice and the responsibility

of researchers in conducting research⁹⁴. This is an online course targeted at research students and lets participants work through a number of case studies and engage in critical reflection and discussion. Eight units cover areas such as intellectual property, consent, animal research and research commercialisation.

Box 10: Case study of the Association of Pacific Rim Universities

Members of the **Association of Pacific Rim Universities** (APRU) include 45 research universities across 17 APEC economies. APRU actively encourages researcher mobility across member institutions in a number of ways, including the sharing of information on opportunities for researchers. These include post-doctoral fellowships, internships, scholarship and grants for research activities⁹⁵.

The opportunities include those at member universities as well as at multi-lateral organisations such as the Asian Development Bank and the World Health Organisation South-East Asia Region. There is also an APRU Early Career Researchers Network which brings together researchers around the region and links them to each other as well as more senior researchers. It is specifically aimed at introducing researchers to potential research collaborators⁹⁶.

Another example is the Worldwide Universities Network includes members in the APEC economies of Australia; Canada; China and New Zealand⁹⁷. It has more than 90 active research projects including more than 2,000 researchers with the support of the United Nations, World Bank, OECD and World Health Organisation. Research focuses on four key global themes: climate change, public health, higher education and research and understanding cultures⁹⁸. Under each theme institutions in the network collaborate with each other and with foundations, government, donors and industry. The Worldwide Universities Network also has a research mobility programme for research students and early-career researchers to gain international exposure and increase their networks.

Box 11: Case study of Innovative Research Universities' engagement in Asia⁹⁹

The **Innovative Research Universities in Australia** (IRU) (a network of six universities) have a strategy to enhance engagements with universities in the Asian region. They place a particular focus on Malaysia and have sent delegations in 2012, 2013 and 2014 to make connections with research universities in Malaysia. This has resulted in agreeing a joint programme of AU\$1.3 million from 2014 and 2016 to strengthen joint research activities.

The IRU also works with the Australian Embassy in Thailand on an early-career researcher mobility program, involving the exchange of researchers between Australia and Thailand. In addition, the IRU has also established the 'IRU Scholars in Asia' programme to support Australian student mobility to Asia and has an Asian Languages Network to teach Indonesian, Japanese, Mandarin, and Hindi.

Beyond universities themselves, disciplines have a vital role to play in supporting and stimulating researcher mobility. There is evidence that 'communities of practice, which are often initiated within disciplinary communities, play an important role in the dissemination of knowledge across economies and regions¹⁰⁰. This may be due to the pre-existence of social ties derived from disciplinary gatherings or simply that the discipline provides an organising framework around which trust is more easily built.

In Australia the four learned academies (the Australian Academy of The Humanities, the Australian Academy of Science, the Academy of The Social Sciences In Australia, the Australian Academy of Technological Sciences and Engineering) have prepared a joint publication on 'Smart Engagement with Asia'¹⁰¹. This states that "international research collaboration represents a significant mode of institutional and people-to-people connectivity between countries"¹⁰².

Two disciplinary examples of initiatives to stimulate research mobility come from the

fields of science and technology:

- The **Royal Society of Chemistry** provides research mobility grants for research students and early career researchers to undertake short term mobility either to the United Kingdom or elsewhere¹⁰³. There are a number of funding options available for British and international applicants which vary in both duration and scope. The grants cover travel, accommodation and subsistence with funding also available for administrative costs such as visa fees and insurance.
- The **Network of Excellence in Internet Science** aims to strengthen joint research activities and has a particular focus on early career researchers and research students¹⁰⁴. Joint supervision of research students is supported, as are networks of PhD students. The programme also aims to foster research collaboration between academia and industry. To this end, mid-career researchers, entrepreneurs and policy makers are also eligible to participate in mobility. Funds are available both for mobile researchers and for the institutions that host them.

4. Mobility throughout the research career

As previous sections have shown, the world of research is increasingly globalised, demanding that researchers collaborate with their peers in other countries. This has important implications for researchers at all stages of their careers. This section considers researcher mobility of research students, early career researchers and mid and late career researchers. It looks at the benefits of researcher mobility and the factors which both facilitate and challenge it. It then goes on to consider strategies to overcome barriers and good practice examples from around the world.

‘Migration of talent now plays an important role in shaping skilled labour forces ... The importance of mobility stems from its contribution to the creation and diffusion of knowledge’¹⁰⁵.

4.1 Patterns and trends of researcher mobility

There are many different types of mobility and different ways of being a mobile researcher. Mobility can vary by length of stay (from short-term visits to long-term relocations), frequency of moves, and whether the researcher returns to their home country. Concepts such as *brain drain* (net outflows from a country), *brain gain* (net inflows to a country), *brain circulation* (short-term mobility), and *return mobility* have been used to describe patterns and trends in researcher mobility.

4.1.1 Research Student Mobility

For research students, there is evidence that mobility is becoming increasingly common. **Table 2** shows that international students make up more than 19 per cent of research students in the five APEC economies for which data is available, compared to much smaller proportions of international students across all levels of tertiary education.

Table 2: International students as a proportion of advanced research students¹⁰⁶

Host Economy	International students as proportion of all tertiary students	International students as proportion of students in advanced research programmes
Australia	18	32
Canada	8	24
Japan	4	19
New Zealand	16	41
United States	4	29

Moreover, research on research students in STEM disciplines in the United States has shown that the number of doctorates awarded to non-citizens rose from around one-quarter to greater than one-half between the 1970s and 2010¹⁰⁷. This corresponds with patterns in other parts of the world¹⁰⁸.

While increasing overall, research student mobility has been shown to differ by field of education. For example, a global study of 7000 research students in technological fields found that top research universities in the USA were

able to attract research students from other institutions around the world in certain disciplines but not in others¹⁰⁹. One of the reasons suggested is that strong domestic industries in some areas act as an alternative pull factor for researchers.

There are increasing indications of the ‘innovative role that graduate students play in promoting new and novel research’¹¹⁰. Evidence suggests that when research students are mobile they add diversity to the research teams they join and their presence also

facilitates cross-border research collaborations, both of which lead to ‘multiplicative effects on innovation’ demonstrated by increased publications and citations¹¹¹. Research student mobility has a positive impact on patent applications and awards to their host universities¹¹² and there is evidence that mobile post-graduate students have a higher research output during their studies than those who are not mobile¹¹³.

Even short-term research placements of graduate students in a partner economy have contributed to research projects at the host institution and the dissemination of knowledge¹¹⁴. The opportunity to develop soft skills is an additional benefit of research student mobility. For example, mobility provides students opportunities to improve language skills, establish independence and gain confidence in their abilities¹¹⁵. Overall, their movement enables them to build up human and cultural research capital which ties together research communities in multiple economies¹¹⁶.

Box 12: Case Study of Research Student Mobility at Mahidol University Thailand

Mahidol University is the top ranked university in Thailand¹¹⁷ and emphasises research collaboration with international and industry partners, as its research activities and publications attest.

Its postgraduate population includes more than 8000 students enrolled in more than 250 postgraduate degree programmes. 150 programmes are international, taught in English and attract graduate students from more than 40 countries.¹¹⁸

Since 2014 Mahidol University is included in the Australia-Thailand Young University Researchers’ Exchange Programme, an initiative which aims to enhance research collaboration through bringing together researchers from both countries¹¹⁹.

A study of research training overseas for research students from six South-East Asian economies found that between 60 and 90 per cent of all research students studied overseas and that return rates varied significantly, from

35 per cent in Viet Nam to 93.2 per cent in Thailand¹²⁰. Mobility enables researchers from the region to build networks and collaborations all over the world. These ‘science conduits’ can be leveraged to enable the flow of knowledge in multiple directions once research students have graduated and commenced their careers¹²¹.

4.1.2 Early Career Researcher Mobility

Once research studies are complete, post-doctoral researchers often move into several years of precarious employment consisting of short term and temporary contracts prior to gaining more security¹²². In navigating this critical phase of a research career it appears that researchers are open to international mobility. A survey of *Nature* readers found that 90 per cent of those who had gained a doctorate in the past two years indicated that they were interested in an international move, compared with just 60 per cent of those who completed their doctorate at least 16 years ago.

It is clear that this willingness to move abroad among early-career researchers plays out in patterns of employment. A GlobSci survey of 17,000 researchers found that foreign post-doctorates outnumbered foreign assistant, associate or full professors in 15 of the 16 economies surveyed, including APEC economies such as Australia; Canada; Japan and the US¹²³.

The percentage of post-doctoral researchers who were employed in an economy other than their economy of citizenship was also greater than the corresponding percentages for established researchers and leading researchers in the MORE2 Higher Education Survey¹²⁴, something which has been confirmed in other studies¹²⁵.

A study on established researchers in the fields of natural and physical science and engineering in the Asia Pacific found that 20.3 per cent of researchers in APEC economies had obtained their research degrees in another economy and 60.2 per cent had held a foreign post-doctoral position but that these proportions varied significantly between economies¹²⁶, as Table 3 illustrates.

Table 3: Foreign research degrees and post-doctoral positions¹²⁷

Economy	Foreign research degree (per cent)	Foreign post-doctoral position (per cent)
Australia	24.2	53.0
China	20.9	54.8
Japan	4.0	64.4
Korea	38.9	70.0
Chinese Taipei	56.2	49.7

It is noteworthy that such a large proportion of Japanese researchers had experienced a foreign post-doctoral position compared with such a small proportion obtaining a foreign research degree. This indicates a coherent strategy of undertaking post-doctoral positions in other economies in order to gain international experience.

Interestingly, the research found that while there is a strong relationship between current networks and collaborations and whether researchers had undertaken a foreign research degree and/or foreign postdoctoral position, the location of post-doctoral positions had *more* of an impact on networks and collaborations than the location of the research degree.

In total, 95.3 per cent of those who had held a foreign post-doctoral position were involved in an international research collaboration that had produced knowledge outputs such as publications¹²⁸. The authors conclude that:

‘Postdoctoral positions are more significant than research degrees in the formation of social-capital networks ... [,] make a positive subsequent contribution to transnational knowledge-production activity ... [and] such activity is also an indicator of the durability over time of social-capital networks formed at the postdoctoral level’¹²⁹.

As this study also shows, however, twice as many respondents in the study had done a research degree as had held a post-doctoral position. Given that so many researchers do not go on to undertake post-doctoral positions, mobility *both* during research degrees *and* during post-doctoral activities is significant in stimulating research collaborations.

Researchers who are mobile early in their careers report a positive impact on research

outputs, research impact, research skills, development of contacts and career progression¹³⁰. There are indications that the mobility of researchers during the post-doctoral phase is critical to establishing international research collaborations.

The post-doctoral phase of a research career is ‘the most vital in the formation of durable networks ... post-doctoral positions appeared strongly correlated to the organisation of transnational collaboration knowledge production activities’¹³¹.

The propensity of young, early career researchers to be mobile is an important factor enabling knowledge sharing between domestic and international research teams. For example, a study of researchers in universities in Norway found that 28 per cent of post-doctoral fellows and 19 per cent of PhD students were foreign born, compared with 14 per cent of full professors¹³².

A range of benefits are experienced by early career researchers. Benefits reported across a range of studies and economies include opportunities for career development, integration into international networks, and higher involvement in national and international research grants. Other benefits reported by mobile researchers have included gaining feedback on their own research, keeping up to date, providing a source of inspiration.

Box 13: Case study of the Indonesian Scheme for Academic Mobility and Exchange

The Indonesian Scheme for Academic Mobility and Exchange (SAME) was created by the Directorate General of Higher Education to form lasting relationships between higher education institutions in Indonesia and the United

States¹³³.

It enables Indonesian researchers to engage in mobility for up to three months in order to forge networks with American colleagues. The SAME scheme has involved more than 450 Indonesian researchers and incorporates a sandwich program to help enhance the quality of publications and grants for collaborative research and publications¹³⁴.

4.1.3 Mid- and Late- Career Researcher Mobility

Once researchers reach the mid and later stages of their careers there are strong patterns of research collaboration with colleagues in other countries. For example data suggests that collaboration with colleagues in other economies is much more common among mid and late career researchers than among postgraduate or early career researchers¹³⁵. But researchers are much less mobile, tending to have established their careers in either their economy of upbringing or another economy.

This indicates two important factors. First that connections built at the early career stage appear to fuel ongoing international collaborations in later career phases. Second that patterns of mobility among mid- and late-career researchers differ from those of younger researchers. As one study found:

‘Over time the ability to return or to put down roots abroad becomes more important to mobile scientists. Ultimately, by mid-career, most respondents were aiming to achieve continuity both professionally and personally, lessening the likelihood of returning to the home country’¹³⁶.

This finding has implications for rates of return mobility in mid and late career stages. A study found that researchers working in another economy were less likely to return home once they were tenured professors than those with contract positions¹³⁷. One of the reasons for this is undoubtedly family ties. Another study of expatriate researchers found that those who were older, those with children integrated into the local school system and those with family

residing abroad (including those married to natives of the host economy) expressed a higher intention of remaining abroad¹³⁸.

Many of the benefits of mobility discussed in relation to early career researchers are also relevant to mid- and late- career researchers. For example, research on past recipients of fellowships for experienced researchers from a foreign scientific foundation found that fellowships increased human and social capital through publications in international journals, involvement in international research projects, integration into international networks, access to better research facilities, and opportunities to attend scientific conferences¹³⁹. In addition, many past fellowship recipients introduced their students and younger colleagues to former host research centres and foreign foundations.

Mid and late career researchers who are mobile have the opportunity to accrue a number of connections, both internationally and domestically. They can be regarded as ‘bridging researchers’, meaning that they are able to ‘broker’ relationships between colleagues in different networks for the purposes of collaboration¹⁴⁰. The researchers most likely to be able to fulfil these essential positions are those with a higher than average number of international linkages and history of collaboration both internationally and domestically.

In a study of the wine industry in Chile and South Africa it was found that these bridging researchers tend to be relatively small in number and are characterised by high publishing productivity. The research makes clear that bridging researchers are particularly important in emerging economies where they can ‘provide gateways to international science for the domestic industry’. As such, policy makers may wish to focus on incentivising the recruitment of particularly outstanding individuals who are well connected both internationally and domestically, particularly in research areas of strategic importance to economic growth¹⁴¹.

Indian and Chinese researchers were behind the establishment of more than a quarter of technology companies in Silicon Valley between 1980 and 2000, creating more than

100,000 jobs and generating US\$37 billion in revenue¹⁴². Equally, the return of many US trained researchers to their home economies has also resulted in innovation hubs. For example the establishment of Hsinchu Science Park in Chinese Taipei was led by the return of researchers from overseas, transferring ‘global best practice [to] support the growth of new technology ecosystems’¹⁴³.

‘Cross-border professional and technical communities transfer technical, market & business information rapidly between distant regions ... Sub-national clusters of skill and technology in peripheral regions, supported by aggressive local policymakers, pursue cross-regional collaboration ... Highly mobile scientists and engineers pioneer entrepreneurial experimentation and innovation that supports upgrading and rising wages’¹⁴⁴.

An emphasis on brain circulation means that the focus of governments needs to be on leveraging researcher networks¹⁴⁵. This is particularly valuable for emerging economies which can draw on diaspora knowledge networks formed by expatriate researchers around the world. It further underlines the desirability of assisting their top students to undertake research training overseas (either through a fully-international PhD or via mobility during their research studies).

4.2 Factors which facilitate researcher mobility

Much of the evidence on factors facilitating researcher mobility is drawn from small-scale studies of mobile researchers from a particular home economy or working in a particular host country. Case studies such as these can illuminate both general trends and regional issues¹⁴⁶. While the research designs and sampling methods in many of these studies may lead to biased results, a number of common themes do emerge.

Mobility is influenced by the interplay of structural conditions (global and national science systems), state policies on mobility, professional opportunities in the home and host

economies and personal factors relating to culture, family situation and lifestyle aspirations and preferences. Different factors assume greater importance at different career stages.

Research indicates that post-graduate researcher mobility is particularly driven by motivations such as the quality of training available, the opportunity to engender career progression, the possibility of working with leading researchers and the availability of facilities and equipment¹⁴⁷.

For example, in a study of researchers working abroad, the motivations for leaving their home economy varied by career stage. Compared with more senior researchers, PhD students placed greater weight on the possibility of establishing international scientific networks, access to equipment unavailable in Portugal, and experiencing life in another country¹⁴⁸. Geographic proximity and the impact of cheaper travel can also facilitate mobility by allowing scientists to maintain family connections at home:

‘For younger doctoral candidates who have followed a direct route through higher education, a move for doctoral research often represents the first time they live away from home meaning that candidates not only have to adjust to living in a foreign country but also to living away from their parents for the first time... Being able to get home with relative ease and within a reasonable amount time can therefore be important’¹⁴⁹.

Early-career researcher mobility appears to be particularly driven by career and funding opportunities¹⁵⁰. In starting out on their research careers, early-career researchers are in search of possibilities which enable them to establish themselves as researchers and to work with leading researchers. For early career researchers, mobility can be a means of getting temporary funding while awaiting opportunities in their home country, a means of gaining international experience as a route to securing permanent employment abroad, or an opportunity to develop/enhance skills and cultivate research interests¹⁵¹.

*'It appears that experience abroad is very highly valued amongst scientists because it shows a certain degree of initiative and independence as well as the ability to work with other people from different cultures and backgrounds with differing approaches to science ... Most respondents felt that this was the way it should be and that especially more junior scientists should be mobile and should be expected to spend some time abroad to learn from more experienced scientists'*¹⁵².

Two types of mobile researchers were identified in a study of mobile researchers: those 'pulled' by high quality research and opportunities in their host economy and those 'pushed' by factors relating to their home country¹⁵³. The former are often young, PhD students or postdoctoral fellows who are drawn to research groups with a reputation for excellence and are there for a limited time to learn.

Pull factors include moving to established research centres with state-of-the-art laboratories and equipment; and moving to build the researcher's skills, knowledge and international networks. The prestige of the host university and the level of opportunities for research and accessing networks in the host economy are of importance¹⁵⁴.

Information and communication technologies (ICT) inevitably make research collaborations over distances much easier to carry out than would otherwise be possible. This raises the question of whether pull factors retain their importance. Despite the fact that ICT advances can make research activities such as access to shared data sets much easier, there is evidence that other factors continue to be critical in both establishing and maintaining the relationships between researchers that underpin collaborations. These include the strength of social connections, social obligations and commonalities between institutions¹⁵⁵. This suggests that researcher mobility remains extremely important in facilitating research collaborations.

Push factors affecting early career researchers include norms and expectations in the home economy that early career researchers should

gain experience abroad¹⁵⁶. More negative push factors such as a lack of job opportunities for early career researchers, a lack of laboratories and equipment, and lower wages and funding for research in their home economy has led to the 'forced' movement of postdoctoral researchers to wealthier economies and institutions¹⁵⁷.

Networks play a substantial role in mobility decisions but may work in different ways at different career stages. In a study of researchers working abroad, established researchers placed higher importance on having received an invitation to work at another institution than did PhD students, while PhD students tended to place higher importance on factors such as a desire to work with a particular scientist, a recommendation from a professor or colleague, having previously studied at the host institution, and the presence of other researchers from their economy on the team¹⁵⁸.

Immigration policies of some economies encourage the recruitment of skilled researchers from abroad and in these economies the higher education sector has relatively fewer restrictions on the number of visas that can be issued to researchers¹⁵⁹. Consequently, some countries, institutions and research groups are better placed to compete for mobile researchers.

Mid- and late-career researcher mobility appears to be particularly driven by a desire to be autonomous in research. At this stage in their careers researchers are likely to have developed a particular area of expertise and will wish to focus on that, and not be drawn away and into other research areas¹⁶⁰.

Family is another important factor. Various studies have shown that family reasons may either facilitate or inhibit mobility. In some instances, a desire to be closer to family and friends can be a factor encouraging mobile researchers to return to their home country. In other instances, mobile researchers may choose to remain in the host economy for family reasons. Having a partner with a job in the host economy or wanting a child to complete their education in one economy can inhibit return mobility¹⁶¹.

The importance of personal factors in the decision to move abroad increased with age in a

study of researchers living abroad¹⁶². A gendered dimension to mobility is also important. Women tend to place a greater importance on personal reasons such as being close to family and friends in the decision to move¹⁶³.

Box 14: Case study of AUN/SEED-Net

The **ASEAN University Network/Southeast Asia Engineering Education Development Network** (AUN/SEED-Net) was established in 2001 and began full-scale operation in 2003. The network currently comprises 40 universities from 10 ASEAN economies and Japan.

AUN/SEED-Net provides support for researchers from member institutions to visit or study at leading member institutions in the region or Japan. Support is available to researchers at various career stages. For example, over 900 academic staff have been supported to study for masters or doctoral degrees, with the majority subsequently returning to universities in their home countries.

Various other support programs are also available for postdoctoral students and faculty staff from member institutions¹⁶⁴.

The missions of AUN/SEED-Net are to:

- Nurture internationally competitive personnel with multicultural awareness through academic cooperation among leading engineering higher education institutions in ASEAN and Japan; and
- Advance engineering education and research capacities of leading engineering higher education institutions in the region through collaboration and solidarity between the educational and industrial sectors in ASEAN and Japan¹⁶⁵.

When researchers first move overseas they frequently intend to return to their home country, but after working abroad for a number of years, the number who consider returning tends to decrease¹⁶⁶. Factors influencing return mobility include family status, as well as political and economic concerns relating to the home country.

Familiarity with the language and culture of the host economy and the geographic proximity of

the home and host economies have also been identified as an influence on mobility¹⁶⁷. Mid- and late-career researchers tend to look for tenured positions, with the option of settling permanently¹⁶⁸, with limited financial resources for research in their home economy a major push factor¹⁶⁹.

Networks play an important role in facilitating mobility, with existing networks influencing location decisions. Additionally, among researchers planning to leave their host country, future short-time mobility has been identified as a means of maintaining the networks developed while in the host country¹⁷⁰.

4.4 Challenges to researcher mobility

A review of evidence makes clear that the greatest barriers to researcher mobility are the availability of opportunities, funding, salary differentials, visas and language proficiency, as well as practicalities such as accommodation¹⁷¹. For post-graduate research students, the biggest barrier to mobility is the availability of funding¹⁷². Tuition fees and the availability of equipment and post-graduate courses can also influence whether students undertake study abroad and where they move¹⁷³.

Visas and work permits are a perennial challenge in researcher mobility. In some economies the category of 'researcher' is not available for visas and researchers thus fall between 'student' and 'business' visa categories, neither of which are necessarily appropriate. Obtaining the right to work, including for spouses, can therefore be particularly problematic¹⁷⁴. Additional factors may include the ability to transfer superannuation, social security rights and the recognition of qualifications¹⁷⁵. Where research focuses on issues of political importance to an economy, such as defence, legal barriers may be even greater.

Similarly to post-graduate research students, the biggest barrier to early-career researcher mobility is the availability of funding, but an additional barrier is the availability of positions and opportunities. While post-graduate research students do not need to be paid and may be able to be accommodated into research teams, there

may be no salaries available for early-career researchers, impeding mobility. There are also indications that early-career researchers are concerned about losing the research networks they have established during their studies¹⁷⁶.

The barriers to mobility among mid- and late-career researchers tend to be somewhat different to those of post-graduate and early-career researchers. Research suggests there are more mobility opportunities for senior researchers, with more funding available¹⁷⁷. At the same time, senior researchers tend to have more personal responsibilities. Moreover, mid- and late-career researchers tend to have obtained a certain level of seniority and salary differentials between economies can impede mobility for extended periods of time unless the home institution continues to pay salary throughout the period of mobility.

A European Commission study found that a greater proportion of researchers live in a couple and have children than other types of employees¹⁷⁸. This inevitably has consequences for their motivation and capacity to undertake mobility. Work rights and career opportunities for the spouses of researchers can act as a barrier to longer terms research mobility, as can practical issues such as finding suitable accommodation.

In addition, home institutions may have concerns in relation to researchers and students visiting areas of high risk, such as regions where there are health or physical safety risks. In such instances, issues such as liability and indemnification, security regulations, evacuation plans, and visa clearance need to be addressed¹⁷⁹.

A final barrier to mobility is language. In highly internationalised research fields it is commonplace for English to have become a default language of research and this requires mobile researchers to be proficient in English¹⁸⁰.

4.5 Strategies to overcome challenges

A number of economies and research groups have developed a range of strategies to attract mobile researchers. These include scholarships,

fellowships, and exchange agreements; encouraging research centres and universities to advertise vacant positions internationally; the establishment of research centres of excellence and graduate schools which select high quality researchers; and policies that simplify procedures for obtaining work and residence permits for both researchers and their families¹⁸¹.

Encouraging brain circulation through the removal of barriers to researchers returning to their home economies is another area of intervention. A range of repatriation schemes have been used to encourage mobile researchers to return to their home country¹⁸². Policies aimed at encouraging return migration need to take into consideration the complex range of factors that influence mobility decisions¹⁸³.

A variety of online resources to facilitate researcher mobility have been developed such as EURAXESS, which focuses on jobs, services, and rights for researchers¹⁸⁴. One online resource, the Academic Careers Observatory (ACO), is designed to provide information on careers and mobility in the humanities and social sciences for early career researchers such as postdoctoral fellows. It aims to offer 'young academics a basic understanding of the structure of [domestic] academic systems and the formal and informal barriers to career advancement'¹⁸⁵.

ACO provides country-level information on topics including the competitiveness and openness of academic job markets to non-locals, as well as a listing of postdoctoral fellowship programs. The primary focus is on Europe, but some information on APEC economies such as Australia; Canada; China; Japan; and the US is also provided.

Box 15: Case study of the Canadian International Scientific Exchange Programme

The Canadian International Scientific Exchange Program (CISEPO) is an international collaboration involving medical scholars from Canada working in conflict zones to address health issues. CISEPO has developed partnerships with over 20 hospitals, 10 universities and a number of mother and child health centres

and citizen organisations¹⁸⁶.

Features include: international networks and workshops; action-oriented research; country-based science teams and projects; graduate scholarships and research fellowships; and mentoring by senior scholars. Over 30 years, CISEPO has arranged over 500 workshops on a range of joint educational and research projects and has been active in supporting researcher mobility¹⁸⁷.

CISEPO is premised on the idea that multinational and multidisciplinary approaches are necessary in order to address health problems. In addition, CISEPO has a broader mission of peace-building through health science in contributing to “relieving the socio-ethnic and political tensions that fuel armed conflicts and exacerbate acute public health threats”¹⁸⁸.

5. Academia-Industry research collaboration

Researcher mobility tends to be thought of in purely geospatial terms, referring to the movement of researchers from one economy to another. But another important form of researcher mobility is inter-sector mobility in which researchers move between academic and industrial sectors. Returning to the APEC Secretariat's emphasis on the role of education in fuelling innovation and economic growth, as well as building technological communities, this form of mobility is another important component.

Research undertaken by universities is increasingly being regarded as having significant potential in stimulating economic growth. Experience across economies suggests, however, that this potential is most likely to come to fruition when academic researchers form alliances with their peers in the business and industrial sectors.

This means that interest in collaborations between academia and industry continues to grow. And yet there are significant imbalances between institutions and between economies in the extent to which these linkages are both established and also successful.

There is evidence that universities are making a real difference to innovation in a number of industries. For example patent applications that cite scientific articles have been found to have increased significantly in the United States¹⁸⁹, with 'substantial expansion in biotech patenting [has been] driven by increasing knowledge spill-overs from university-based science'¹⁹⁰.

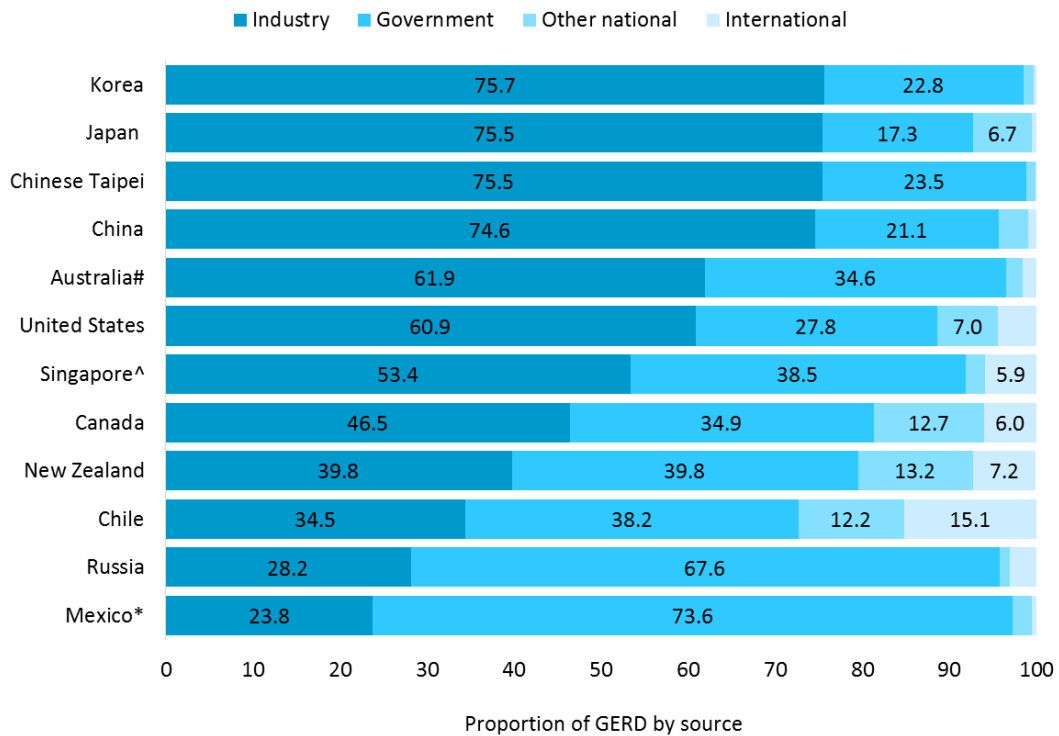
There are also indications that the two key factors in determining innovation are relationships between experts and knowledge dissemination¹⁹¹. The implication for economies is that using policy interventions to cultivate an environment in which academia and industry are able to build trust with each other are critical in fuelling innovation. Examples include support for networking and knowledge transfer between universities, the establishment or reinforcement of 'knowledge clusters' and industry and supporting existing collaborations.

5.1 Patterns and trends

A good indication of engagement of industry in research is the proportion of expenditure on research and development that comes from industry. Figure 7 illustrates all spending on research and development across APEC economies and from all sources. This extends beyond the higher education sector to cover all kinds of research funding.

The proportion of gross domestic expenditure on research and development (GERD) by industry varies from 75.7 per cent in Korea to 23.8 per cent in Mexico for the twelve APEC economies for which data is available. A degree of caution needs to be taken with this data as defence spending is often included in data on expenditure on research and development. Nevertheless, **Figure 7** does indicate that there are significant variations in industry funding of research across APEC economies.

Figure 7: Proportion of GERD by source, OECD, 2013¹⁹²



2008, ^ 2012, *2014

European research suggests that researchers in academia in the USA and Japan are highly active in collaborating with industry, much more so than in Europe, with co-publications with industry in 2008 at 70.2 per million population for the USA, 56.3 for Japan and 36.2

for EU countries¹⁹³. This is supported by metrics on average innovation performance, a composite indicator comprising twelve measurements with scores ranging between 0 and 1. Korea, the USA and Japan exceed EU performance, as Figure 8 indicates.



Figure 8: Innovation Performance and Growth Rates, European Commission 2014¹⁹⁴

When innovation growth rates between 2006 and 2013 are also considered, China and Korea have the highest growth rates but some other APEC economies, including Australia, Canada, Japan and the USA, have growth rates of 2 per cent and less and in Russia the growth rate is negative, at minus 1.8%. Other APEC economies are not included in the data sets and there is no equivalent data collection among these other economies.

These patterns are closely monitored in the EU with the Innovation Union Scoreboard report each year which comparatively assesses the research and innovation activities of EU members to inform policy decisions about how to support innovation¹⁹⁵. Interestingly, the biggest differences between the most innovative economies in the EU (Germany, Sweden, Finland and Denmark) and less-innovative economies are less to do with the number of researchers and the funding available.

Instead, critical factors appear to be the

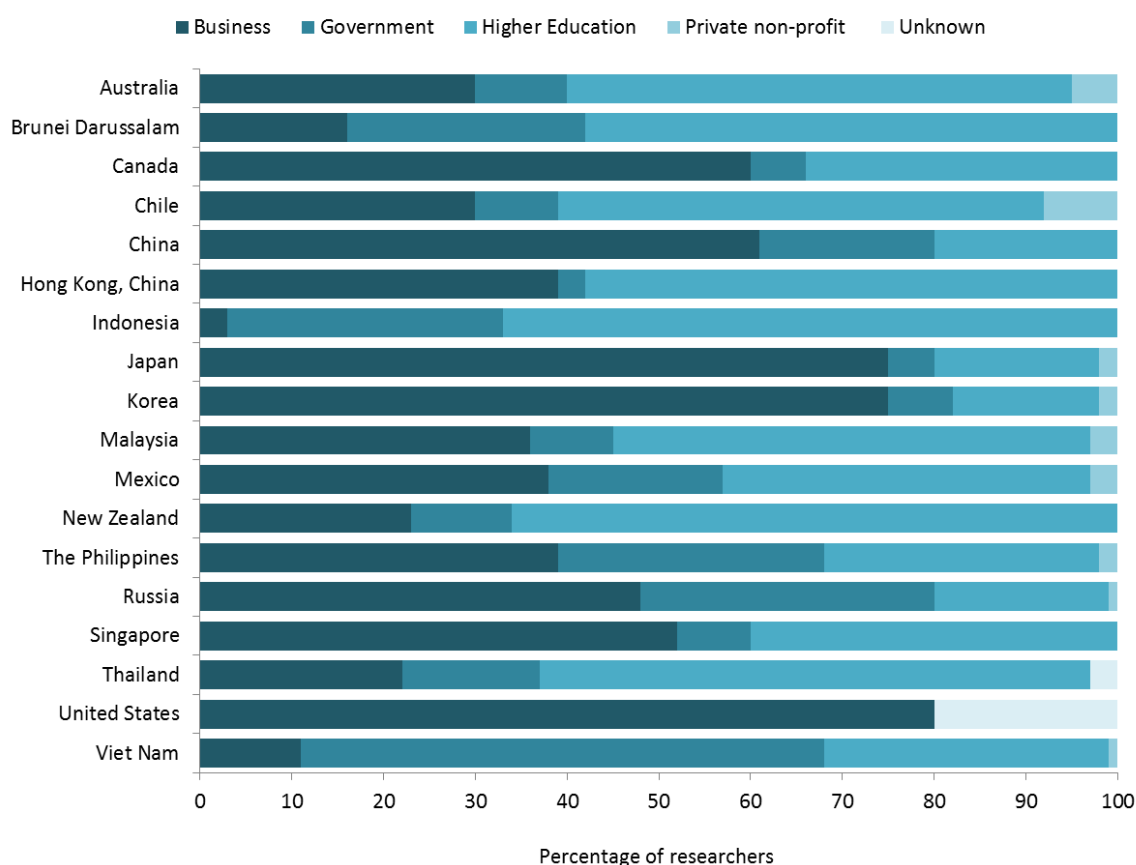
openness of their research systems to international cooperation and partnerships and the depth of connections between researchers and industry with “the research systems in these countries ... geared towards meeting the demand from companies”¹⁹⁶. This has important implications for APEC economies, suggesting the need for greater openness of the research environments in each economy towards collaboration with partners from other economies.

More than half of all researchers in the world are located in the APEC region, with Japan and the United States having the highest proportions of researchers per population¹⁹⁷. Researchers are not only found in the higher education sector but also in business, government and non-profit sectors.

As **Figure 9** shows, the distribution of researchers across sectors varies considerably from one economy to another.

Figure 9: Percentage of researchers by sector of employment

(Adapted from UNESCO Factsheet 21/2012 – Human Resources in R&D – no data available for Chinese Taipei, Papua New Guinea or Peru)¹⁹⁸



In Japan, Korea and the United States more than 70% of researchers are located in business, while this figure is just over 50% for Singapore, 30% for Australia and less than 10% in Indonesia. These figures are important because they indicate where academic-industry engagement is particularly important, notably in those economies whose research workforce is heavily concentrated in the higher education sector.

5.2 Benefits

Innovation is acknowledged to play a significant role in economic growth and development¹⁹⁹. The higher education sector plays a critical role in innovation in training researchers, contributing to innovation through

collaborations with industry partners and through its own innovation practices. Innovation is important in numerous economic sectors but the greatest focus tends to be on innovation in manufacturing and science and technology.

A 2013 UNESCO Institute of Statistics (UIS) Study considered innovation in four categories – product innovation, process innovation, organisational innovation and marketing innovation²⁰⁰. With consideration to just the first two, UIS data suggests that manufacturing firms in many APEC economies are active innovators, with more than a third of manufacturing firms in Canada, Malaysia and the Philippines being categorised as both product and process innovators, as Table 4 shows.

Table 4: Innovative manufacturing firms in APEC economies, UIS 2015²⁰¹

Economy	Product innovators (% manufacturing firms)	Process innovators (% manufacturing firms)	In-house R&D (% of innovation active manufacturing firms)	Firms that cooperate with HEIs (% innovation active manufacturing firms)
Canada	46.0	48.0	^	^
Malaysia	43.6	44.1	69.3	20.7
Philippines	37.9	43.9	^	47.1
New Zealand	31.6	23.2	34.5	7.2
China	25.1	25.3	63.3	^
Indonesia	20.2	18.1	58.4	8.4
Australia	19.9	23.9	18.0	1.4
Japan	19.6	20.2	55.9	15.7
Korea	13.5	8.0	86.4	10.0
Mexico	9.7	6.8	42.9	7.0
Russia	8.0	5.9	18.9	9.1
Hong Kong China	2.9	0.4	83.7	^

^ Information not available

It is important to note that the most common activity deemed to be innovative is the purchase of machinery, equipment and software. Nevertheless, the UIS emphasises that ‘internal R&D’ prevails as the activity performed by most of the innovation-active firms’. The fourth column shows the percentage of firms deemed ‘innovation active’ (defined as having implemented product or process innovations) that conduct in-house R&D. There are quite striking differences here.

For example more than 80 per cent of

‘innovation active’ manufacturing firms in Hong Kong, China and in Korea conduct in-house R&D, compared to less than 20 per cent of innovation active firms in Australia and Russia. There are also large differences in the proportion of innovation active firms that report collaborating with higher education institutions, varying from 47.1 per cent in the Philippines to just 1.4 per cent in Australia. This indicates that there is some way to go in leveraging the mutual benefits which higher education institutions and industry can gain from collaborating.

5.3 Facilitating factors

Academic-industry collaborations have the potential to generate a large number of benefits for both partners, but they need to be carefully fostered. An important characteristic of academia-industry collaborations are their geographically localised nature. Evidence from a number of economies suggests that proximity is important in bringing academia and industry together²⁰². Indeed, proximity to industry appears to be even more important than the ranking of a university in stimulating innovation, particularly in the case of applied research²⁰³. This highlights the importance of innovation clusters such as of Silicon Valley in the United States.

Local level initiatives are extremely important in fostering innovation but cannot be seen independent of international developments²⁰⁴. What is most interesting about the importance of academia-industry geographical proximity in innovative activities is that it appears to increase the likelihood that partners will also collaborate internationally. This, however, as the themes explored in this paper make clear, requires partners to establish international connections through researcher mobility:

‘Academic institutions keen to promote collaboration with industry must improve their research performance and encourage researcher mobility. These two factors could reduce the constraints deriving from location in an under-industrialized area, improve the visibility of university research, and extend researchers’ networks’²⁰⁵.

A number of Asian APEC economies provide good practice examples of academia and industry collaborations, including China; Japan; Korea; Singapore and Chinese Taipei²⁰⁶. These take a number of forms such as joint ventures, strategic alliances, research and development contracts and innovation networks. They may be driven by government or corporate sectors and may have a broad remit of innovation or a focused target of commercialisation in a narrow field of applications. They may also simply involve the broader dissemination of existing knowledge from academia to the private sector²⁰⁷.

Dodgson et al. suggest that in contrast to industry-academia collaborations in Europe and North America which focus on risk reduction, those in Asia have had an explicit focus on ‘technological learning, upgrading and catch-up industry creation’²⁰⁸.

In order to enter established markets, companies in such economies have used research networks to enable them to utilise their domestic resources and then to enhance and improve them in order to deliver a competitive advantage. This has frequently been done through the use of groupings of innovative firms in particular locations (often developed with significant support from government).

Box 16: Case study of the Pohang University of Science and Technology

The **Pohang University of Science and Technology** (POSTECH) in Korea was established as a private university by the Pohang Iron and Steel Company in 1986²⁰⁹. It is relatively unusual in Korea as it teaches almost all classes in English. Its objective is to remain a small and focused university with strong connections to industry²¹⁰.

The Research Institute of Industrial Science and Technology is located on its campus, as is an innovation incubation centre, and applied research accounts for around three-quarters of university funding for research and development.

Korean researchers are reported to view commercialisation of research favorably²¹¹ and this, combined with a governmental approach which encourages the application of research to industry, ensures a supportive

context for POSTECH's orientation to innovation and commercialisation. In 2009 the value of its knowledge transfer was estimated at US\$2 million²¹².

More than 50 venture companies have been established by university staff and alumni, with POSTECH providing support including training in entrepreneurship, seed funding and management consultancy services. POSTECH focuses on high-impact research that feeds the development of new technologies for transfer to industry²¹³.

Infrastructure and research centres include a synchrotron radiation accelerator, a 4th generation light source, the Max Planck Centre of Attosecond Science, the National Institute for Nanomaterials Technology and a 7-floor building for researchers to specifically focus on high-growth areas²¹⁴. In 2014 POSTECH registered almost 300 patents domestically and more than 100 internationally.

Examples include Samsung in Korea, which developed local capacity through a number of joint ventures until it was able to invest in local research innovation through the Samsung Advanced Institute of Technology²¹⁵. This has led to Samsung establishing a number of research centres which undertake numerous collaborations with universities around the world.

Another example is the Hsinchu Science Park in Chinese Taipei which has encouraged academics to work closely with industry in order to leverage research for innovation. A third example is Ericsson in China which has worked closely with local researchers to generate a constant stream of new technology. These examples can be regarded as illustrating approaches to technological learning, ones that commenced with firms of different sizes²¹⁶.

A critical element of the process of partnership formation between industry and academic partners is the selection of partners²¹⁷. Data on research partnership between a university in the United States and its industry partners indicates that publishing capabilities of the partners tend to be complementary but that patent capabilities

are not and instead substitute for each other. Moreover, when researchers or firms are highly specialised in a narrow disciplinary area they gain the greatest advantage in collaborating with a firm or researchers which has a greater deal of diversity²¹⁸.

The Times Higher Education World University Ranking counts industry innovation (worth 2.5% of the overall score) towards university rankings suggesting that 'a university's ability to help industry with innovations, inventions and consultancy has become a core mission of the contemporary global academy'²¹⁹. The measure includes the amount of research income earned from industry as a proxy for a university's ability to attract funding from the business sector.

In some economies public funding of research requires that researchers are active in seeking opportunities to transfer knowledge, including seeking out opportunities for collaboration with universities²²⁰. In counterpart to policy-driven collaborations, however, are collaborations that are driven by industry. In these approaches industry itself provides funding for research, as they 'play godfather to scientific research', usually in return for intellectual property rights²²¹.

The pharmaceutical industry could be regarded as leading this trend. While industry is a valuable source of research funding there are inevitably trade-offs between the demands of innovation – patents, competition and profit making – and the demands of scientific development – transparency, knowledge sharing, and the need to expose findings to critique.

One approach is for intellectual property to be shared among limited parties, using one or more of a variety of possible approaches:

- 'Creating and sharing intellectual property (IP) within communities of collaborators to enhance the scale, scope and speed of innovation;
- Using cross-licensing, patent pools, and patent exchanges to lower the cost of exchanging IP;
- Embracing open standards to enhance

inter-operability and encourage collaboration; and

- Investing in pre-competitive information commons to boost their downstream product development²²².

Beyond contextual factors, it is also important that individual researchers are motivated to work with industry. If collaboration is regarded as a ‘strategic choice’ for researchers then several factors need to be regarded as disincentives to researchers to engage in collaborations with industry²²³.

Box 17: Case Study of Shanghai Jiao Tong University

Shanghai Jiao Tong University leverages university-industry partnerships in research student education²²⁴. This reflects the desire of the University to provide excellent educational opportunities for top students and its strong engagement with industry. It has established a number of collaborative research projects with industry and research students are able to gain experience through placements in industry partners. Senior engineers from industry also lecture at the university and supervise research students.

One example is the Shanghai Baoshan Iron and Steel Company. The collaborative research done with the university has helped the training of almost 100 research students over a five year period. The University has numerous partnerships with industry and has established the Shanghai Zizhu Science-based Industrial Park and the Zizhu University Student and Teacher’s Entrepreneurship Center²²⁵.

5.4 Challenges

One of the major challenges to academia-industry partnerships is the under-preparedness of research students to work with industry. This is partly a consequence of the assumptions which shape research training programmes. For example a study of researchers in 45 economies found that many PhD programmes incorporate training in communication, presentation and ethics but that few include training in areas such as intellectual property rights and entrepreneurship²²⁶.

The side-lining of commercialisation in research training continues on to patterns of collaboration, with relatively little collaboration or mobility from academia to industry. Just 12 per cent of EU researchers, for example, have been mobile from academia to industry and just 3 per cent hold joint roles in academia and industry²²⁷. Interestingly, mobility from academia to industry is most likely in early research careers with very few senior researchers making this move.

On a large scale, pertinent factors include the ‘culture’ of a discipline or university, establishing expectations of researchers. At a small scale, if the academic culture encourages researchers to focus on publications and grant applications in order to gain promotion this also acts as a disincentive to collaboration with industry.

There is evidence that in many economies early-career researchers are not made aware of career paths outside of academia, perhaps because their research supervisors have no relevant experience to share with them²²⁸. Indeed, research suggests that many researchers have only ‘weak’ knowledge of knowledge-transfer opportunities²²⁹, focusing on doing their research for its own sake rather than considering ways in which it could be commercialised. Moreover, researchers find that it can be difficult to move from academia to industry, while industry can find it difficult to find out about the research being done in universities, and hence their research strengths²³⁰.

Industry also requires researchers to have more than a research degree alone. Aspects highlighted as being important include communication, negotiation and management skills so that researchers can undertake responsibilities such as explaining technical aspects to non-technical people, managing staff, applying for funding, reacting to unpredictable situations and demonstrating flexibility²³¹.

One approach to achieving this outcome is to establish collaborative doctoral programmes between universities and industry, something that requires partners to be willing to share research outputs and which demands a sustained and trusting relationship²³². Relationships between industry and academia can usefully be

nurtured by government, both through funding joint research programmes and also through stimulating dialogue and close cooperation.

Other factors that can act as a barrier to academia-industry links include high transaction costs such as time required to manage projects and monitor the progress of partners²³³. Another factor is whether collaboration places any restrictions on academic freedom, with researchers limited to only publishing results which support the commercial interests of industry partners.

In contrast, prior experiences in successful collaborations are likely to prime researchers to be willing to engage in future opportunities. Other factors which motivate researchers to engage in collaborations with industry include the existence of strategic networks which are specifically set up to encourage the building of links between academia and industry, the availability (and length of award) of research funds and the proximity of partners²³⁴.

5.5 Strategies to overcome challenges

In this context, each of the facilitating and deterring factors need to be explicitly addressed if industry collaborations are to be encouraged among researchers. An Australian review has found that there are a number of important areas for policy makers to address²³⁵:

Mechanisms to increase the motivation of academia in industry collaborations

- Evaluation metrics for institutions that include measures of the impact of research collaborations
- Rewards for institutions that demonstrate strong collaborative performance
- Greater reference to collaboration with industry in promotion criteria for researchers

Resources to promote industry collaborations

- Assess existing resources for further dissemination
- Establish engagement principles for collaborations
- Training for researchers in

- intellectual property and project management
- Awareness raising about collaboration opportunities available

Consideration of the terms of collaborative agreements

- Sharing good practice around indemnities and intellectual property
- Training for research contract managers in terms and conditions
- Support for universities to enhance intellectual property management

Perhaps most importantly, strategies need to recognise that many academia-industry research collaborations are led by personal relationships developed outside of government and institutions and only become institutionalised at a later date²³⁶. This again points to the need for researcher mobility between sectors so that they can build up the personal relationships that fuel future collaborations.

Interestingly, co-publications between academics and industry partners have been shown to indicate subsequent technology commercialisation in the form of patents, the creation of spinoffs and licensing²³⁷. This suggests that an initial focus on encouraging collaborative publications can yield dividends. It also suggests the co-publications can be used as a way to monitor trends in collaboration.

Another factor which universities may need to consider in partnering with industry is the potential for leading to high impact publications. Evidence from China indicates that although university-industry co-authored publications remain a minority in terms of all publications, they increased significantly in number between 1997 and 2013²³⁸. They tend, however, to have low academic impact, perhaps reflecting the greater interest among other researchers in fundamental rather than applied research.

This suggests that universities need to find a balance between industry collaborations which are valuable for innovation and high quality research outside of these collaborations. It also suggests that the measurement of academic quality in promotion should take account of the

degree of their collaboration with industry in addition to their publication output.

Box 18: Case Study of innovation in Korea

Korea is an excellent example of the evolution of innovation activities through collaboration between university, industry and government²³⁹.

There are three stages:

- **In the 1980s**, government research institutes established strategic alliances with industry under domestic research and development programmes. Universities played a limited role in innovation, which was instead driven by policy makers.

- **In the 1990s**, industry became the major driver of innovation. Large Korean firms became increasingly international and invested heavily in research and development. Government research institutions also stimulated collaborations with industry, and university research was stimulated through government innovation programmes.

- **In the 2000s**, the government reconfigured the regulatory environment for innovation. Universities became increasingly entrepreneurial and innovative and this led to a massive expansion of university-industry collaborations, with generous government support for research facilitating these partnerships.

The pattern followed by Korea in university-industry-government collaboration to develop innovation is not universal. For example the pattern in China appears to have commenced with government (as in Korea) but then moved to university and then industry, in a different pattern to Korea²⁴⁰.

There are a number of ways in which universities can collaborate with industry partners beyond collaborative research projects. These include: joint patent applications with industry partners; the sale of patents to industry; licensing of patents to industry; providing technical support to industry through

consultancies ; contracts around technology transfer and researcher mobility.

Data collected from sixty-one Chinese research universities between 2009 and 2013 suggests that the greater the diversity of these types of linkages with industry partners, the better a university's academic research performance (measured through publications and patent applications) ²⁴¹ . This may be because universities gain greater experience in managing industry collaborations, gain greater insight into different industry areas and develop higher levels of trust of external partners.

In contrast, the greater the intensity of focus on particular kinds of collaborations with industry partners, for example always focusing on providing technical support to industry, the more likely this is to lead to a negative impact on research performance²⁴². This may be due to 'path-dependency' which results in diminishing returns

Moreover, if universities try to have a great diversity of linkages with industry partners as well as a deep focus on all of these types of linkages this appears to have a negative impact on academic performance²⁴³. This may be due to university coordination and management resources being overstretched, meaning that researchers are called on to take over the role of coordination. This suggests that universities need to carefully coordinate their collaborations with industry partners, balancing the types of interactions (or channels) with how deeply they focus on those interactions. Inter-institutional research collaborations.

6. Inter-institutional research collaborations

Higher education institutions play an important role in researcher mobility. They do so in two key ways. First, through the establishment of policies and practices which encourage and reward researcher mobility. Second, through the establishment of formal relationships with institutions in other countries, establishing a framework within which researcher mobility and collaborative research can take place.

6.1 Patterns and trends

The international outlook of a higher education institution is increasingly regarded as a key element in establishing its reputation. International rankings are extremely influential on university practices, establishing key performance indicators. Beyond research, teaching and citations, the Times Higher Education World University Ranking counts two elements related to research collaboration: industry innovation (worth 2.5% of the overall score) and the international outlook of staff, students and research (worth 7.5%)²⁴⁴.

‘International outlook’ incorporates the extent to which researchers collaborate with colleagues in other countries, the proportion of journal publications with at least one co-author from another economy, and the proportion of international staff.

An analysis of 25 million research papers published between 1981 and 2012 has shown that the proportion of papers written by authors from only one economy is falling, with growth coming from collaborative publications written by authors from more than one economy²⁴⁵. Papers that are written collaboratively are also cited more often than single economy ones and this benefit extends to all papers written by researchers at institutions with a great deal of international collaboration.

There is also international clustering of research collaborations based on institutional ranking with the top institution in one economy tending to collaborate with their equivalent in another economy. This indicates the importance for institutions of maintaining collaborative relationships with those in other economies.

It is possible to see clear themes in the trajectory of relatively young universities which have built themselves up to a position of being world class. In the APEC region these include the Hong Kong University of Science and Technology in Hong Kong, China; The Pohang University of Science and Technology in Korea; the National University of Singapore in Singapore; The Monterrey Institute of Technology in Mexico; the Higher School of Economics in Russia and the Pontifical Catholic University in Chile.

6.2 Facilitating factors

In any kind of collaboration, from institutional to that between individuals, it is important that the relationship is well managed.

Bammer points to three key considerations in managing research relationships²⁴⁶:

- managing the differences between partners through clarity about the goals of the collaboration, its intended beneficiaries, which elements are going to be integrated and who will be involved in the collaboration;
- making a clear determination of the scope of the collaboration to manage restrictions and facilitate innovation; and
- gaining authorisation from legitimate stakeholders, whether this be government, institutional leaders, commercial partners or other interested parties.

While institutional collaboration requires the authorisation of institutional leaders, there is evidence that “‘more institutionalised’ does not necessarily equate with ‘more effective’”²⁴⁷. Sometimes close institutional oversight of research partnerships can stymie innovation, with evidence that researchers ‘flourish’ in less institutionalised environments where they are able to be creative²⁴⁸. Nevertheless, there is a need for agreed norms among research partners and while these may derive from the discipline they can also be led by institutional agreements.

Institutional collaborations need to take account of the human relationships which underlie all research collaborations. This is essential as good relationships foster productive research outcomes and poor ones can derail research collaborations entirely²⁴⁹. Bozeman et al. suggest that “with declining grant money and fewer academic positions in most fields, competitive dynamics intercede to a degree not common in the past”, indicating a need for careful oversight of research collaborations by institutions.

The establishment of research centres at institutions, whether or not they are established with industry partners, has been shown to impact on the behaviour of researchers, including increased research output and greater collaboration with other institutions, other disciplines and with industry²⁵⁰. It is thought that the opportunities and resources provided by institutional research centres stimulate a number of positive outcomes, but are particularly likely to lead to collaborative behaviour among researchers²⁵¹. A key factor is that researchers are able to engage in large research projects whose scope are beyond the capacity of individual researchers or institutions, hence demanding collaboration²⁵².

Box 19: Case study of Jilin University and Rutgers Collaboration

Jilin University (JLU) and Rutgers, the State University of New Jersey established an official cooperative relationship in 1978, resulting in multiple collaborations in the area of chemistry particularly faculty exchange. In 2006 JLU and Rutgers, jointly established a Confucius Institute. The Center for American Studies at Jilin University was established in 2013 and the Center for Chinese Studies at Rutgers was established in 2015, featuring multidisciplinary scholarly exchange and joint research.

A number of additional collaborative programmes have been launched. These include scholars from both institutions giving talks on each other’s campuses, leaders from JU participating in intensive leadership training at Rutgers,

international conferences, faculty exchange and joint research and student mobility.

An increasing number of research collaborations have been established between institutions. Some may be designed for short-term activities only but many are assumed to be for the long term. In this case, institutions need to invest in sustaining research collaborations as well as establishing them. Evidence from fifteen years of research collaborations at Stanford University indicates that research collaborations are most likely to be sustained if social ties are strong and the experience of collaboration is positive on both sides²⁵³.

Those ties most likely to persist involve a range of different types of engagement, encompassing elements such as teaching, publishing, student supervision and research grants. This is important because “persistent ties [have] greater returns on the rate of productivity and quality of performance than [do] new ties”²⁵⁴. It is also interesting to note that interdisciplinary collaborations tend to involve less close ties and may thus require more efforts to sustain, through the facilitation of frequent interactions

This indicates an important role for institutions in “corralling faculty and promoting continued distant collaborations”²⁵⁵.

6.3 Challenges

Collaboration between institutions is not something that is easy to manage. As Brew et al (2013) note:

*Collaboration is a complex phenomenon. It involves different parties located in separate contexts, each with their own structures, constraints, and assumptions about the world connecting with each and working on matters of mutual concern*²⁵⁶.

It could be argued that the level of complexity increases with the diversity between partners. Particular challenges for inter-institutional cooperation include mismatched expectations and capabilities and bureaucracy²⁵⁷. When

institutions are in economies with significantly different economic strengths sensitivities around reciprocity and power relations can also occur.

Moreover, the type of research collaboration can create more or less complexity. Basic sharing of facilities is regarded as something which has minimal risk to academics and relatively few interaction costs²⁵⁸. But if collaborations incorporate the sharing of data, contrasting academic cultures or themes which are politically or culturally sensitive the number of potential risks and costs increase.

6.4 Good practice examples

Cotutelle and Joint PhD programs have become increasingly popular among research-intensive institutions, as they are increasingly regarded as an important element of international research mobility. According to the European Commission Erasmus Mundus program, Cotutelle means the joint supervision of doctoral studies by two universities from different countries, if successful, the doctoral candidate will be awarded a joint or double doctoral degree awarded by the two institutions.²⁵⁹

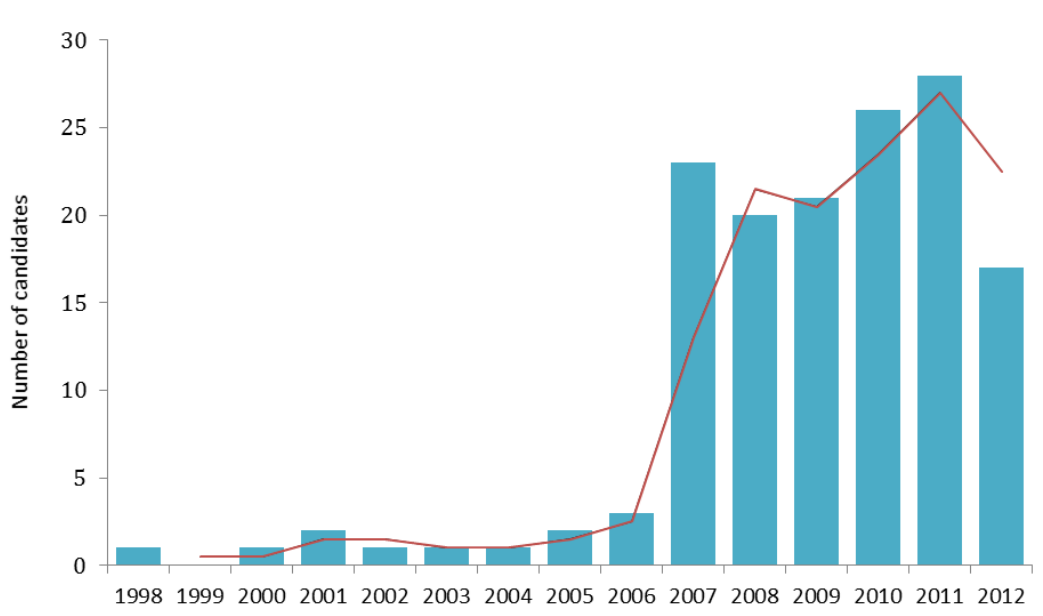
Macquarie University (MQ) is a research-intensive Australian university which places significant emphasis on Cotutelle agreements

with partner institutions in other countries. MQ is a publicly funded institution, located in Sydney Australia with 38,747 students and 2,786 staff²⁶⁰. Its research strengths lie in a number of areas including bio-molecular frontiers, biofuel and fuel efficiency, laser and photonics, vascular sciences and wireless communications²⁶¹.

The research conducted by Higher Degree Research (HDR) students, forms a vital part of an institution’s overall research effort. MQ has the largest Cotutelle and Joint PhD program in Australia. As **Figure 10** illustrates there are more than 228 PhD (cumulative) candidates in the programme. Cotutelle and Joint PhD candidates are a very important part of Macquarie’s HDR community. They are generally encouraged to publish their research results with their supervisors from Macquarie and International partner Institutions.

Many of MQ’s cotutelle and joint PhD partner institutions are in Europe – with Germany and France the greatest sources of students. The geographic focus on Europe is largely a consequence of complexities and regulations around joint supervision. European economies have a history of these sort of programmes and this means that a domestic and institutional policy environment is in place which tends to be more conducive to cotutelle and joint PhD arrangements than in other parts of the world.

Figure 10: Headcount of Cotutelle / Joint degree candidates Macquarie University 1998-2012



But MQ's collaboration with APEC economies is growing. China is the most important partner economy at this stage, with Chinese HEIs providing a total of 36 students to cotutelle and joint PhD programmes at MQ. Other APEC economies which are partners in this programme include Canada; Chile; Japan; Mexico; Russia; Thailand and Chinese Taipei. Relationships with partner institutions in Indonesia; Korea; Malaysia; New Zealand; Peru; and Viet Nam are currently under negotiation.

authored with researchers from other Australian institutions. This is clearly not all attributable to the cotutelle programme but the influx of foreign researchers has certainly contributed to this outcome.

Box 20: Box: Case Study Universiti Putra Malaysia²⁶²

Universiti Putra Malaysia has instigated an 'International Research Attachment and Mobility Programme (IRAMP) to enable postgraduate students and other researchers to gain research experience at foreign research institutions. It aims to expand the research skills and knowledge of participants as well as to build professional networks and become 'global professionals' in the international research community. IRAMP incorporates two key elements. The first is short term internships in which researchers can gain clinical training, work experience in industry or community projects in order to enhance their research. The second is a research attachment in which researchers can conduct research projects overseas, either in universities, research institutions, industry or the community. The second type involves mutual agreements between supervisors and/or research collaborations between institutions. The research management centre provides financial assistance to enable these two programmes.

Beyond providing opportunities for students to be mobile during their higher degree studies, the cotutelle and joint PhD programmes at MQ have also been shown to contribute significantly to the institution's research outputs. Between 2008 and 2012, Macquarie's publications underwent a 5-year compound annual growth rate (CAGR) of 11.9%. This rate is higher than the overall Australian CAGR of 6.7%. In the same five-year period, 66% of all MQ's publications were co-authored with a researcher outside of the institution, with 43% internationally co-authored and 24% co-

7. Ensuring integrity in researcher mobility

Complexities that relate to differing assumptions about, and regulations around, research are notorious in adding to the complexity of international research collaborations. There are a range of variations in how research integrity is governed, implemented and policed among APEC economies. These encompass a broad gamut from highly rigorous, strictly controlled and closely monitored research environments in some economies to few or no policies or procedures in others.

Moreover, there are significant differences in the emphasis placed on research ethics in different disciplines. In general, research involving human or animal participants are the most highly governed around the world, but some economies have little to guide researchers in ethical conduct. In the area of international medical research there has been significant attention paid to how high ethical standards can be maintained²⁶³.

There is significant concern about the exploitation of poor, marginalised and disadvantaged populations around research areas such as pharmaceutical drug trials, and there are enough examples of truly egregious researcher behaviour to fuel strategies to address these concerns. As Turale states:

‘Bridging an understanding of the differences in ethical values and concerns held by various groups of people around the world is a critical aspect of international research ... it is a prerequisite for best practice in research that researchers explore the local ethical values held by their collaborators, potential participants and the gatekeepers of the research in the host country’²⁶⁴.

7.1 Governance of research

Governance and management of research mobility is essential in providing a structure in which international research collaborations play out. It is a critical issue in researcher mobility as it establishes the context in which research takes

place. Any large differences in the way that research is governed in different economies can cause immense challenges for mobile researchers, not just in confounding their assumptions about how research needs to be carried out but also potentially conflicting with the governance arrangements at other institutions they are associated with.

The professionalisation of research management has only emerged during the last three decades and is very unevenly distributed among APEC economies. Research management is led by a number of key groups. The Australasian Research Management Society (ARMS) is the peak body on research management in Australasia. Founded in 1999, ARMS has 2,100 members across Australia, New Zealand and Singapore.

In North America, there are a number of similar organisations including the Society of Research Administrators International (SRA International); the National Council of University Research Administrators (NCURA) and the Canadian Association of Research Administrators (CARA). In the absence of similar professional research management associations in other APEC economies, ARMS, SRA International, NCURA and CARA are taking the lead role in the governance and management of research mobility.

All of these bodies belong to the International Network of Research Management Societies (INORMS), formed in 2001 to bring together research management societies and associations from across the globe. The objective of INORMS is to facilitate interactions between member organisations, the dissemination of good practice between members, and collaborative activities between member societies.

INORMS's establishment reflects both the proliferation of domestic and regional research management organisations throughout the world, and the clear need for international collaboration and common standards in the global market for university research. It highlights the commonalities faced by researchers and enables forums in which

member organisations can learn from each others' practices. Research governance and management includes a range of elements from research strategy, the management of grants and the management of ethics and integrity to the management of commercialisation, project management and research training.

An investigation of research management across fifteen universities (including in the APEC economies of Australia; Canada; China; Japan; New Zealand and the United States) found that there were both similarities and difference in how research was managed, one of the similarities being that research management structures were undergoing rapid transformation, much of it in response to changes in national government policies²⁶⁵.

There is growing recognition of the need for researcher mobility to be reciprocal. This is important in enabling two way flows of researchers and to facilitate the use of research infrastructure around the world by researchers from different backgrounds. In a world in which researchers are addressing issues of global relevance, reciprocity of research mobility enables research which is globally coordinated and minimises duplication²⁶⁶. It will be increasingly important for APEC economies to be regarded as 'good global citizens' when it comes to research reciprocity in order to maintain their place at the global research table.

7.2 Embedding research integrity in researcher mobility

Research integrity is often assumed to refer only to research ethics but in fact covers a range of elements of research from the proposal stage to the use of research results. The National Institute of Health in the United States defines research integrity as²⁶⁷:

- the use of honest and verifiable methods in proposing, performing, and evaluating research;
- reporting research results with particular attention to adherence to rules, regulations, guidelines; and
- following commonly accepted professional codes or norms.

Particularly important elements of integrity in relation to research mobility include the storage and management of data, mentoring, social responsibility, conflict of interest, authorship of publications, policies to deal with misconduct and policies and protocols covering research with humans and animals²⁶⁸. In the absence of international standards on research integrity there are discussions about whether research is now significantly internationalised for these to be developed²⁶⁹.

The responsibility for research integrity management can be separated into international, domestic and institutional levels. At the international level, there are two important statements that need to be studied. The Singapore Statement on Research Integrity was drafted in 2010 at the 2nd World Conference on Research Integrity in Singapore. This conference included researchers, funders, editors and publishers of research management and administrators, and industry representatives from more than 50 e economies²⁷⁰.

The Statement includes four principles and fourteen responsibilities²⁷¹:

Box 21: The Singapore Statement on Research Integrity

The Principles:

- Honesty;
- Accountability;
- Professionalism; and
- Stewardship.

The Responsibilities:

<ul style="list-style-type: none"> • Integrity; • Adherence to regulations; • Research methods; • Research records; • Research findings; • Authorship; • Publication acknowledgement; 	<ul style="list-style-type: none"> • Peer review; • Conflict of interest; • Public communication; • Reporting irresponsible research practices; • Research environments; • Societal considerations; and • Responding to irresponsible research practices.
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The principles and responsibilities set out in the Singapore Statement on Research Integrity represent the first international effort to encourage the development of unified policies, guidelines and codes of conduct, with the long-range goal of fostering greater integrity in research worldwide. But it is important to note that the Singapore Statement on Research Integrity is not a regulatory document.

The Montreal Statement on Research Integrity in Cross-Boundary Research Collaborations was drafted in 2012 through the 3rd World Conference on Research Integrity in Montreal. It provides guidance on the conduct of research collaborations between different institutions, disciplines, sectors, and economies. The Statement includes four Responsibilities of Individual and Institutional Partners in Cross-Boundary Research Collaborations:

- General Collaborative Responsibilities
- Responsibilities in Managing the Collaboration
- Responsibilities in Collaborative Relationships
- Responsibilities for Outcomes of Research

In terms of conducting cross-boundary investigation on research misconduct, the OECD’s guide on the Best Practices for Ensuring Scientific Integrity and Preventing

Misconduct is another important document²⁷². Investigating allegations relating to collaborative research can be particularly challenging, especially international research collaborations. Mistakes can be made and important issues missed. The OECD guide is an invaluable document and any organisation entering into international collaborative research should consider following the Guide.

At a domestic and institutional level, research integrity management has become increasingly important. Australia is one of the few economies in the world that has a national code on responsible conduct for research. In 2007 the National Health and Medical Research Council and The Australian Research Council in conjunction with the Universities Australia released the Australian Code for the Responsible Conduct of Research (the Code). The main purpose of the Code is to guide institutions and researchers to responsible research practices.

7.4 Regional approaches to research ethics

In the same way that the management of research sets the context in which researcher mobility takes place, research ethics guides what researchers can and cannot do. There are numerous examples of instances in which differing approaches to ethics cause complexities for mobile researchers as they take the requirements from one economy and try to apply them in another²⁷³.

As researcher mobility increases and collaborative international research projects become more and more common variations in norms around research ethics are becoming increasingly significant. The main responsibilities defined in the Singapore Statement (as summarised in Box 21 on the previous page) express general common understandings of research ethics but it is their interpretation that varies. Famous cases such as that of Hwang Woo Suk in Korea have highlighted the complexities that can arise when ethics are breached by researchers²⁷⁴.

There is a dearth of comparative research on research ethics in APEC economies but where investigations have been done around the world they point to multiple differences in how principles of research ethics are implemented in practice. A 2014 study of responses to scientific misconduct noted that formal response mechanisms still remain in development in a number of economies, including a number of APEC economies²⁷⁵. Moreover, they found that many economies have yet to establish any agency to respond to scientific misconduct and even in economies where responses to misconduct are well developed (such as the United States) ‘multiple definitions are found’.

In the EU, with a long experience of joint-research projects across economies there continues to be concerns about a lack of common understanding on ethics. Respondents to the public consultation on the European Research Area Framework suggested that there is a need for research ethics committees, domestic bodies and the research community more general to determine common principles and practices which can facilitate cross-border research. In addition, respondents felt that is

was necessary to make processes involved in cross-border ethics reviews as simple and streamlined as possible, albeit without undermining ethics standards²⁷⁶.

Governance of research ethics can vary significantly even among similar cultures and economies. Research from Europe, for example, finds that even though the Declaration of Helsinki requires that all human research is approved by a research ethics committee this is not applied in a uniform way²⁷⁷.

There are significant variations in the application process and length of time required, leading to conclusion that ‘the striking variations mean we are too careful in some economies or too lax in others’²⁷⁸. Researchers from the United Kingdom faced such arduous and lengthy processes that this delayed studies and this could stymie efforts at international collaboration. In contrast researchers in The Netherlands were not required to gain approval from a research ethics committee for exactly the same project.

A study of medical research ethics across five economies found that common expectations were participant autonomy, avoiding harm to participants, providing benefit and being impartial. Beyond this, however, ‘ethical requirements differed markedly between the various countries’²⁷⁹. Variations included when ethics committee approval was required, rewards for participation, the interpretation of potential ‘harm’ to participants and the notion of who benefits from research, whether individual or societal.

This situation is made more complex when it is considered that domestic research ethics are regularly updated. For example revisions to the National Statement on Ethical Conduct in Human Research and the Australian Code for the Responsible Conduct of Research in Australia called for institutions to review and revise their research governance in response²⁸⁰.

It is important that cultural traditions and their implications for research ethics are taken into account when conducting research across significantly different cultural contexts. This should be balanced, however, with stringent protection of research subjects. Research across Asian research contexts finds that Confucian,

Hindi and Islamic traditions incorporate ethical concepts that are different to Western notions²⁸¹. These include familial autonomy, the principle of public interest and protective truth-telling. Having reviewed the variations the authors conclude that:

‘Ultimately, a commitment to conduct ethical research according to prevailing international, yet foreign, standards cannot be divorced from the influence of local context and culture. Without engaging in debate and building shared understandings ... there can be little confidence about what is communicated in discussion about the observance of ethical standards ... Empirical research should be carried out into how the principles encoded in international guidelines on the ethical conduct of research are applied’²⁸².

8. Opportunities for APEC collaboration to enhance researcher mobility

The APEC Researcher Mobility workshop was held on 1 and 2 December 2015 at the Hotel Borobudur in Jakarta. Participants from 12 APEC economies attended and the workshop was facilitated by Professor Sakkie Pretorius, Deputy Vice-Chancellor (Research) at Macquarie University, Australia.

The workshop addressed the key themes highlighted in chapters 1 to 7 of this report, with presentations from experts drawn from a number of APEC economies. The workshop also provided a number of opportunities for participants to discuss challenges encountered in relation to researcher mobility and possible solutions to these challenges. The workshop agenda can be viewed at Appendix A.

Opening and closing remarks were made by Associate Professor Craig Ritchie, Branch Manager, International Mobility, Department of Education and Training, Australia; Professor Ainun Na'im, Secretary General, Ministry of Research, Technology and Higher Education, Indonesia; and Dr Wang Yan, Education Network Coordinator, APEC Human Resources Development Working Group.

The workshop speakers noted the importance of researcher mobility in enabling APEC economies to work collaboratively to solve shared problems in the region and to lay foundations that support innovation and economic growth. They suggested that researcher mobility leads to the expansion of research horizons, a valuable asset in our globalised world, and discussed the need for a shared global knowledge ecosystem.

Speakers focused on the critical role that universities play in serving the communities of APEC economies, the key role of researchers in knowledge creation and the transformative value of higher education in broadening

perspectives and finding new ways to collaborate. They highlighted the importance of researcher mobility in expanding the research capacity of APEC economies and the need to forge greater collaboration, both within academia and between academia and industry.

Speakers noted the importance of raising the profile of researcher mobility among policy makers to demonstrate the myriad of ways in which it drives innovation, achieves tangible outcomes and contributes to economic growth.

Speakers also highlighted that serendipitous meetings between researchers plays a key role in research collaboration and suggested that researcher mobility is therefore important in enabling serendipitous meetings to take on an international flavour.

Participants arrived at five key recommendations which are discussed in greater detail below (see 8.2).

- APEC economies consider and agree on a minimum data set for recording the mobility of researchers and aim to share this information across the region.
- APEC economies could undertake further research to examine the economic and social impact of researcher mobility.
- APEC economies consider and agree to priority fields of research which reflect the shared interests and common challenges faced across the region.
- APEC economies consider the need for information on expert researchers in priority fields of research to be shared between economies.
- APEC economies consider and agree to activity focused on the issue of research quality and integrity. APEC members

continue to examine the issue of research ethics and aim to develop guiding principles for integrity matters to provide consistency and transparency across the region.

A number of examples of best practice were illustrated during the workshop which could be of value to other economies. These are highlighted below.

8.1 Good practice examples

8.1.1 Encouraging researcher mobility

Methods implemented by economies and institutions to encourage researcher mobility throughout the research career were discussed by participants at the workshop. Presenters on this topic were:

- Dr Trakarn Prapasongsa, The Faculty of Engineering, Mahidol University, Thailand;
- Professor Ocky Karna Radjasa, Director, Directorate of Research and Community Services, Ministry of Research, Technology and Higher Education, Indonesia;
- Professor Zhang Shizhuan, Director, General Affairs Office, Chinese Academy of Sciences, China; and
- Nancy Pritchard, Director of International Programs, Australian Academy of Science, Australia.

Speakers raised the importance of researcher mobility in shaping a shared global knowledge system in which researchers can collaborate to address common challenges and learn from each other. Moreover, participants highlighted the key role that researcher mobility and international collaboration play in the enhancement of innovative capacity within economies, including through the return of diaspora researchers, noting the vital role of innovation for economic competitiveness in the

contemporary world.

To achieve positive outcomes participants identified that collaboration between researchers from APEC economies can best transcend political and religious differences for the greater good. Participants further noted that increased cultural understanding is an important outcome of mobility. They suggested that the personal contacts developed through researcher mobility were the foundation of ongoing research collaboration, something which can be facilitated through virtual mobility to enable sustained engagement.

Participants from emerging economies highlighted the small proportion of academics at universities who have gained research qualifications and the negative impact that this has on research productivity, impact and excellence. This suggests the need for the development of doctoral programmes, research capacity building, the exchange of researchers between economies, an increase in joint publications, the creation of joint conferences and incentives to use research for innovation.

Examples of strategies to increase researcher mobility include making it a condition of promotion, targeted funding and the establishment of joint research centres. In contrast, participants also highlighted barriers to researcher mobility including a fear of losing tenure, uncertainty whether international mobility will be recognised in career progression, a lack of funding, poor language skills, a lack of information about mobility opportunities and a lack of knowledge about research that is being undertaken in different economies.

Box 22: Good practice examples of encouraging researcher mobility and collaboration

The Australia-Thailand Young University Researchers Exchange Programme²⁸³

The Department of Education and Training in Australia, the Office of the Higher Education Commission in Thailand and the Australian Innovative Research University Group have developed this programme to fund the exchange of twenty young researchers between Thailand and Australia each year.

Participants are undertaking research in a wide range of areas including nanotechnology, agricultural biotechnology, clean technology and modern languages.

The programme aims to develop networks for sustained research and university collaboration and to build cultural understanding.

Recruitment Programme of Foreign Experts, China²⁸⁴

The 'One Thousand Talent Plan' focuses on attracting international researchers to work in China who are able to contribute to achieving technological breakthroughs and advance the high-tech industries.

Applicants who meet the requirements of 'talent' are granted significant financial support including a subsidy for housing costs and a research subsidy in addition to their salary.

They are required to work in China for 9 months out of every year for 3 consecutive years. 'Talent' is defined as including professors or experts from high status international universities and research institutes as well as entrepreneurs with experience of establishing businesses in other countries.

Australian Academy of Science links with China, Japan and Indonesia²⁸⁵

The Australian Academy of Science is an independent organisation that aims to advance science and evidence in policy making. Its members are the top scientists in Australia across a wide number of disciplines.

The Academy supports researcher mobility through numerous activities including researcher mobility programmes with the Chinese Academy of Sciences, Japan Society for the Promotion of Sciences and Indonesian Academy of Sciences.

The Academy also hosts an Early- and Mid-Career Researcher Forum and surveys members about their motivations for mobility.

8.1.2 Building institutional partnerships

Approaches to building partnerships between research institutions were discussed by participants at the workshop. Presenters on this topic were:

- Dr Chris Martin, Science Program Officer, The Kavli Foundation, United States of America
- Dr Chantavit Sujatanond, Director, SEAMEO RIHED, Commission on Higher Education, Thailand
- Professor Flavio Salazar-Onfray, Vice President of Research and Development, University of Chile, Chile

Participants discussed the value of a regional approach to research collaborations between institutions, encompassing a range of institutional stakeholders including university leaders, researchers, students and administrators in international offices. Participants also considered means to enhance the capacity of institutions to collaborate such as mutual recognition agreements and the support for networking that can be given at a regional, domestic and institutional level. They discussed the need for institutions to build relationships over time and with a range of different approaches.

It was also noted that at the level of individual economies and the APEC region it is possible for governments to stimulate collaboration between institutions by identifying research areas of common importance as well as on transdisciplinary approaches to solving challenges. They highlighted ways in which institutional collaboration can lead to joint investigations, joint publications and the mobility of research students. Participants also specified the need for institutions to be supported in managing their relationships with

partners, suggesting that professional development in this area may be required.

Participants highlighted the need for institutions to build strong relationships with the various agencies that are engaged in, or have an interest in, research. Traditionally, these have included government, business and research but participants also considered the growing importance of non-traditional sources such as private non-profit foundations. These include the Alfred P. Sloan Foundation, the Simons Foundation, the Gordon and Betty Moore Foundation, the Howard Hughes Medical Institute and the Kavli Foundation.

The desire of many foundations to bring together a number of research institutions, industry partners and other stakeholders in order to catalyse research on particular issues was also discussed. Depending on their focus, foundations may provide seed funding for basic science or may support researchers to increase the impact of research and to ignite and capitalise ideas.

Participants determined that the key barriers to institutional research partnerships included differing institutional frameworks and objectives, a lack of sustainability when people move and retire, a mismatch in expectations around key elements such as research integrity and intellectual property and a lack of funding to support sustained institutional partnerships. Participants considered that overcoming these barriers would benefit from the identification of common research interests among APEC economies and the establishment of research hubs to address these. Participants felt that this approach would enable the sharing of physical and human resources as well as research data in order to tackle shared challenges.

Box 23: Good practice examples of encouraging institutional research collaboration

The Kavli Foundation²⁸⁶

The Kavli Foundation has established 20 institutes around the world in the areas of neuroscience, nanoscience, astrophysics and theoretical physics.

These include two in China and one in Japan. For example the Kavli Institute for Theoretical Physics China at the Chinese Academy of Sciences in Beijing focuses on physics and undertakes much interdisciplinary work. Its aim is to stimulate new approaches and also to promote basic research and interdisciplinary research in order to bridge theory and application.

SEAMEO RIHED²⁸⁷

SEAMEO RIHED works to enhance efficiency, effectiveness, and harmonization of higher education in Southeast Asia, including through collaboration between institutions and the development of mechanisms to facilitate sharing.

These include the ASEAN Research Cluster and the ASEAN Citation Index. SEAMEO RIHED has used the ASEAN International Mobility for Students (AIMS) Programme to build strong relationships between institutions around student mobility in several key disciplinary areas. This is laying the groundwork for future research collaboration around issues of common importance in health and medicine, environment and biodiversity, agriculture and food and social science.

University of Chile²⁸⁸

The Universidad de Chile aims to establish itself globally and to encourage greater regional cooperation in research. The that personal connections (such as alumni links) are critical in establishing these. Participants reported that in many economies there are government schemes to incentivise researchers to work with colleagues in different sectors.

university has collaborative agreements in place with institutions around the world and has a number of schemes in place to encourage research mobility between partner institutions.

The Laguna Caren initiative is a science and technology park that focuses on areas including seismic monitoring and disaster response, the development of alternative energy resources and the management of desertification. It aims to enable the state universities in Chile to cooperate on research while attracting stakeholders from the business and industry sectors to enhance technological and scientific development.

8.1.3 The role of research in powering economic growth

Approaches to linking researchers in industry and academia in order to ensure that research is leveraged to support innovation and economic growth were discussed by participants at the workshop. The presenter on this topic was:

- Mr Masaki Sato, Director, Japan Science and Technology Agency, Japan

Participants discussed the need to ensure that research is inspired by both fundamental understanding of a research area as well as an interest in application. Participants commented that many researchers were driven by maximising research publications rather than by how their research could be used to fuel innovation. In some economies there was a great deal of research undertaken in industries but there was a lack of connection with the research done in academia.

Participants considered the factors that encouraged links between academia and industry, suggesting

These include financial support, forums with industry associations, improved promotion prospects for academics who spend time in industry and the establishment of centres of excellence. Participants felt that academia-

industry links are more common in certain areas of research due to the immediate applicability of research, such as in medical science.

Participants also reported a number of barriers to academia-industry research collaborations. These included conflicts over intellectual property, differing expectations about research outputs, divergent forms of self-interest from both parties and a lack of knowledge from both parties on the research being undertaken by colleagues in the other sector.

Participants recommended that APEC economies could encourage greater research collaboration between academia and industry through the encouragement of collaborative research centres that are explicitly focused on bringing industry and academia together, and that allow research infrastructure to be shared. Participants also considered the value of a research database that enables academic researchers to find out about research being done in industry, and vice versa. Other ideas raised by participants were for economies to expand matchmaking between universities and industry and to consider tax deductions for industries which collaborate on research with academia.

Box 24: Good practice example of encouraging academia-industry research collaborations

Japan Science and Technology Agency²⁸⁹

The Japan Science and Technology Agency focuses on the development of science and technology and its infrastructure in Japan. They have a particular focus of encouraging collaboration between academia and industry on research in order to boost innovation. Almost one-quarter of the Agency's funding (in total US\$1.2 billion in 2015) goes to industry-academic collaboration programmes, including funding matching, support for research and development and support for intellectual property.

Since 2004 there has been an annual day termed Innovation Japan to demonstrate cutting edge research outcomes and to encourage 'matchmaking' between industry and academia. The agency also hosts numerous New Technology meetings where academic researchers can inform industry about their research achievements (with a total of 85 meetings in 2014-2015), leading to numerous successful partnerships.

Another activity is Open Innovation Seminars in which industry can present to academia about technological bottlenecks they are experiencing (with a total of 6 meetings in 2014-2015) also leading to successful partnerships. The Agency also offers a portal site including a magazine and a database of industry-academia collaborations, numerous funding opportunities for researchers, such as the Adaptable and Seamless Technology Transfer Program (which has contributed to two Nobel prizes), intellectual property services and global programmes with international partners including the Science and Technology Research Program for Sustainable Development.

8.1.4 Ensuring integrity in researcher mobility

Differing approaches to research integrity and its implications for researcher mobility were discussed by participants at the workshop. The presenter on this topic was:

- Dr Ren Yi, Director, Research Training and International Research Training Partnerships, Macquarie University, Australia

Participants highlighted the numerous examples of research misconduct and their impact on the reputation of researchers, institutions and economies, suggesting the need for greater attention to be paid to research integrity. Participants considered the three key components of research integrity – soundness, honesty and accuracy and noted that academic freedom could only exist when research integrity was adhered to.

The absence of an agreed code on research integrity at the international or regional level was discussed. The closest is the Singapore Statement, developed when 340 people from 51 economies came together to agree on research principles, highlighting the notions of honesty, accountability, professional courtesy and good stewardship. Participants also discussed domestic and global efforts to raise awareness about research integrity such as the OECD guide on investigating allegations of research misconduct and the Australian Code for the Responsible Conduct of Research.

It was noted that many economies do not have a domestic code on research integrity, with notions about proper research behaviour often determined by research funding agencies of institutions. Cross-institutional comparisons of research integrity tend to find numerous variations in how research integrity is interpreted and this suggests that difficulties that can arise when researchers move between institutions and/or institutions collaborate on research.

Box 25: Good practice example of research integrity policy

Macquarie University, Australia²⁹⁰

Macquarie University has developed its own code for the responsible conduct of research. This lays out principles and best practices at the institutional level and for researchers and also provides a framework for handling breaches of The Code.

The Code incorporates management of research data, supervision of research students, dissemination of research findings, peer review, conflicts of Interest and the management of collaborative research across institutions.

Macquarie University has also established a network of Research Integrity Advisors who can advise on proper conduct of research.

8.2 Recommendations

At the conclusion of the workshop participants considered five recommendations that could be put forward for further consideration by APEC economies. Each of these tackles some of the barriers to researcher mobility.

8.2.1 APEC data set on researcher mobility

Participants discussed the need to develop a data set on the mobility of researchers among APEC economies. Data available on researcher mobility in APEC is currently limited to that which can be extrapolated from broad data sets held by multilateral agencies such as the OECD, UNESCO and the World Bank. These lack specific reference to researcher mobility and some data sets omit a number of APEC economies.

Without rigorous data on researcher mobility it is difficult to inform relevant policy making around researcher mobility, with many economies unable to determine how many researchers are mobile, where they are going, for what duration and who they are partnering with. The lack of information stymies the development of policies and practices which could be used to provide incentives for greater researcher mobility, help researchers overcome some of the barriers they face to mobility and enable collaboration between APEC economies on researcher mobility.

Participants at the workshop therefore highlighted the need to agree on a minimum data set for recording the mobility of researchers and aim to share this information across the region. For reasons of efficiency this could start by drawing from research undertaken in other parts of the world and in APEC economies. Within APEC the Institute for International Education's Centre for Academic Mobility Research and Impact produces a number of outputs including the Open Doors Report. While primarily focused on the mobility of international students to the

United States this report includes data on research student mobility²⁹¹. More specific data collection on research mobility is undertaken outside APEC through the European Commission's MORE2 study. Although ambitious, its methodology and definitions could inform future APEC initiatives in this area.

8.2.2 Research into the impact of researcher mobility

Beyond developing a data set which identifies the scope and patterns of researcher mobility among APEC economies, participants discussed the need for research to identify the impact of researcher mobility, not just in terms of innovation but also in terms of social, economic, environmental and cultural impact. This kind of data is not currently available, both within many economies and across the APEC region.

Similar to data on researcher mobility, the absence of data on the impact of researcher mobility means that it is difficult to inform policy making that directs resources towards outcomes that are known to generate benefits. Statistics on research publications produced with the collaboration of researchers from more than one economy do provide some indication of researcher collaboration. This is inadequate, however, as a representation of the outcomes of researcher collaboration and may or may not suggest researcher mobility.

Rather than starting from a blank slate, research on the impact of researcher mobility among APEC economies could draw on existing research from around the world. Examples include Lawson et al.'s *Report on the Effects of Researchers' Mobility in Terms of Scientific Performance* (2013)²⁹², Jonkers and Cruz-Castro's report on *The Effect of International Mobility on Scientific Ties, Production and Impact* (2013)²⁹³, Fernandez-Zubieta et al.'s analysis of *Researchers' Mobility and its Impact on Scientific Productivity* (2013)²⁹⁴ and

Science Europe's report on *Comparative Benchmarking of European and US Research Collaboration and Researcher Mobility* (2013)²⁹⁵.

8.2.3 Consider and agree to priority fields of research

The third recommendation made by participants was that APEC economies work together to determine a number of priority research areas. A shared research agenda would catalyse greater collaboration and would facilitate a set of structures in which researchers from APEC economies could pool their resources, expertise, facilities and infrastructure to work towards the solution of key common problems.

The definition of priority research areas would likely stimulate multidisciplinary research and could enable the development of policies to engage researchers in industry and business to contribute their expertise in these areas. One possibility would be to establish centres of excellence in APEC economies around each key theme in order to cluster key experts and to facilitate exchange between leading institutions.

In addition to addressing shared challenges that all economies are facing, such as air pollution, renewable energy, food security, ageing society and security, the APEC priority research areas could also focus on issues that are likely to be of critical importance in the future, but on which research remains at a preliminary stage.

8.2.4 Sharing information on expert researchers in priority fields of research

One of the challenges that workshop participants noted in encouraging researcher mobility was a lack of information on who is doing research in particular fields. Participants thus suggested the development of an APEC database of expert researchers in various disciplines that could be searched by researchers in other APEC economies with an interest in collaboration and mobility.

A database of this kind could also be used to bring together researchers in industry and academia, identifying who is working on which areas as well as opportunities for cross-sectoral collaboration. This could be based on the approach taken by the Japan Science and Technology Agency and would likely stimulate greater academia-industry research collaborations in the future.

8.2.5 Develop guiding principles for research integrity

The final recommendation of participants was to develop an APEC approach to research integrity. The Singapore Statement provides a good foundation but participants felt that further work is required to develop a set of guiding principles to demonstrate APEC's commitment to research quality. This approach would help the research communities in APEC economies learn from the experiences of their peers in other economies and share good practice. Once developed, the guiding principles would greatly reduce the complexities involved in researcher mobility.

Appendix A – Researcher Mobility Workshop Agenda



Australian Government
Department of Education and Training



Asia-Pacific
Economic Cooperation

APEC Researcher Mobility Workshop

Bringing together research opportunities and institutional linkages across the Asia-Pacific

DAY 1: Tuesday 1 December 2015 Room

Hotel Borobudur Jakarta: Timor

8.30 am **Registration. Tea and coffee**

Welcome and introduction

9.00 am	Welcome and introduction	Australia <u>Associate Prof Craig Ritchie</u> , Branch Manager, International Mobility, Department of Education and Training
9.10 am	Welcome	Indonesia <u>Prof Ainun Na'im</u> , Secretary General, Ministry of Research, Technology and Higher Education
9.20 am	Opening remarks	Facilitator <u>Prof Isak S. Pretorius</u> , Deputy Vice-Chancellor Research, Macquarie University, Australia
9.30 am	Researcher mobility and cross-border education cooperation in APEC	APEC <u>Dr Wang Yan</u> , Education Network Coordinator

The policy context: Reporting research findings

9.40 am	Presentation on Discussion Paper Research	<u>Dr Sarah Richardson</u> , Principal Research Fellow, Australian Council for Educational Research and <u>Dr Ren Yi</u> , Director, Research Training and International Research Training Partnerships, Macquarie University
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Q+A 10 mins

10.20 am **Morning Tea**

Encouraging researcher mobility

10.35 am	Session introduction	Facilitator <u>Prof Isak S. Pretorius</u>
10.40 am	Researcher mobility – early career researchers and research students	Thailand <u>Dr Trakarn Prapasongsa</u> , Lecturer, Department of Civil and Environmental Engineering, the Faculty of Engineering, Mahidol University and
11.00 am	Researcher mobility – early career researchers and research students <i>Q+A 15 mins</i>	Indonesia <u>Prof Ocky Karna Radjasa</u> , Director, Directorate of Research and Community Services, Ministry of Research, Technology and Higher Education
11.35 am	Short break	
11.40 am	Researcher mobility – mid and late career researchers	China <u>Prof Zhang Shizhuan</u> , Director, Asian and African Affairs, Department of International Cooperation, Chinese Academy of Sciences
12.10 pm	Researcher mobility – mid and late career researchers <i>Q+A 15 mins</i>	Australia <u>Nancy Pritchard</u> , Director, International Programs, Australian Academy of Sciences
12.45 pm	Lunch	
1.35 pm	Group discussion: Encouraging researcher mobility	Chaired by Facilitator <u>Prof Isak S. Pretorius</u>
2.05 pm	Report group findings	Group spokespeople

Building institutional partnerships

2.20 pm	Session introduction	Facilitator <u>Prof Isak S. Pretorius</u>
2.25 pm	Institutional partnerships <i>Q+A 15 mins</i>	USA <u>Dr Chris Martin</u> , Science Program Officer, The Kavli Foundation
3.10 pm	Group photo and Afternoon tea	
3.30 pm	Regional approaches to grow institutional collaboration <i>Q+A 15 mins</i>	SEAMEO <u>Dr Chantavit Sujatanond</u> , Director, SEAMEO RIHED, Commission on Higher Education, Thailand Chile <u>Prof Flavio Salazar-Onfray</u> , Vice President of Research and Development, University of Chile
4.25 pm	Group discussion: Stimulating institutional partnerships	Chaired by Facilitator <u>Prof Isak S. Pretorius</u>
4.55 pm	Report group findings	Group spokespeople
5.15 pm	Review of Day 1	Facilitator <u>Prof Isak S. Pretorius</u>
5.25 pm	End of Day 1 Program	

Dinner

6.30 pm – 8.30 pm	Hotel Borobudur Jakarta	Timor Room: Informal networking dinner
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DAY 2: Wednesday 2 December 2015

8.30 am	Tea and coffee	
9.00 am	Welcome and overview	Facilitator <u>Prof Isak S. Pretorius</u>

The role of research in powering economic growth in APEC economies

9.10 am	Session introduction	Facilitator <u>Prof Isak S. Pretorius</u>
9.15 am	Research and industry links contributing to economic growth	Japan <u>Mr Masaki Sato</u> , Director, Japan Science and Technology Agency
	<i>Q+A 15 mins</i>	
10.00 am	Group discussion: Regional approaches to stimulating industry linked research	Chaired by Facilitator <u>Prof Isak S. Pretorius</u>
10.30 am	Morning tea	
10.45 am	Report group findings	Group spokespeople

Ensuring integrity in researcher mobility

11.05 am	Session introduction	Facilitator <u>Prof Isak S. Pretorius</u>
11.10 am	Embedding research integrity in researcher mobility	Australia <u>Dr Ren Yi</u> , Director, Research Training and International Research Training Partnerships, Macquarie University
	<i>Q+A 15 mins</i>	
12.05 pm	Lunch	

Opportunities to increase research mobility across the Asia-Pacific

1.00 pm	Panel discussion led by group spokespeople	Chaired by Facilitator <u>Prof Isak S. Pretorius</u>
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Closing

2.00 pm	Wrap up of program	Facilitator <u>Prof Isak S. Pretorius</u>
2.15 pm	Closing remarks	APEC <u>Dr Wang Yan</u> , Education Network Coordinator
2.25 pm	Closing remarks	Indonesia <u>Prof Ainun Na'im</u> , Secretary General, Ministry of Research, Technology and Higher

Education

2.35 pm **Closing remarks**

Australia Associate Prof Craig Ritchie, Branch Manager, International Mobility, Department of Education and Training

2.45 pm **End of the workshop program and Afternoon tea**

Participating economies

Australia

Chile

People's Republic of China

Indonesia

Japan

Malaysia

The Philippines

Papua New Guinea

Singapore

Thailand

United States of America

Viet Nam

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