

# Effectiveness of research and Innovation Management at Policy and Institutional Levels

CAMBODIA, MALAYSIA,  
THAILAND AND VIETNAM



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## Executive summary

The OECD has carried out a study on *Effectiveness of Research and Innovation Management at Policy and Institutional Levels* as a part of the OECD project on Innovation, Higher Education and Research for Development (IHERD), which is financed by the Swedish International Development Cooperation Agency.

This final report includes:

- An introduction to the project on effectiveness of research and innovation management at policy and institutional management.
- An overview of the emerging landscape in research and innovation management.
- A typology of knowledge and skills requirements for effective research and innovation management.
- Empirical accounts of the research management capacity of four countries in Southeast Asia: Cambodia, Malaysia, Thailand and Vietnam.
- A summary of the gaps in knowledge and skills for effective research and innovation management in the selected countries.
- An overview of actors providing training on skills and knowledge in research management and in research and innovation policies

The typology was developed both from a methodological point of view – to assist the analysis of the research and innovation management needs of the case study countries – and as an analytical tool – providing guidance on strategic options for addressing current gaps in research and innovation management at policy and institutional levels. The typology is based on the following thematic areas:

Theme 1: governance and leadership of research and innovation by government

Theme 2: leadership *of research* in institutions

Theme 3: management to support leadership of research in public institutions

Theme 4: leadership *of researchers* in institutions

Theme 5: management to support leadership of researchers

Theme 6: personal behaviours and qualities of research leaders and managers

The report assumes that those leaders and managers who pay attention to the factors identified in the six themes will have the potential to ensure that the future development of their societies and countries can benefit from the intellectual and imaginative efforts of their populations.

The case studies of Cambodia, Malaysia, Thailand and Vietnam show that:

- Policy makers in general need to become better informed about the national importance of making a stronger commitment to R&I by investing more heavily in capacity building and the expansion of opportunities for research in universities.
- Policy makers and institutional leaders need to become much better informed about global research trends, policy settings and funding arrangements affecting R&I management.
- Policy makers need to be assisted to develop skills in developing R&I policies that are based on evidence and informed by strategic considerations.
- Policy makers need to develop an appreciation of the training needs of researchers in universities and research institutes concerning the processes of commercialisation.
- Policy makers need to develop a better appreciation of how important institutional autonomy is to universities if universities are to be expected to make a significant contribution to R&I.
- Research managers and administrators within universities and research institutes need more support with the development of knowledge and skills related to their responsibilities.

One option to address these gaps is to establish regional collaboration across the four countries to improve R&I management at policy and intuitional levels, particularly but not limited to the ASEAN framework of co-operation, giving the countries their own expertise and access to a regional network of professionals in this domain.

## Acronyms

<b>ARMA</b>	Association for Research Managers and Administrators
<b>ASEAN</b>	Association of Southeast Asian Nations
<b>BRIC</b>	Brazil, Russia, India and China
<b>GDP</b>	Gross domestic product
<b>GERD</b>	Gross expenditure on research and development
<b>GNI</b>	Gross national income
<b>GNP</b>	Gross national product
<b>HEI</b>	Higher education institution
<b>HERD</b>	Higher education expenditure on research and development
<b>ICT</b>	Information communications technology
<b>IGO</b>	Inter-governmental organisations
<b>IP</b>	Intellectual property
<b>IHERD</b>	Innovation, Higher Education and Research for Development
<b>IMF</b>	International Monetary Fund
<b>KAUST</b>	the King Abdullah University of Science and Technology
<b>MFP</b>	Multi-factor productivity
<b>PPP</b>	Purchasing power parity
<b>R&amp;D</b>	Research and development
<b>R&amp;I</b>	Research and innovation
<b>RAE</b>	Research Assessment Exercise (UK)
<b>STEM</b>	Science, technology, engineering and mathematics
<b>STI</b>	Science, technology and innovation
<b>TVET</b>	Technical and vocational education and training
<b>WTO</b>	World Trade Organization

### **Cambodia case study**

<b>ACC</b>	Accreditation Committee of Cambodia
<b>ADB</b>	Asian Development Bank
<b>AUN</b>	ASEAN University Network
<b>CDRI</b>	Cambodia Development Resource Institute
<b>CSES</b>	Cambodia Socio-Economic Survey
<b>EFA</b>	Education for All
<b>HEQCIP</b>	Higher Education Quality and Capacity Improvement Project
<b>MoEYS</b>	Ministry of Education, Youth and Sport
<b>MoLVT</b>	Ministry of Labor and Vocational Training
<b>NSDP</b>	National Strategic Development Plan
<b>NTB</b>	National Training Board
<b>RAC</b>	Royal Academy of Cambodia
<b>RUPP</b>	Royal University of Phnom Penh
<b>SEAMEO</b>	South-East Asian Ministers of Education Organization
<b>SNEC</b>	Supreme National Economic Council
<b>TWG</b>	Technical Working Group

<b>UMAP</b>	University Mobility in Asia and the Pacific
<b>UNDP</b>	United Nations Development Programme
<b>UNESCO</b>	United Nations Educational, Scientific, and Cultural Organization

### **Malaysia case study**

<b>AKEPT</b>	Malaysia Higher Education Leadership Academy
<b>APEX</b>	Accelerated Programme for Excellence
<b>AVRDC</b>	Asian Vegetable Research and Development Centre
<b>AYEN</b>	AKEPT Young Entrepreneurs Network
<b>AYGEC</b>	AKEPT Young Global Educators Caucus
<b>AYGLC</b>	AKEPT Young Global Leaders Caucus
<b>AYRC</b>	AKEPT Young Researcher Circle
<b>CDR</b>	Centre of Drug Research, USM
<b>COE</b>	Centre of excellence
<b>CRDF</b>	Commercialisation of R&D Fund
<b>DAGS</b>	Demonstrator Application Grant Scheme
<b>EPU</b>	Economic Planning Unit
<b>ERGS</b>	Exploratory Research Grant Scheme
<b>FRGS</b>	Fundamental Research Grant Scheme
<b>GLC</b>	Government-linked company
<b>GNH</b>	Gross national happiness
<b>GRI</b>	Government research institute
<b>GSAC</b>	Global Science and Innovation Advisory Council
<b>HED</b>	Higher Education Department, MOHE
<b>HICoE</b>	Higher Institution Centre of Excellence
<b>IGS</b>	Industry R&D Grant Scheme
<b>IHC</b>	Innovative Human Capital Development
<b>IHL</b>	Institution of higher learning
<b>INFORMM</b>	Institute for Research in Molecular Medicine, USM
<b>IPPTN</b>	National Higher Education Research Institute
<b>IPS</b>	Institute of Postgraduate Studies, USM
<b>IRRI</b>	International Rice Research Institute
<b>KPI</b>	Key performance indicator
<b>LRGS</b>	Long Term Research Grant Scheme
<b>MARDI</b>	Malaysian Agriculture Research Development Institute
<b>MIGHT</b>	Malaysian Industry-Government Group for High Technology
<b>MGS</b>	Multimedia Super Corridor R&D Grant Scheme
<b>MNC</b>	Multinational corporation
<b>MOHE</b>	Ministry of Higher Education
<b>MOSTI</b>	Ministry of Science, Technology and Innovation
<b>MoU</b>	Memorandum of understanding
<b>MYR</b>	Malaysian Ringgit
<b>MyRA</b>	Malaysia Research Assessment
<b>NCCR</b>	National Committee for Clinical Research

<b>NHESP</b>	National Higher Education Strategic Plan
<b>NITC</b>	National IT Council Malaysia
<b>NSRC</b>	National Science and Research Council
<b>NYAS</b>	New York Academy of Sciences
<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>PASS</b>	Postgraduate Academic Support Services
<b>PPD</b>	Personal and professional development
<b>PRGS</b>	Prototype Research Grant Scheme
<b>RAGS</b>	Research Allocation Grant Schemes
<b>RCMO</b>	Research Creativity Management Office
<b>RSE</b>	Researchers, scientists and engineers
<b>RU</b>	Research university
<b>SME</b>	Small or medium-sized enterprise
<b>STEM</b>	Science, technology, engineering and mathematics
<b>TAF</b>	Technology Acquisition Fund
<b>UNICEF</b>	United Nations Children's Fund
<b>USIC</b>	USAAINS Industry Council
<b>USM</b>	Universiti Sains Malaysia (Science University of Malaysia)
<b>WHO</b>	World Health Organisation

#### **Thailand case study**

<b>ARDA</b>	Agricultural Research Development Agency
<b>ASEAN</b>	Association of Southeast Asian Nations
<b>BIOTEC</b>	National Center for Genetic Engineering and Biotechnology
<b>HSRI</b>	Health Systems Research Institute
<b>KNIT</b>	Knowledge Network Institute of Thailand
<b>MTEC</b>	National Metal and Materials Technology Center
<b>NANOTEC</b>	National Nanotechnology Center
<b>NECTEC</b>	National Electronics and Computer Technology Center
<b>NIA</b>	National Innovation Agency
<b>NRC</b>	National Research Council
<b>NSTDA</b>	National Science and Technology Development Agency
<b>STI</b>	National Science, Technology and Innovation Policy Office
<b>THB</b>	Thai Baht
<b>TISTR</b>	Thailand Institute of Scientific and Technological Research
<b>TMC</b>	Technology Management Center
<b>TRF</b>	Thailand Research Fund
<b>TSP</b>	Thailand Science Park
<b>USPTO</b>	United States Patents and Trademarks Office

## **Vietnam case study**

<b>MOET</b>	Ministry of Education and Training
<b>MOST</b>	Ministry of Science and Technology
<b>MOF</b>	Ministry of Finance
<b>MOIA</b>	Ministry of Internal Affairs
<b>MPI</b>	Ministry of Planning and Investment
<b>NAFOSTED</b>	National Fund of Science and Technology Development
<b>VNU</b>	Vietnam National University

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# **Chapter 1**

## **Introduction and project overview**

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Lynn Meek and Åsa Olsson

## Introduction

The OECD has carried out a study on *Effectiveness of Research and Innovation Management at Policy and Institutional Levels* as a part of the OECD project on Innovation, Higher Education and Research for Development (IHERD), which is financed by the Swedish International Development Cooperation Agency.

## Background

The management of research and development (R&D) and innovation has emerged as a specialised area within both funding agencies and higher education institutions. New modalities of research and innovation have evolved over the last 10 to 20 years against a backdrop of major changes in the tertiary education sector as a whole (OECD, 2008). Research management activities include: attracting funding, managing funds, liaising with funding bodies, project planning, implementation, monitoring and evaluation. All this comes on top of research activities such as producing publications, research dissemination and, in many cases, commercialisation.

The professionalisation of higher education administrations has affected finance departments, student admissions, and building and grounds management, particularly in countries where there have already been substantial increases in institutional autonomy and changes to the governance arrangements within institutions (OECD, 2008). Moreover, higher education institutions are becoming increasingly dependent on research into the higher education system as a whole, for example to help them better understand the external environment, in order to construct relevant strategic plans ("stay in the game").

These changes can lead to some tensions between the priorities and strategies of the institution, as well as those of individual researchers. This may also impede participation in collaborative research within and across institutions. The systems of rewards for both institutions and individual academics are important. While a healthy tension between executive management and academic staff is inevitable, clear responsibilities and processes are required to ensure that the tension does not become counterproductive.

The sheer scale of many universities, some of which have multi-billion dollar budgets, requires highly competent managers and leaders. Research managers not only have responsibility for developing and implementing research policy at the institutional level, they also play a key role in ensuring that the researchers themselves have adequate skills in such areas as research grant writing, grant management, research team leadership, research student supervision, writing for

publication and ethics. This has led to the development of an increasingly sophisticated range of training programmes and qualifications for research management and administration, as well as specialised associations for research administrators.

A further field where there has been considerable development is in the transformation of university-based research into innovation. This too requires expertise – from building collaborative links with business through to the more technical aspects of technology transfer. This has also led to the development of specialised technology transfer training programmes,<sup>1</sup> and groups supporting these activities.

These programmes (across OECD countries and beyond) provide expertise on the complex set of knowledge and skills required by research policy makers and institutional research and innovation managers. They also provide training to improve the skills and knowledge of those operating in these important positions an important role.

The challenge for development is to build the skills and expertise of the research and innovation managers in developing countries to help them ensure that the scarce research resources available to institutions are effectively deployed and managed. The role of this study was to categorise and analyse the requirements for effective research and innovation management in developing countries at the policy and institutional level. It examines possible approaches for how to best support effective research management.

## Objectives of the study

The objectives of the study were to:

- To develop a typology of the knowledge and skills required for effective research and innovation management, in OECD and emerging countries, and to assess their applicability for research and innovation management in developing countries.
- Guided by the typology, to assess the knowledge and skills gaps for effective research and innovation management in developing countries for:
  - higher education institutions carrying out research and innovation
  - funding agencies and policy makers.
- Develop strategies and options that developing countries could adopt in order to address their knowledge and skills gaps and build capacity for more effective research and innovation management.
- Identify key providers of capacity-building programmes in OECD, emerging and developing countries, in both research and innovation policies, and research and innovation management at the institutional level.

The typology was tested against the political and institutional realities of four developing countries in the Southeast Asian region: Cambodia, Malaysia, Thailand and Vietnam.

## Workshop

As a key component of the overall project, an “International Workshop on the Effectiveness of Research and Innovation Management at Policy and Institutional Levels” was held in Kuala Lumpur, 27 February to 1 March 2013.

The objectives of the workshop were to:

- Identify the main challenges and assess the knowledge and skills gaps for effective research and innovation management at policy and institutional levels based on the contexts in Southeast Asia.
- Assess the applicability of the IHERD draft typology on the effectiveness of research and innovation on policy and institutional levels in the South East Asia context.
- Develop strategies and options that countries might adopt in order to address their knowledge and skills gaps and build capacity for more effective research and innovation management.

The workshop showcased the IHERD research and focused on research and innovation management in the Southeast Asia region, including a presentation of the typology of the knowledge and skills required for effective research and innovation management, and the identification of key providers of capacity-building programs in this area. Another very important component of the workshop was the presentation of country case studies for Cambodia, Malaysia, Thailand and Vietnam, which assessed the knowledge and skills gaps in those countries for effective research and innovation management.

The workshop brought together leading experts from the four East Asia case study countries with expertise and responsibilities in one or more of the following categories: a) ministries responsible for science, technology and research policy; b) senior executive officers from leading research institutions – university and/or major research institutes; c) CEOs of leading research funding agencies; and d) leading scholars in the area of science policy and innovation.

The workshop attracted 44 invited participants from the region and further afield. The workshop agenda is presented in Appendix A and the list of participants in Appendix B. The various research reports comprising the IHERD study (outlined below and presented in full in the remainder of this volume) on research and innovation management were subsequently revised in light of the discussions that took place during the Kuala Lumpur expert meeting.

## Organisation of the study and presentation of outcomes

Any understanding of the evolving importance of research and innovation management at policy and institutional level must take into account the global socio-economic policy context. This fact was emphasised during the Kuala Lumpur workshop. Many of the drivers shaping research and innovation management lie outside the direct control of individual countries, much less that of individual research managers. In Chapter 2, Mary-Louise Kearny discusses the global policy imperatives in research and innovation management.

Following Chapter 2, the remainder of this volume presents the final results of the IHERD project on research and innovation management. The first stage of the project consisted of an overview study of key providers of capacity-building programmes in research and innovation policy and higher education management. The study was led by Fabiana Barros de Barros and was based on a web search and a list of key providers including a description of their services, such as undergraduate, graduate, PhD, postdoctoral and executive courses. The results of this study are reported in Appendix C.

In the second stage, Alan Pettigrew led a study to develop a typology of the knowledge and skills requirements for effective research and innovation management at a policy and institutional level. The typology was assessed against a mixed set of countries, with particular attention given to developing and emerging economies, to ensure its usefulness for assessing context-specific needs. The typology took into account such factors as system parameters, role designation, institutional type, levels of responsibility and country context. This aspect of the project is reported in Chapter 3.

The third part of the study involved a thorough application of the typology to assess the needs of selected middle- and low-income countries in Southeast Asia, namely Cambodia, Malaysia, Thailand, and Vietnam. The typology was used as a basis for discussion with key stakeholders – e.g. government policy makers and institutional leaders – who were asked to a) identify the main challenges they face in managing research and innovation effectively; b) review the typologies of knowledge and skills; and c) compare them with their main challenges to identify where the core research management knowledge and skills need to be adapted to meet their specific requirements and challenges.

This third stage of the project produced four case studies. In Chapter 4 Sideth S. Dy discusses the Cambodian experience, in Chapter 5 Molly Lee and her colleagues discuss the Malaysian experience, in Chapter 6 Charas Suwanwela examines Thai developments, and in Chapter 7 Pham Thi Ly reviews developments in Vietnam. Martin Hayden then produced a summary report of current gaps in efficient research and innovation management and suggestions of how

to address these gaps based on the four case studies and in light of the discussion at the expert meeting in Kuala Lumpur. This is presented in Chapter 8.

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# **Chapter 2**

## **Policy imperatives in research and innovation management**

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Mary-Louise Kearney

## Introduction

It is increasingly recognised that sustained economic prosperity for both developed and developing countries is linked to the development of the knowledge economy (Beerrens, 2008; Cassity & Ang, 2006; Etzkowitz et al., 2000; Meek & Davies, 2009; OECD, 1996). This paper assumes that the basic questions concerning knowledge production and innovation, and the research cultures and capacity required to support these activities, span all jurisdictions and are as relevant to developing as to developed countries.

This report supports the OECD claim that "The notion in development theories that countries need to 'exhaust' their potential for catching up before embarking on their 'own' innovation and R&D activities is being challenged. This opens up avenues for mutual learning and multilateral collaboration on science, technology and innovation between OECD and developing countries." (OECD, 2010, p.149)

The challenge for development is to build the skills and expertise of research and innovation managers to ensure that the scarce research resources available are effectively deployed and managed.

Countries' performance in research and innovation is underpinned by a number of important functions carried out by government officials who assist politicians in the formulation and implementation of national policy in these areas, the leaders and senior staff of research institutions, and those staff who provide essential institutional functions to ensure that the management of research is conducted effectively.

The objective of this study is to provide an overview of the emerging political landscape in the area of innovation and research in the current global higher education landscape.

### **The knowledge economy in 2013**

In a globalised world, policy makers seeking effective strategies to address major challenges related to national and institutional development need a thorough understanding of the context. Rapid socio-economic transformation means that the specifics of context must be given careful consideration in ways that were not as important in the past.

Since the 1990s, the advance of the knowledge economy has been an unstoppable force worldwide, affecting national growth and prosperity as well as forging closer international linkages amongst countries with varying levels of social and economic development. Fuelled by ever-evolving information communication technology (ICT) capacity, this is regarded as the

natural result of globalisation. It has spurred nations of varied economic strengths to invest more heavily in knowledge as a motor for growth and to reorient their policies to address the issues involved. Yet, since the advent of the global crisis in 2008, the knowledge economy has battled against a climate of extreme uncertainty as it seeks to resolve the most synchronised global recession since the 1930s. In 2013, OECD countries and emerging economies alike are struggling to develop strategies capable of assuring sustainable recovery. Although the crisis unleashed its major damage in 2008-09, the fallout has continued. Combating it involves multiple actors, notably governments, the private sector, higher education institutions and the research community as well as civil society at large. Key areas for action include governance, resources, knowledge generation and management, research and innovation, employment, technology, relevance and sustainability. These demand both short- and long-term perspectives as countries deal with uneven economic performance and volatile labour market trends while seeking to implement more effective policies to stimulate solid and sustained stability and growth.

A brief overview of events from 2008 to 2013 recalls the severe degree of economic shock registering around the globe:

- The near implosion of the financial sector and actual banking collapse caused heated debate amongst leading central bankers as to the best policies to employ to assure adequate economic stimulus of the economy.
- Opinion is divided as to whether the banking sector is fully committed to sharing the high costs of a recovery strategy alongside taxpayers.
- Economic experts (as opposed to politicians) continue to debate about how to handle the inevitable results of continued stimulus packages and financial bailouts (usually higher taxes or rising inflation) and mitigate the negative impact for citizens already battered by the crisis.
- National economic bankruptcy (e.g. Cyprus, Iceland, Ireland, Latvia) and serious damage to key industries (e.g. the automobile industry in the United States, tourism in Spain, property development in Ireland) as well as in the global market (e.g. overall decline in consumer spending, falling or volatile prices for commodities vital to developing economies), have launched calls for global financial reform and for a new commitment to business ethics demonstrating social responsibility.
- Employment figures have been broadly fluctuating, raising the spectre of a jobless (or job-poor) recovery.
- Progress in important areas of social policy reform has slowed as nations wrestle with high deficits and lacklustre quarterly economic performances (e.g. France, the United Kingdom, the United States) and sovereign debt forcing austerity measures (i.e. frozen budgets and higher taxes).
- OECD countries have watched perplexed as other economies seemed to deal with the situation with impressive dynamism, thus reinforcing the fast-changing world economic

order. The strategies employed are diverse – some countries (e.g. China, Malaysia, Qatar, Singapore, the United Arab Emirates) have increased investment in research and innovation (R&I) and in human capital, while others have developed alternative economic engines, for example Brazil, which despite seeing growth fall from 7.5% in 2010 to less than 1% in 2012, has avoided recession by switching from industry to services to maintain high employment levels.

Taking stock in 2013, what challenges lie ahead? The recession has engendered a deep malaise over the true dividends of globalisation as future generations face unstable employment, costly environmental disasters and social issues such as ageing populations and cross-cultural immigration. Forecasts from the OECD, the World Trade Organization (WTO), the World Economic Forum, the International Monetary Fund (IMF) and other bodies suggest there will be some improvement but robust economic recovery remains elusive. The post-recession world remains alarmingly volatile with harsh impacts being felt in most sectors of the economy. National policy makers, institutional leaders and managers as well as the academy at large will need steady governance accompanied by flexible management to ensure the best outcomes for the policies and strategies they select in their country.

As post-crisis volatility may continue for another decade, policy makers are turning to research, innovation, and tertiary and higher education to help resolve problems and trigger growth. Certain questions take centre stage:

- Which countries are able to post positive socio-economic performances?
- Which policy directions help to create these positive effects?
- Which tertiary and higher education systems and institutions have found resourceful and innovative ways to face these new challenges?
- Which countries ones are battling to survive the adverse conditions because their chosen policies and strategies may have come too late or lack optimal impact?

These questions are of concern for all OECD countries and beyond. The survival tactics that have been adopted constitute a valuable resource for consultation and eventual adaptation because the crisis is global and success stories need to be shared. The nexus of research, innovation and tertiary and higher education will likely continue to receive priority attention worldwide. This is evident from the BRIC countries (Brazil, Russia, India and China) to economies of varying scale (Chile, Jordan, Kenya, Malaysia, Singapore, Tanzania, Trinidad and Tobago, Tunisia and the United Arab Emirates), many of which are already modernising their systems. Even the most populous countries, like Indonesia, Mexico and Nigeria, despite facing huge social development challenges including basic education, are investing significantly in these areas in an effort to benefit from the knowledge economy.

## **Constants and variables related to global research and innovation policy**

R&I policy demands that high-level research capacity be assured by robust institutions in both the university and R&D sectors. Here, both constant factors affecting all countries, and variable factors specific to individual countries, come into play.

### **Constant factors**

- Growth, both for countries and their institutions, depends on three constants: a) adequate policies (including governance and management); b) sufficient resources and investment; and c) highly trained human capital.
- R&I is a key force for growth because innovation often, although not exclusively, is linked with advanced knowledge. Today, the world's best-performing economies are innovation driven with robust public and private investment in this sector.
- Research universities (as part of the higher/tertiary education sector) are among the major actors producing advanced knowledge. These institutions are now critical for governments because they are sources of new fields of knowledge which are essential for national development. Current changes in higher and tertiary education will ultimately result in more clearly differentiated institutions with specific missions. Thus shorter, undergraduate teaching-based degrees will contrast with advanced research degrees. This change is already under way but could accelerate to meet pressing needs. Already, research functions are becoming increasingly specialised and supported by governments and other funding sources. For this reason, most emerging economies – depending on their size and wealth – are aiming to establish one or more world-class research universities. These are intended to function as hubs of advanced knowledge and interact with partners worldwide, including the Super Research Universities (RUs mainly located in certain OECD countries. Elsewhere, China aims to have eight top research universities and Saudi Arabia has invested heavily in KAUST (the King Abdullah University of Science and Technology)).
- R&I is a *concept* as well as an *activity* – i.e. it is about managing the generation, application and dissemination of advanced knowledge as much as the specific discipline-related areas being investigated. Policy makers must understand the conceptual aspect of R&I so that they obtain optimal results from public investment in research.
- Major IGOs (inter-governmental organisations) such as the OECD, the World Bank, UN agencies and their regional counterparts (e.g. the European Union, African Union, ASEAN, APEC, MERCOSUR, ISESCO) deliver policy advice to governments in areas such as governance, investment, quality assurance, R&I, health, agriculture, energy, education and human capital development, private sector linkages and international co-operation. In all these areas, one principal function is providing foresight. Their role is to help predict global growth patterns, including approaching challenges and opportunities and their implications for international, regional and national progress. Sustained economic

development is perhaps the most critical area of analysis, given its importance for areas such as social progress and employment. In 2013, global wealth patterns continue to shift significantly and those economies performing well are driven by a variety of motors of growth. Thus, this foresight function – notably its accuracy and reliability – assumes new importance and even affects the credibility of these agencies.

## **Variable factors**

- The capacity of a country to develop effective R&I policy, whether at national or institutional levels, will depend on its wealth levels.
- All countries are interested in the socio-economic returns on R&I investment. These are usually outlined in policy documents such as white papers, think tank reports and political manifestos which describe the potential benefits for national development accruing from this investment. Countries need to commit to optimise the current bases of their economies or to identify and development new sources of growth.
- According to the traditional OECD indicators, countries attain better levels of economic growth if they invest equally in three crucial domains: innovation, higher education (notably fields related to science, technology, engineering and medicine) and ICT capacity. Conversely, when investment is not fairly balanced, across the three areas of higher education, innovation and ICT growth can seriously falter.
- Middle- and low-income countries face tough choices when seeking to invest in R&I as the cost of the key components is high. Establishing sound and sustainable ICT systems, building world-class universities and financing top research (basic or applied) are expensive endeavours. Nevertheless, counties in each region are choosing to make this investment and, consequently, are emerging as hubs of economic growth. These include Chile, Qatar, Singapore and South Africa.
- In stark contrast, political instability represents a particularly serious impediment to socio-economic development, for example Congo, Mali and Syria.
- The prolonged duration and unexpected aspects of the global crisis have become special variables affecting R&I policy efforts. Although the OECD countries are generally stable democratic economies, their growth, employment levels and the costs of their social systems (e.g. health, education and pensions) have been negatively affected by the crisis. In some instances, this has caused profound political and social unrest (e.g. Greece, Italy and Spain). Moreover, due to their domestic woes, the major donor nations are struggling to maintain aid levels to less developed states. Overall, the crisis has left OECD countries less wealthy than in the past and most have revised their predictions for growth. Yet they must strive to find adequate funding for their R&I policies since innovation is vital for stimulating development.

Because the dynamics between constant and variable factors have reached new proportions, these are now influencing the forecasting approaches made by expert bodies such as OECD and others. For this reason and with the global economic landscape in permanent flux, R&I now dominates the policy discourse.

## **Policy guidelines for investment in research, innovation and higher education**

The current economic woes and the changing dynamics between constant and variable factors for development have reduced potential output growth, increased unemployment and provoked soaring public debt. Consequently, concerned policy makers have intensified their interest in R&I and higher education as vital repositories of knowledge and skills which must be harnessed to spur development.

Globalisation, which rolls on with unprecedented speed and scale, is characterised by increased international trade, deeper economic integration involving high and middle income economies, and widespread geographical fragmentation of production processes resulting in more complex global value chains. The motors of economic growth are changing as well. Whether economies are driven by manufacturing and industry (Germany), resources (energy in the Central Asian Republics, agriculture in Denmark and New Zealand), minerals and commodities (Africa, Australia, Chile) or by services and investment (tourism in small island states, the financial sector in Switzerland and Luxembourg), efficiency has been the common watchword to ensure growth. Now, innovation is the preferred watchword because each and every source of growth needs to be constantly scrutinised to identify how new approaches (including vital ICT applications) can modernise production processes, thus realising hitherto untapped potential. In brief, invention must become innovation which, with the contribution of multiple stakeholders, translates into economic growth.

Recent and current policy documents related to science, technology and innovation from the OECD and similar organisations outline the “new geography of growth” where established players are being increasingly challenged by new trends and actors. These are complemented by the reforms recommended for tertiary/higher education so that a modernised academy may educate and train human capital equipped with the range of knowledge and skills required for tomorrow’s world. Given that Project IHERD links directly to the OECD mandate, a sample of policy guidelines from that organisation merit attention.

### **Innovation guidelines**

*The OECD Innovation Strategy: Getting a Headstart on Tomorrow* (OECD, 2010), builds on the earlier Oslo Manuals (e.g OECD, 2005 *Oslo Manual: Guidelines for Collecting and Interpreting Innovation, 3<sup>rd</sup> Edition*) to articulate the economic challenges facing countries, along with the changing social landscape and the expectations surrounding innovation. It defines innovation as a new or significantly improved product, process or method, which will increasingly be needed to drive growth and employment and improve living standards. Innovation covers both

intangible assets (e.g. R&D, software, and databases and skills) as well as physical capital (e.g. equipment and infrastructure). Investment is balanced by multifactor productivity (MFP) growth which links to innovation and improved efficiency. Not only does this mix tackle economic growth but it is also crucial for resolving global social issues such as climate change, health and food security.

Because innovation is regarded as a priority if countries are to emerge from the global crisis, governments must continue to invest in future sources of growth namely education, infrastructure and research. These, combined with public service reform to boost efficiency, the removal of regulatory barriers and well-designed demand-side policies will all help to stimulate innovation and entrepreneurship. Importantly, policies should reflect the reality of innovation today which rarely occurs in isolation. Innovation has multiple stakeholders (from government, the private sector and education) and complementary activities (such as organisational change, in-house training, testing, marketing and design). This holds true for science which is an essential area of innovation although not the only one. Monitoring national innovation performance has become another key requirement, not for its own sake but because the applications of innovation improve social and economic wellbeing.

Governments should consider adopting a coherent and comprehensive approach to innovation policy based on five priorities:

***Empowering people to innovate:*** promoting broad and relevant education and skill acquisition; improving teacher quality; using tertiary education institutions, including independent, competitive and entrepreneurial universities, as bridges to government and the private sector; encouraging entrepreneurial education; harnessing internationally mobile talent via dynamic immigration policies; and involving consumers in innovation.

***Unleashing innovation:*** supporting innovative firms to translate new ideas into jobs and wealth; creating favourable tax climates for entrepreneurial businesses; helping small and medium-sized firms to enhance their expertise; facilitating access to finance; and protecting intellectual property rights for innovative businesses.

***Creating and applying knowledge:*** promoting excellence in science as a prime motor of innovation and collaboration between scientific research and the private sector; providing reliable and high-speed communication networks such as broadband networks to support innovation; establishing systems to ensure incentives, protect patents and provide collaborative mechanisms including licensing markets, pools and clearing houses for access to knowledge; and underpinning of efficient knowledge networks and market structures by governments.

***Addressing global and social issues through innovation:*** committing to collective solutions to global challenges; exploring new models for the governance of multilateral co-operation in international science, technology and innovation; balancing public and private investment in research; and enhancing educational attainment and strengthening framework conditions in middle and low-income countries which lack the necessary foundations for generating advanced knowledge and innovation.

**Improving governance and management:** adopting “whole-of-government” approaches to policies for innovation via co-ordinating mechanisms and medium and long-term planning; tapping into the benefits of coherent and complementary interaction amongst local, national, regional and international co-operation; and improving evaluation methods to better monitor national innovation efforts and ensure essential feedback into the policy-making process.

Worldwide, the tertiary and higher education sector has witnessed profound changes over the past two decades. Consequently, there is now general consensus amongst policy makers and (perhaps rather less enthusiastically) academia on the directions to follow. Countries are shaping policy to take account of the changing tertiary/higher education agenda to address mass enrolments, increased internationalisation, new roles for research and the sector’s obligations for effective social engagement.

The OECD policy document *Tertiary Education for the Knowledge Society* (OECD, 2008) focuses on the areas of governance, funding, quality, equity, R&D, labour market linkages, the academic career and international co-operation, with ICT capacity as an assumed support. Each area relates to the R&I process in particular ways, for example: assuring the governance of research via efficient research management structures including quality assurance mechanisms; providing adequate funding for research; facilitating the transfer of research, particularly in science, technology, engineering and mathematics (STEM), to labour market applications, thus helping to generate employment; attracting and nurturing gifted research staff as part of the modern academy; and engaging in international research efforts and networks.

### **Monitoring interaction between STI and higher education policies for innovation**

Today, there needs to be significant interaction between science, technology and innovation (STI) and higher education. The *OECD STI Scoreboard* (OECD, 2011) lists current trends and indicators to help countries assess their progress. The STI Scoreboard alternates with the *OECD STI Outlook*, with the latest 2012 version illustrating how countries juggle austerity measures with measures to stimulate growth. The STI Scoreboard attests to the breadth of the innovation landscape, its multiple stakeholders and actors and the constantly changing factors which influence this activity. Although there will always need to be specific policies for each sector, their closer interaction is now crucial for sustained socio-economic wellbeing. To map impact, countries will need a data infrastructure capable of monitoring linkages amongst actors, outputs and outcomes.

**Knowledge economies.** Indicators: gross national product (GNP) and new sources of growth such as intangible assets; the new geography of growth (e.g. foreign direct investment in Asia); the changing landscape of innovation (notably high-impact universities); innovation today including science for green innovation and international collaboration in STI fields; and the main global issues ahead which will shape society (e.g. the environment, ageing populations and the dominance of women in education and the workforce).

**Building knowledge.** Indicators: new doctorate graduates and their career paths, science and technology occupations, the research community and international mobility, R&D expenditure (including in business), higher education and basic research; investment in ICT.

**Connecting to knowledge.** Indicators: funding for R&D (public, private and international); science/technology linkages; labour market mobility; innovation, technology and knowledge flows; national and international collaboration for innovation.

**Targeting new growth areas.** Indicators: government funding of R&D, health and environment technologies (including biotechnology R&D), ICT access, services and costs.

**Unleashing innovation in firms.** Indicators: mixed modes of innovation, trademarks, tax incentives, access to capital, creating a facilitating policy environment and nurturing an entrepreneurial culture with talented people (including the role of education – especially tertiary/higher education – in this process).

**Competing in the global economy.** Indicators: employment; services/manufacturing balances; firm sizes and dynamics; trade openness, R&D and technology specialisation; E-commerce; patenting advances; innovative sectors (including education and training); and the quality and impact of technology performance.

## Capacity building as a process

At the OECD/IHERD seminar (Kuala Lumpur, 2013), participants emphasised that capacity-building activities should be undertaken to strengthen national infrastructure and human capital and to reinforce international linkages. However, because capacity building must be recognised as a process in itself involving various preparatory aspects, important questions include

- What are the pre-conditions for capacity building? For example, which authorities should approve such training?
- Which strategies should be used? (e.g. case studies, peer review, national or regional focus, international networking).
- Which actors are involved in training? (e.g. policy-makers, institutional managers, researchers – or a mix).
- Who within the research community is involved? (e.g. managers, early career or experienced researchers).
- What outcomes are expected? (e.g. outcomes for policy-makers, for higher education institutions, and for the research community).
- What evaluation may be undertaken to measure impact? (e.g. assessment after one or several years).

Should such training be funded by donors, those running the programmes will be required to provide answers to these questions. Although certain levels of failure and wastage or non-return may be inevitable in any development process, these may be less well tolerated by policy

makers and funders during difficult economic times. Thus, planning needs to be comprehensive in nature to achieve the intended objectives.

## **Chapter 3**

# **A typology of knowledge and skills requirements for effective research and innovation management**

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## Executive summary

Research and innovation are strong drivers of economic activity, as well as of social health and well-being. National research and innovation efforts take place in industry and public research-oriented institutions such as universities, government research agencies, hospitals and not-for-profit research institutes. Due to a number of evolving factors, the complexity of management and leadership of research and innovation is increasing, as is the setting of research and innovation policy at both government and institutional levels.

The purposes of this chapter are:

- to synthesise the essential elements of existing and evolving knowledge and skills-development programmes for leadership and management of research and innovation
- to compile a typology of research and innovation leadership skills to be used in the further development and delivery of development programmes for existing and aspiring research leaders and managers, particularly in developing countries.

A country's performance in research and innovation is underpinned by the work of a number of different people at different levels of responsibility. These include the government officials who assist politicians in the formulation and implementation of national research policy, the leaders and senior staff of research institutions, and the staff who provide essential institutional functions to ensure that the management of research is conducted effectively.

A draft typology of knowledge and skills for leadership and management of research and innovation has been prepared from an examination of existing development programmes conducted in a range of countries with "mature" research and innovation systems. The typology has six main themes that reflect the range of requirements at different levels of research and innovation systems.

Theme 1: governance and leadership of research and innovation by government.

Theme 2: leadership *of research* in institutions.

Theme 3: management to support leadership of research in public institutions.

Theme 4: leadership *of researchers* in institutions.

Theme 5: management to support leadership of researchers.

Theme 6: personal behaviours and qualities of research leaders and managers.

Each of these themes has many elements that together comprise the requirements for strong leadership and achievement. The ***leadership*** themes consider the cultural and personal influences on the creativity of individuals and groups within research institutions. These influences apply as much to leaders in government as those in institutions. The ***management*** themes deal with the extensive procedural, financial, legal, compliance and reporting requirements that underpin the proper conduct of research and innovation. The final theme deals with the personal behaviours and qualities that leaders and managers must demonstrate in order to maximise the productivity and creativity of the research and innovation staff under their care.

Effective leaders and managers who pay attention to these factors will have considerable opportunity to ensure that the future development of their societies can benefit from the intellectual and imaginative efforts of their populations.

## Introduction

Research and innovation are activities that have long been associated with strong economic activity and social health and well-being (OECD, 2011a; The Royal Society, 2011). These activities typically account for between 1% and 4% of a country's gross domestic product (GDP), with developed countries such as Australia, Denmark, France, Germany, Japan, Korea and the United States spending between 2% and 3.5% of GDP on R&D. The average share of GDP spent on R&D in 2009 among OECD countries was 2.25% (OECD, 2011b). In most, the bulk of R&D expenditure occurs in business enterprises, with businesses accounting for 68% of gross expenditure on R&D (GERD) on average across the OECD (OECD, 2011b). About 30% of GERD in OECD countries occurs in higher education institutions and government agencies. On average 0.4% of GDP is expended on R&D in higher education institutions, but this figure is much higher in some countries such as Denmark and Sweden (0.9%). In most countries, higher education institutions and government agencies conduct more than 60% (typically about 80%) of the basic research that underpins later-stage innovation and development. Indeed, higher education institutions conduct research across the continuum of activity including traditional academic investigation (whether basic, applied or strategic), professional and creative practice, and knowledge and technology transfer. Governments also invest in research and development for defence and security purposes. Understandably much of this effort is confidential, although it can have spin-off effects for public and private good.

The amount of expenditure on R&D being undertaken in higher education institutions (HERD) alone is significant. OECD data from 2009 show that HERD expenditure was over USD 48 billion in the United States, USD 18 billion in Japan, USD 11 billion in Germany, USD 9 billion in the UK and USD 8 billion in each of Canada, China and France (OECD, 2011b). These are significant investments and it is not surprising that countries are developing sophisticated strategies for governing and steering public funding for research and development according to national priorities (OECD, 2008a). It is also the case that governments are currently dealing with economic challenges resulting from the global financial crisis and are seeking areas of growth and improved productivity. Again it is not surprising that governments have continued to invest in their R&D sector so as to provide a lead in improving their economic circumstances. This is a truly global challenge for all governments.

At the same time as governments are challenged with changing economic circumstances, there have been profound and continuing changes in the nature of research activity conducted in all sectors. Some of these changes, as described by Houghton (2005), include:

- “increasing diversity in the location of research activities – with a greater range of organisations involved in research (e.g. universities, research institutes, hospitals, firms, industry associations, etc.);
- increasing focus on interdisciplinary and transdisciplinary research – with teams of researchers coming together to work on common problems that cannot be tackled adequately within a single disciplinary framework (e.g. environmental or health problems);
- increasing focus on problems, rather than techniques, with solutions being sought from a range of disciplinary “toolboxes”, but findings valued for their contribution to the solution, rather than to the toolbox;
- increasing blurring of organisational borders and greater emphasis on collaborative work and communication, with a more flexible team based approach in which teams form around problems, and then break up and move on to form different teams around different problems;
- changes in the modes of communication, including some increase in commercial guarding of intellectual property, somewhat less emphasis on publication in refereed journals and more emphasis on informal communication through networks of researchers and practitioners; and
- more diverse forms of accountability, with economic and social, as well as disciplinary outcomes taken into account, and quality judged on a broader range of criteria”. (McWilliam, *et al.*, 2002, p 41 cited in Houghton, 2005)

Other noteworthy recent developments in the conduct of research include:

- increased use of the internet, linked datasets, and electronic information repositories
- requirements of funding agencies for open access publishing
- performance measurement and data-based evaluation at institutional and individual levels
- use of these data in compilation of international rankings of institutional performance
- an increased emphasis on technology transfer and the translation of basic research towards practical outcomes for businesses and society (Kitagawa, 2005)
- greater consideration of risk-taking and entrepreneurialism (Shattock, 2005)
- increased government interest in sponsoring and supporting the notion of research clusters between public and private institutions driven by innovation (Watson and Freudmann, 2011)
- increasing interest in the governance of international co-operative research endeavours (OECD, 2012).

All of these evolving influences and patterns of activity contribute to the increasing complexity of management and leadership of research and innovation, as well as the setting of policy for these activities at government and institutional levels.

Just as the research environment has changed, there have also been other changes in higher education and its administration. These include substantial increases in institutional autonomy and changes to the governance arrangements within institutions (OECD, 2008a). Universities

are now much larger institutions with considerable fixed assets and recurrent expenditures that rival many corporate enterprises. Student numbers are increasing, and there is more mobility and exchange of students between institutions. Indeed, international students are a prominent feature in many countries, and many universities now operate campuses abroad. Today's education experience for undergraduate students is often characterised by increased class sizes, the use of the internet and other issues that challenge university leaders and administrators. As a result of these and other factors, higher education administration has become more professionalised and specialised. The management of research and innovation in these institutions is not exempt from this development.

All of the changes associated with international growth in higher education, combined with the increased sophistication of research and demand for competitive research and innovation, are occurring at a time when the academic workforce in many countries is ageing and nearing retirement. The result is an increase in the pressure on the international labour market for staff who have skills in research and innovation (Coates et al., 2009; OECD, 2011c). What training there is in these skills occurs mainly in the universities, which are themselves under pressure. Not surprisingly, there have been a variety of institutional and national responses to these emergent pressures (see for example Australian Government, 2011). Included in these responses has been the recognition that the attractiveness of science *per se* and research as a career need to be improved (OECD, 2011c).

The current workforce pressures experienced by many countries with more mature research and innovation systems are manifest in higher levels of competition for talent across the world. Greater demand, and greater opportunities for researchers in turn pose a particular challenge for countries with developing research and innovation systems as their most talented researchers find opportunities for personal advancement elsewhere. However, given the right incentives and structural settings, emerging economies could also benefit from these exchanges. For example, researchers could gain greater experience overseas and then return to assist in building their nation's research capability (OECD, 2008b).

Many of the issues described above are common to countries with mature or emerging research and innovation systems. Just as there are requirements for improved skills and training in many fields that underpin economic growth and development (OECD, 2011a), there is a common requirement for improved levels of training and skills development for leaders in research and research management (OECD, 2011c; Debowski, 2010).

In recent years an increasingly sophisticated range of training programmes and qualifications for research management and administration have been developed, particularly in countries whose R&D productivity is already strong by world standards. Specialised associations for research administrators have become more prominent, such as the Australian Research Management Society;<sup>2</sup> the US National Council of University Research Administrators, which issues the Research Management Review Journal;<sup>3</sup> the Swiss Association of Research Managers and Administrators;<sup>4</sup> the UK Association of Research Managers and Administrators;<sup>5</sup> the Association of Commonwealth Universities;<sup>6</sup> the Association of African Universities;<sup>7</sup> and SRA International.<sup>8</sup> (see Appendix C for a list of organisations and their websites).

In the specialised area of intellectual property (IP) management, groups specialising in IP issues have become more prominent. These include the Association of University Technology Managers<sup>9</sup> and the ipHandbook website, which is supported by the Concept Foundation.<sup>10</sup> Many of these organisations offer various programmes, seminars and conferences for members. Some countries have also now established specialist centres to train and support tertiary education managers and leaders.<sup>11</sup> These centres offer extensive training modules for senior leaders in small interactive groups.

In developing and emerging nations, there is an apparent gap in opportunities for leaders and potential leaders and administrators to build their knowledge and skills in the increasing globalised research endeavour. This is a critical issue because leadership in research and innovation management in developing countries, where resources and capacity are limited, is especially challenging.

With these challenges in mind, the first step is to review existing work in this area in order to identify the essential elements needed for skills development in research leadership and management. This information has then been combined into a typology for effective research and innovation leadership and management. The typology could be used as a basis for formulating the most effective programmes for leadership and management development across countries, and especially in those countries where there is an urgent need for assistance and reform.

## **Objectives of the study**

The objectives of this study are:

- To synthesise the essential elements of existing and evolving knowledge and skills development programmes for leadership and management of research and innovation.
- To compile a typology of research and leadership skills to be used in the further development and delivery of development programmes for existing and aspiring research leaders and managers, particularly in developing countries.

Through this work, and the complementary regional studies being undertaken for this project proposals can be developed for the delivery of more effective assistance to address the challenges of development in an increasingly global research and innovation community.

## **Background**

Government policy settings for research and innovation are designed to achieve social and economic benefits for the nation. Many, if not most, publicly funded universities and research agencies, as well as many private institutions, rely heavily on these policies and related funding measures to support research and innovation. Policy and funding are, in turn, a major driver of

policy and management responses in higher education and research institutions (Connell, 2004) as well as in corporate organisations that undertake research and innovation.

Policy and management settings in public institutions are also driven by the need to create reputational value for the institution. In an increasingly international and competitive environment, this is done in order to achieve higher levels of performance as judged by various criteria. The requirement, which is often unstated but is nevertheless paramount, is to improve an institution's position on national and international reputational scales. Indeed, in her report of a survey covering a wide range of universities, Hazelkorn (2005) states "For all participant institutions, a strong research profile is critical not just for institutional mission but also for status and survival".

However, as described by Taylor in relation to higher education institutions,

"Research is an intensely personal activity, strongly dependent on the ideas and imagination of individuals or groups of individuals. Academic staff feels a fierce personal ownership of their research; it shapes and dictates their career development and their status with their peers. Research is ultimately linked with fundamental beliefs about academic freedom and the opportunity to challenge longstanding orthodoxies. Moreover, research, by its very nature is unpredictable, moving in unforeseen directions with unexpected consequences; further, it is this unpredictability that often gives rise to some of the most important outcomes and is therefore to be applauded, not curbed.

Research, therefore, does not lend itself to control and management. Yet, in the fast-changing competitive world of today's higher education, there are constraints that require the application of some sort of management framework. Funding and quality issues require priorities to be agreed; adequate resources are needed to be expended in the optimum way; and there are legal and ethical controls to be applied. Research may also imply risk; for the modern university, risk-taking is an essential part of institutional vitality, but risk must be understood and managed." (Taylor, 2006)

Of course the same issues arise, but with perhaps slightly different emphasis, in relation to the leadership and management of research in public research agencies and private enterprises.

Research leaders and managers also have to make decisions with reference to both scientific dynamics and society. Thus, research leaders and managers need to have a general view of a subject matter, as well as the ability to co-ordinate interdisciplinary efforts and to support individuals who are highly interested in the societal implications of their fields of endeavour (Schuetzenmeister, 2010). Research leaders and managers also have to make difficult decisions based on judgments of relative merit, likely impact and potential value, usually across a range of research and innovation activities.

It is possible to differentiate three levels of a national research system: a) the policy and regulatory levels of government agencies; b) the strategic level of research organisations; and c) the operational level where research work is done (Morris, 2002; OECD, 1991; Rip and van der Meulen, 1998). A fourth level can be added where groups of scientists are self-governing and the group leaders have autonomy over setting research goals (Schuetzenmeister, 2010).

Whitchurch (2006) suggests a four-domain model of research management: a) the knowledge domain; b) the institutional (or organisational) domain; c) the sector domain; and d) the domain of scientific and administrative projects at the university. Clearly, research leaders and managers require skills that transcend these four domains.

Fundamentally, and with these definitions in mind, the development and delivery of effective research outcomes requires leadership and management that falls into two categories:

- a) developing individuals to become leaders *in* research in a discipline area (broadly defined)
- b) developing individuals to become leaders *of* research generally in an institution or group of institutions.

It is assumed here that in OECD countries with a "mature" research and innovation strategy, the need for research policy leadership is met through the identification of individuals with highly developed skills and experience in research practice and policy and/or the use of consultation mechanisms with the research and innovation sector. This assumption may not, however, always apply across all OECD or developing countries. One of the objectives of this project is to assess the need for development programmes in nations with a "less mature" research and innovation presence.

The two categories of development described above require different sets of knowledge, skills, attitudes and behaviours but these are not mutually exclusive. In addition, there is a clear distinction in practice and in the literature between leadership and management that applies to research and innovation just as much as it does in other fields such as business and commercial industries. According to Kotter (1996), leadership encompasses activities such as establishing direction, and aligning, motivating and inspiring people so as to produce change. Management, on the other hand, is concerned with activities such as planning and budgeting, organising and staffing, controlling and problem solving, all of which serves to establish predictability and order.

Consistent with many authors who have written about leadership and management in general, the Association of Research Managers and Administrator has noted that research management usually involves three areas: leading (providing the inspiration and the climate for research to be done better), managing (overseeing processes related to research), and doing (undertaking operational tasks).

For example, the development of a proposal to conduct a clinical trial in medical research will have resulted from leadership in research in a discipline, and leadership by senior officers in an institution in making strategic decisions to support moving this research from the lab to the point where a clinical trial can be contemplated. However, the conduct of clinical trials in medical research has strict requirements that must be incorporated into the design of the clinical research program and managed at every stage of the execution of the research. There are now many development programmes that are designed to train and qualify specialised staff in the management of clinical trials.<sup>12</sup>

Another area where specific research strategies and methods are prominent is that of agriculture. There are a number of training programmes in skills in research and innovation in agriculture and related disciplines, especially for nations where food security is under threat and where economic circumstances are particularly challenging (see for example Michelsen et al., 2003; Pound et al., 2011).

Aspiring research leaders need to appreciate at least two major aspects of the environment in which they seek to operate. First, they must appreciate and understand the cultural and practical differences that characterise the conduct of research in different fields and disciplines. These differences between fields and disciplines occur not only in the design and practice of the research endeavour but also in the practices for publication and dissemination of knowledge. At the same time, these practices will be constantly evolving, especially with increased use of information technology and the Internet.

Second, aspiring leaders and managers must appreciate and understand the variety of ways in which knowledge is transferred from research to society, and their significance. These also vary across disciplines, and different institutions adopt different mechanisms according to their strategic positioning and preference. According to the United States National Research Council,

“The transition of knowledge into practice takes place through a variety of mechanisms, including but not limited to:

- movement of highly skilled students (with technical and business skills) from training to private and public employment;
- publication of research results in the open academic literature that is read by scientists, engineers, and researchers in all sectors;
- personal interaction between creators and users of new knowledge (e.g., through professional meetings, conferences, seminars, industrial liaison programs, and other venues);
- firm-sponsored (contract) research projects involving firm-institution agreements;
- multi-firm arrangements such as university-industry cooperative research centres;
- personal individual faculty and student consulting arrangements with individual private firms;
- entrepreneurial activity of faculty and students occurring outside of the university without involving university-owned IP; and
- licensing of IP to established firms or to new start-up companies.” (Merrill and Mazza, 2010)

These broad features of research and innovation systems and practice point to the significant challenges faced by both experienced and potential leaders and managers of research and innovation. The following sections provide greater detail and further examples of these challenges within the context of a typology of the knowledge and skills these individuals require in order to provide effective support for research and innovation.

## Framework for a typology

The development of a typology for knowledge and skills requirements for effective leadership and management of research and innovation can be approached in one of two ways – "bottom up", or "top down". A bottom-up approach would start with the knowledge and skills individual researchers need to develop to become leaders *in* research *in* their discipline(s). However, as important as this is to the outcome of improved performance in research generally, the knowledge and skills development of individuals has to be viewed and implemented through the prism of overall policy settings for research and innovation, at the institutional and ultimately the national level. For example, strategies to address the publication of research findings by an individual in an institution must be viewed within the context of the policies set by government for the recording of institutional and discipline-based publication rates, quality and impact, and the uses that are made of those data, especially for funding purposes. Imposing a strategy on individuals that is inconsistent with national policy goals will not be effective for the institution as a whole. Those who undertake research and innovation are usually not unaware of how their individual efforts contribute to the wider performance of their group, school/department/division and their institution's relative position.<sup>13</sup> This is the context within which they work. It is for these reasons that the approach preferred here is top down – where the fundamental requirement in developing an overall research and innovation strategy for is to understand the overarching national policy settings .

As described earlier, research and innovation occurs in publicly funded institutions such as universities and government research agencies, as well as in private not-for-profit institutions (for example, private hospitals and medical research institutes) and commercial enterprises of all sizes and types. The typology for skills development for research and innovation developed here is likely to apply across all sectors although the emphasis may differ - for example, in higher education institutions there is an inherent tension between the requirements of teaching and learning, and the conduct of research (de Jonghe, 2005; Kogan, 2004). However, because the higher education sector is responsible for conducting most research training, and because universally so much research takes place in this sector, the typology primarily concentrates on universities, public research organisations and not-for-profit research institutes.

The applicability of the typology will also vary across nations. Reasons for this include:

- The level of autonomy and the governance of institutions varies in different countries (for example, compare Australia and Vietnam).
- The level of funding available for research varies in comparison to the funding allocated for teaching and learning.
- The level of international co-operation and collaboration varies between countries.
- There is a very wide variation across some countries in the level of research activity and the productivity of institutions called universities.
- There are natural and geographic differences between nations that influence the nature of research priorities. For example, nations in the tropics have particular health-related challenges, while nations like South Africa, South America and Australia have advantageous conditions for disciplines such as astronomy.

- There is a wide variation in the philosophy of research between countries. Some concentrate research on finding solutions to immediate problems, especially in public health and agriculture, with little if any attention given to basic or fundamental research. In other countries there is a push towards the commercialisation and "translation" of basic and applied research to practical outcomes, especially for industry and in health care.

The typology of the knowledge and skills required of research leaders must encompass all these variations and possibilities. These are additional to the knowledge that research leaders must develop about different disciplines, including, for example, variations in research culture, practice and infrastructure requirements.

## **The typology: six broad themes**

The typology of knowledge and skills required for effective leadership and management of research is presented in six broad themes or areas of activity. The information provided here has been drawn from many primary sources (see Appendix C) as well as reports from surveys of leadership and management practices in different groups of institutions.<sup>14</sup>

Consistent with the decision to adopt a top-down framework for the typology, it starts with the knowledge and skills governments need to provide effective national leadership in research and innovation. Governments usually have a strong interest in how much research and innovation is conducted within their nation, principally because governments understand the important link between these activities, economic strength and social well-being. Governments the world over have also recognised that one prerequisite for developing and sustaining a knowledge economy is that higher education, research and innovation systems need to be more tightly linked to industry partners in order to facilitate economic development.

This recognition has led to the adoption of a variety of policy instruments and mechanisms in the higher education, research and innovation systems of countries with different levels of economic development. The range of policy measures now emerging across countries provides a unique opportunity for policy dialogue and learning, which can lead to fruitful comparisons and the establishment of best practices.

## **Theme 1: Governance and leadership of research and innovation by government**

### **Funding arrangements**

It is common for governments to provide considerable public funding to support research and innovation, especially to higher education institutions and other national research agencies. It is not surprising then that governments will either directly or indirectly provide a national context within which research and innovation is to be conducted, for the benefit of the nation (OECD,

2003a). This is most often seen when governments develop and promote national priorities for research, innovation, infrastructure and capacity building. These national priorities may be broadly or narrowly defined and they may be accompanied by funding mechanisms that are aligned to the priorities.

The setting of national priorities in research and innovation is a very high-level task for governments, one that requires high levels of knowledge and understanding of the existing levels and intellectual distribution of national performance as well as future needs and capacity for research and development. It is for these and other reasons that governments often choose to adopt a consultative approach to determining national research priorities. Other approaches to priority setting include using Foresight processes (see, for example, Georghiou and Cassingena Harper, 2011) and drawing on international collaborations on policy analysis and development.<sup>15</sup>

Governments also determine the level of public resources directed towards research and innovation activity, and to which institutions those resources are distributed. Funding is provided not only to support research activity, but also to provide necessary infrastructure (the costs of which can be beyond the capacity of individual institutions to support), and to develop national capacity through training and development of researchers. An important part of this government process, which has significant implications for leadership and management of research institutions and individual researchers, is the development and application of strategies for the distribution of these funds. These strategies usually condense to three major options: providing funds directly through institutional grants, providing them indirectly through open competitive mechanisms, or a combination of both these avenues.<sup>16</sup>

There is evidence that the balance between these options is under review in a number of countries as governments attempt to position their research and innovation strategies for maximum national benefit within a highly competitive global community. Another factor that influences government support for public and not-for-profit research institutions and agencies is the diversity of other possible funding sources. These are usually dominated by corporate sponsorship for commissioned or contract research. Given that such sources usually concentrate on research and innovation towards the "applied" end of the research spectrum, governments are often challenged to support higher-risk research at the more fundamental levels of knowledge generation where the application of the outcome is less certain. It is generally accepted that supporting and facilitating contact between those doing basic and applied research, commissioned corporate research, and entrepreneurial innovation is necessary to maintain excellence. Thus governments need a clear understanding of the various components that comprise their nations' research performance landscape, from research institutes, government research agencies, universities, and hospitals, to the level of corporate innovation.

The knowledge and skills required for these high-level policy tasks vary considerably. They include an understanding of the incentives that influence research and innovation performance, macroeconomics, financial regulation, conduct of research, and an understanding of human behaviour in research and innovation.

Not surprisingly, governments often set rules and guidelines for public funding and conduct compliance checks to ensure public credibility of the expenditure that is being made on behalf of the population.<sup>17</sup> Governments also often offer incentives to business enterprises for R&D activity, through avenues such as tax concessions and direct grants. Finally, governments determine the tax and incentive environment for philanthropic investment in research and innovation. When governments set policies to encourage greater collaboration between public organisations and private enterprises, it is essential that leaders and managers in these organisations in turn understand the complex financial and tax environments within which each is operating. This is important because governments can seek an advantage by providing funds that must be matched by the participating partners in order to be eligible for specific grants.<sup>18</sup>

In recent years many governments have recognised the importance of international collaboration in research and they have provided funding to support these co-operative ventures. For example, the Australian government has provided funding for international science linkages, and, more recently, has entered into substantial co-funding agreements for bilateral research activities with the governments of India and China.<sup>19</sup> Perhaps the best known of these joint funding arrangements are those supported by the European Union.<sup>20</sup> These funds are international in so far as researchers outside the EU have access to funding through co-funding arrangements with their national funding agency partners. Other examples of support for international research collaborations include the Human Frontiers Science Program, which was initiated in Japan in the 1980s and which has expanded significantly since then. Additionally, many trusts and foundations, such as the Bill and Melinda Gates Foundation and the Wellcome Trust, support international research collaborations. Each of these funding programmes have their own funding rules and philosophies, and government officials and research leaders need to understand them so as to provide appropriate advice and support to research institutions and teams. In addition, there are many complexities associated with varying national laws and international agreements related to the protection of intellectual property. As expected, these international funding sources also have complex and rigorous accountability processes that need to be understood, with researchers needing management support to facilitate their participation.

The knowledge and skills required for policy makers and regulators in research and innovation at government level include understanding:

- the implications of decisions on funding levels, distribution and regulation or research funding
- the capacity of government and institutional officials to manage oversight and regulation of public funding
- the complexity of international financial, tax and intellectual property environments for research and innovation.

### **Governance and regulation**

Governments are responsible for establishing the national governance structures for research and innovation within which their research institutions operate. By doing so governments establish the distribution of powers and responsibilities between the government itself,

government-supported agencies that act on behalf of the government but with a level of independence, and the organisations that are supported to undertake research and innovation. These arrangements have important implications for the establishment of priorities and the level of stakeholder involvement in these and other evaluative and regulatory processes. For example, many countries have established independent councils through legislation, which are responsible for the distribution of government funding to research providers and which provide a level of independent regulation and evaluation of outcomes.<sup>21</sup>

Many countries have established legislative instruments for the approval of research involving animals or manipulation of genetic material. The processes by which the conduct of research involving humans is approved is important. These policy settings by governments are intended to protect the population both directly and indirectly, through maintaining the reputation and importance of research as a benefit for society.

National governments are also concerned about the integrity of research conducted in public organisations. As with ethics approval, the reputation of individual researchers and of a national research system is dependent on the integrity with which it is conducted. Whilst there is little national legislation in this area, governments have taken a variety of indirect regulatory and compliance approaches to ensure researchers are aware of the proper conduct of research.<sup>22</sup>

The significant funding provided by governments for research is usually accompanied by rigorous accounting, reporting and audit requirements and procedures. These requirements are set to ensure compliance with the government's funding rules and regulations. Research leaders and managers in these institutions need to appreciate and address the procedures that are required. More broadly, governments also require other forms of performance reporting on research and innovation. Measures include numbers of postgraduate research student completions, research theses and publications in various classifications; listings of policy contributions; and measures of patents and other registrations of intellectual property, including financial returns on the sale, licensing or transfer of intellectual property. Many countries are now assessing the quality of research publications through extensive data collections and peer assessment.

In a new and possibly unique initiative, the Australian government has introduced the formulation of institution-specific "compacts" between the government and its universities.<sup>23</sup> The intention is to encourage institutions to differentiate their missions and strategic approaches. Each compact represents an agreement between the parties regarding, among other things, the number of research higher degree enrolments, the level of research performance in specified disciplines and the quality of publications in nominated disciplines. Special funding arrangements have been put in place to assist institutions in the collection and submission of these data. All of the compacts are now publicly available for scrutiny and the extent of differentiation between institutions is also now under scrutiny and analysis.

Thus, policy makers and regulators in research and innovation at government level need varied and complex skills and knowledge. As well as understanding research and its conduct, and how to benchmark research performance between institutions and nations, these officials need to be aware of the burden of administration on institutions and individual researchers. Officials need to be aware of the efficiency of their policy settings, regulation and reporting so that resources

are not wasted. Such waste can include the time taken from actual research and innovation in order to meet regulatory requirements.

All research and innovation leaders and managers need to be made aware of the requirements established by their government. There need to be good processes for communicating government policy and regulatory requirements. Institutional leaders need to be able to interact directly with government officials at appropriate levels. One of the complicating factors for institutional leaders is the variety of different government ministries that may have responsibility for research. Many government portfolios provide funding opportunities for research in their individual sphere of influence<sup>24</sup> and each may have its own set of rules and requirements to understand. Having different ministerial portfolios with responsibility for different aspects of higher education and research in universities can also be a complicating factor for university heads and their support teams, especially when the different ministries have duplicate or different requirements.

## **Theme 2: Leadership of research in institutions**

### **Awareness**

It almost goes without saying that successful research institutions need leaders who are as aware of the conditions and developments outside their institution as those inside it. Leaders need to be aware of the broad trends in research activity such as increasing collaboration and the formation of networks<sup>25</sup> so that they can support their research staff and provide the conditions under which collaboration can flourish. It is important that they keep abreast of high-level observations such as those reported by the OECD (2011b), which find that research publications involving international collaborations generally have a higher impact than those without such collaboration.

Similarly, it is important for leaders to be aware of national and international policy settings for publicly funded research agencies and universities, as well as the policy settings for business R&D, all of which have an impact on the potential for effective collaboration.<sup>26</sup> Some government initiatives seek to increase the level of collaboration in research and innovation between public agencies and private enterprises. Such programmes offer significant opportunities for advancement of cooperation. However, success in these collaborations also requires a flexible approach on both sides so that there can be true co-operation between researchers used to very different cultures. It is essential that any potential barriers to collaboration are identified and ameliorated, where possible, which may require a level of compromise over the foundation agreements underpinning such collaborations.

Opportunities for international collaboration, like national collaborations, are dependent on funding opportunities. Research leaders must be aware of international funding policy settings and opportunities for grants well ahead of the closing date for applications. Over the longer term, research leaders should be aware of trends in public and private investment in R&D as a proportion of GDP, and other indicators of economic strength. It is in this area that the OECD is such an important provider of information.

When considering international collaborations between researchers, at either a project or institutional level, it is important that leaders are aware of the bilateral, or even multilateral, legislative requirements, related regulatory provisions and the funding arrangements that support the research activity. Similarly, they need to fully understand and respect their financial auditing, compliance and performance reporting requirements. Failure to do so can lead to complex issues for institutional leaders to resolve or the application of penalties. Other potential outcomes include a breakdown in interpersonal relationships, which can be fatal for ongoing collaboration. Finally, managing any intellectual property brought into or arising out of a collaboration is a complex area that also requires close attention (OECD, 2003b). This is particularly important when public and private partners join in late-stage (or proof-of-concept) collaborative R&D. Many international treaties and agreements govern the management and protection of intellectual property associated with collaborative research across international borders.<sup>27</sup> Fortunately, there are avenues for assistance in these areas.<sup>28</sup>

Collaboration between researchers and institutions improves the output, impact and reputation of institutions engaged in research and innovation, as well as providing opportunities to address major research questions (The Royal Society, 2011). As a result, leaders of institutions regard co-operation and collaboration between institutions within national innovation systems positively. By contrast, the same innovation systems can mean competition for funding, something leaders need to manage carefully. Grant programmes for projects are universally highly competitive, and other funding can depend on success in winning grants, alongside other institutional performance measures. Leaders must find the ideal balance between collaborating with other institutions whilst maximising their own institution's funding and profile (Schuetzenmeister, 2010). On the other hand, for emerging researchers in newer institutions, collaboration with their more experienced colleagues in more established institutions provides an important opportunity for development. These advantages depend, however, on the co-operation of the more established institution.

Research leaders can maintain their awareness of these issues through several mechanisms, the most important of which is strong personal communication with their peers and with research networks. Communication with key funding agencies, government officials, industry groups and associated institutions is also vital. Conferences, specialist journals and other publications commonly help leaders keep up to date with national and international events and developments in research and innovation. There are now also online services that specialise in providing up-to-the-minute information on recent developments on a global scale.<sup>29</sup>

It is essential too that leaders of research institutions, particularly the larger research-intensive universities and major government research agencies, are aware of the range of activities and the capacity and capability of staff in their institution. There is now a growing trend in some larger organisations to "map" the range of research that is being undertaken in order to provide information relevant to existing and potential collaborations between internal and external researchers.<sup>30</sup> This is only one of several important aspects of the information about an institution of which research leaders need to be aware. Other aspects of this are covered in Theme 3, management support for research leadership.

## **Institutional governance**

Supervision and oversight of the management of research institutions such as universities and public research agencies with high levels of autonomy in their operations is commonly done by a governing council or board. It is also common that the legislative instrument defining the institution and its purposes also defines the role and membership of the governing council or board. In addition, the board itself or the founding legislation may determine the role and membership of sub-committees such as finance, audit and remuneration committees. Research advisory committees are common features of many such research institutions. The board or council and sub-committees often include a majority of members who are independent of (that is, not employed by) the institution.

The success of these sorts of research institutions depends critically on the effective functioning of the governing board or council and the leadership that the body provides in supporting the organisation and its management. The relationship between the chair of the governing body and senior management is important, as is the relationship between the chair and the members of the governing body. As Shattock (2003) observed, “good governance makes a positive contribution to institutional success when the lay element in governance, the executive and the academic community work closely together; on the other hand progress will be inhibited if one of these elements becomes over dominant”.

It is common that the governing body of autonomous research institutions has responsibility for selecting, appointing and potentially dismissing the head of the institution (generally termed the Vice-Chancellor, President, Rector, Director and/or Chief Executive Officer, or other similar titles). Given this relationship and the responsibility of the governing body to oversee the institution’s management and performance, the head of the institution will usually want to ensure that the governing body is well supported in its operations and that all its expectations are met. The leadership team need to be able to fully assure the governing body on the details of institutional performance and management, relationships with internal and external stakeholders and planning for the future (see below). Management will report to working committees of the governing body covering matters such as finance, audit, infrastructure, risk and remuneration. It is also common for these committees to review major proposals for action or development and to pass recommendations for approval to the governing body. The leaders of the institution are responsible for ensuring that all of these committees are well supported and provided with accurate, timely information as well as meeting any request of the committees and the governing body. The leaders and their senior managers must be aware of their responsibilities in all of these areas.

Circumstances can also arise that require leaders to propose changes to the governance of their institution in ways that have not been specified in the establishing legislation. Leaders need to be prepared to assist their governing body in ways that will improve the efficiency, effectiveness and transparency of governance in their institution. The ability of higher education and research institutions to change and adapt their governance operations in the light of rapidly changing local and global circumstances, including political influences, is a significant leadership issue (Larsen et al., 2009). This is an area that is often neglected in the training and development of leaders in research institutions.

In some countries, a government ministry or ministries will have oversight of higher education and research institutions rather than an autonomous council or board. These institutions may still have a governing body with some external membership and authority for making some decisions. However, the leader of the institution is usually appointed by the government or an overseeing ministry. In these situations, the relationship between the leader, the governing body and the overseeing government ministry is very different to that found in independent institutions with higher levels of autonomy. Nevertheless, leaders of these less-autonomous institutions must still have a strong appreciation of their role and responsibilities and their relationship to the overseeing body and ministry. They must also be vigilant to ensure that the operation of their governance is efficient and effective.

## **Planning**

One of the most important functions that leaders must undertake, whatever the size of their institution and its governance arrangements, is to establish the broad framework for the development and future operations of the institution. This process is often termed "strategic planning", and there is a vast literature on the principles and implementation of the process. Other more detailed implementation or operational plans often flow from the formulation of an institutional strategic plan. As with the day-to-day governance, it is usual, and indeed important, that the governing body of an autonomous institution should be closely involved in the development of the institution's strategic plan as well as giving it final approval (see also Hazelkorn, 2005). It is difficult for leaders to establish momentum for the development of an institution without that commitment from the governing body. In institutions overseen by government ministries, strategic planning is more directed and more operational in nature.

The processes adopted by leaders of research institutions in developing a strategic plan will differ in accordance with the nature of the institution and its external environment, including its governance arrangements. They will also need to consider internal constraints, which might include matters such as available finances and the capacity and capability of staff.

The major elements that leaders need to consider in a major planning exercise include:

- Seeking input from internal stakeholders, both bottom up (i.e. the staff) and top down (the governing body), as well as external stakeholders such as funders, enterprise partners, government and the community.
- Analysing the external environment: identifying and understanding the external drivers of research behaviours.<sup>31</sup> (Butler, 2010)
- Analysing the institution: identifying strengths, areas for priority attention, weaknesses, paradoxes in approach and institutional settings relative to external influences, and opportunities for change and development;
- Developing a vision and a timeframe (or timeframes) for achieving the steps required to achieve it.
- Gaining acceptance of the vision from the governing body and the institution's internal and external stakeholders;
- Designing feasible and achievable strategies to achieve the desired outcomes.
- Establishing feasible milestones for achievements.

- Designing a framework against which the performance of the institution in achieving the desired outcomes can be assessed.
- Establishing processes for review and refinement of the plan over time.

It is essential for leaders to engage with their staff and stakeholders throughout this process and to communicate the developing vision and plan prior to its approval by the governing body. Without such engagement there will be little "ownership" of the plan by those who have to put it into action, and the achievement of outcomes will be compromised. Leaders must also expect to encounter, and deal with, resistance to change (Julius et al., 1999). Finally, it is also essential that the leaders who develop such plans must also "live" the plan – without visible commitment by the leadership to the plan, then little if anything will happen, and the institution will have little chance of success.

### **Implementing institutional change**

When an institution sets about making changes in its direction and the profile of its research aspirations it is essential that leaders and managers pay close attention to staff planning (which usually involves large recurrent expenditure). Matters to be considered include understanding the age profile, career projections, research skills and aspirations of existing staff and identifying areas where new staff are required, or where existing staff need opportunities for development and/or workload re-distribution. Nowhere is this more important than in universities where an appropriate balance has to be struck at an institutional level between the dual functions of teaching and research (OECD, 2003b). In addition, when plans call for changes in research emphasis it is important that leaders understand the highly competitive nature of research staff recruitment at both the national and international level. Such competition can bring unexpected costs in terms of the incentives required to attract the best candidates.

Research institutions commonly aspire to establish a so-called critical mass of researchers in priority areas or areas of specialisation. As Kenna and Berche (2011) report, the traditional notion of critical mass in academic research groups is that research groups need to reach a minimum threshold of researchers if they are to produce high quality research. From their bibliometric analysis of data from the United Kingdom's Research Assessment Exercise (RAE), Kenna and Berche observed that interactions between researchers in a group lead to an "increase in research quality with group quantity, but only up to a limiting size, beyond which meaningful collaborations between all group members cannot be sustained." This led to the term "upper critical mass" being coined, a size beyond which "further concentration of resources does not lead to significant increases in research quality." Not surprisingly, the upper critical mass appears to be discipline specific. Leaders will need to consider such analyses in the design and implementation of their institutional plans, and keep abreast of new studies as they emerge from institutional, national and international performance analyses and benchmarking exercises.

With a strategic or overarching plan in place, it is common for further more detailed plans to be developed in certain functional areas. For example, asset or infrastructure planning, which usually involves infrequent but large expenditure, is a critical element in supporting an institution's development. Leaders should be aware of the institution's current buildings and

information technology infrastructure and their future maintenance requirements. However, they should also consider whether these facilities are adequate or excessive for future operations, and take steps to deal with these issues. If an institution is planning to move into new areas of research then infrastructure planning is essential, especially when issues such as biohazards are involved. Indeed the costs in these areas can be prohibitive, preventing institutions from moving into otherwise desirable areas. If so, these constraints must be reflected in the overall strategic plan, as strategies must be feasible and achievable.

Depending on the size, complexity and structure of an institution, it is often not possible for a single leader to deal with all these complex issues, and they will need to delegate responsibility to other senior members of the management team. It is essential, however, that the most senior leaders remain in a position to ensure that decisions taken at lower levels are consistent with the overall strategic goals of the institution.

## **Ethos**

A critical role for leaders of research in institutions is to establish and maintain a strong research culture and ethos. A number of approaches may be used. These include supporting opportunities for the institution to host leading researchers from other countries, supporting staff in their strategies for higher level interactions and collaborations, and, importantly, developing and implementing incentives and rewards for positive performance that are consistent with the goals of the institution. Acclimation of success and entrepreneurialism at an individual or team level, and overt support for advancing that research effort (even through improved access to infrastructure that will further the research effort) are both powerful mechanisms to engender a positive culture and ethos. Other important factors include having flexible career structures and opportunities, as well as consistent, transparent and fair appointment and promotion procedures that include peer review. Programmes for induction, training and development of staff as well as succession planning are also important for generating a strong commitment and ethos in an institution.

Perhaps the most powerful influence on the ethos and culture of a research institution is the attitude of senior leaders to promoting and implementing codes of conduct and integrity in research. It is important that an institution adopts and promotes the highest international standards in research integrity and ethical review of research activities. If there is even one isolated weakness in an institution in this regard, then everyone in the institution, and their collective reputations, will suffer – from the governing council to the director and to all staff. Accordingly, leaders must be aware of the many international codes and practices in research integrity as well as national protocols and legislative requirements for ethical approval of research involving humans and animals. Many countries also have legislative instruments that limit research involving human embryos and genetic manipulation of biological entities. Skilful leadership and management of research and innovation requires frequent communication with all staff about these requirements, as well as the requirements of national strategies and international agreements for the management of intellectual property, research funds, and other laws such as those dealing with safety (especially building and operational codes for handling dangerous substances and biohazards).

Leaders must ensure that policies and procedures for the institution are developed and applied fairly and consistently. While much of the mechanics of dealing with these issues may fall to the senior management staff (see Theme 3), the demeanour of the institution's leaders in dealing with these issues and promulgating best practice is the most powerful influence on an institution's culture. Even when an adverse event occurs at another institution, the response of leaders must be to ensure that policies and procedures are in place to protect the interests of their institution.

## **Risk**

The issues described above fall within the responsibility of leaders in research institutions to identify and mitigate risk. By its nature there is inherent risk in any research activity and it is for this and other reasons that peer review is such a common feature of decision making in research institutions. Risk assessment in decision making is most commonly related to the likely success or failure of the research activity to address the research questions that are being investigated. Other activities that require risk-based decision making include entering inter-institutional collaborations and partnerships with industry. Decisions about whether or not to make financial commitments to projects where there is high risk are difficult and can create great tension amongst researchers and leaders. It is important for leaders in research institutions to open such risk assessments to peer review. Making such judgments as an individual, even for the institution's leader, is indeed itself inherently risky as far as staff morale is concerned.

Research institutions also run additional management risks including financial risk, performance risk and infrastructure risk. Many larger institutions employ risk managers to undertake the tasks of identifying risks in these areas. The leader's responsibility is to ensure that these risks are identified, and that the institution has the policies and procedures in place to deal as effectively as possible with unpredicted incidents. This feature of leadership can be termed "risk preparedness".

Leaders of research institutions will always suffer some "risk unpreparedness" – when something happens that no-one has foreseen, and has probably not happened elsewhere. When dealing with these situations, sometimes on an emergency basis, leaders must continue to apply principles that are consistent with the values, ethos and direction of the institution. A leader should be ready to call on senior staff to help manage these situations, and these staff should be ready to assist. Such readiness for dealing with the unexpected can only be generated through there being good working relationships, knowledge about the institution and its values, and experience, all of which are fundamentally founded on trust and respect.

There will be occasions when risk events are sufficiently significant that they need to be brought to the attention of the governing body. Governing bodies often prefer a "no surprises" approach from senior managers and leaders, and it is better to inform the governing body of an event, especially when there is a risk of reputational impact on the institution. The leaders may also benefit from seeking counsel from the governing body in unusual circumstances. The threshold of seriousness for taking these steps is something that needs to be discussed between an institution's leader and the chair of its governing board.

## **Communication**

Effective leadership of research in institutions is critically dependent on strong communication with staff, students, alumni and other internal and external stakeholders. As stated above, it is particularly important that institutional leaders establish sound processes for communication with staff so that information about government policy and compliance with regulations is well understood. Failure of institutions to accommodate these government requirements can lead to financial disadvantage and have considerable reputational impact. General internal communication can take a number of forms, such as newsletters, emails and use of social media. However, personal communication, either through forums, small group or sectional meetings, or one-on-one, is the most important for developing understanding and rapport with staff, as well as for testing and developing morale. These avenues are vital in difficult times, especially when institutional financial resources are constrained and institutions cannot meet staff aspirations in the short term. As described earlier, communication between leaders and staff is essential when undertaking planning and improvement strategies.

Leaders of public research institutions also have a responsibility to communicate with governments and their supporting bureaucracies beyond simply making reports to meet regulatory requirements. Authorities who provide public funding need to be kept aware of the outcomes of their funding so that they have confidence in the effectiveness of their expenditure on behalf of the public. Determining the means and extent of this type of communication is difficult and is a skill gained through experience. Communication needs can change significantly when other political events occur, such as during elections. Communication with the general community is just as important, and can be synergistic with direct communication with governments.

Communication with known and potential benefactors and commercial partners is an essential responsibility for leaders of research institutions. Relationships that have the potential to develop into worthwhile collaborations are founded on the development of trust and respect on all sides. This is most successfully achieved when leaders show personal commitment to the development of such a relationship. These relationships often have their genesis in the relationship between individual researchers who share common or synergistic aspirations. Extending those opportunities, where appropriate, to inter-institutional relationships can be a significant benefit for all concerned. In the context of increasing levels of international collaboration between institutions, and more diversified research workforces within institutions, it is essential that research leaders and managers have high levels of inter-cultural understanding and sensitivity. This is particularly important when negotiating and preparing proposals involving international participants and funding bodies.

At the beginning of this theme it was posited that leaders of research institutions often play a leading role in defining the conditions and developments for research generally outside their institution just as much as they are aware of conditions inside their institution. Having a public and international profile is an important aspiration for research leaders – each has a responsibility to add insight and experience for the benefit of society.

## **Theme 3: management to support leadership of research in public institutions**

### **Organisational structure**

Having a sound and appropriate management structure is essential to the effectiveness of leadership in any research institution. There are many intersecting factors that will influence the design of organisational structures and no single model fits all situations. The main factors that can influence the organisation of research groups include the notions of critical mass and interdisciplinarity on the one hand, and practical issues such as space, infrastructure and other academic responsibilities such as teaching on the other. Factors such as leadership capacity, the level of devolution of responsibility and the capacity to provide effective management and administrative support to the research groups also influence decisions about structures (Taylor, 2006). It is common for research institutions to gather management and administrative support staff together to form an institutional research office as a mechanism to ensure high levels of efficiency, skill and co-ordination of policy and procedural requirements (Hazelkorn, 2005; Taylor, 2006). Above all, organisational structures need to be designed to facilitate appropriate leadership, management and timely decision making (Connell, 2004).

Leaders of research in institutions are most effective when they have the support of colleagues in positions of responsibility who can exercise judgment, have authority to make decisions and who can manage operational requirements. The number and nature of such positions and their reporting lines to the leader of the institution vary with the size and complexity of the institution. Some post holders, often labelled “executive”, can operate in a similar way as the leader, but at a more specialised and detailed level. Others, often labelled “management”, usually have high-level administrative roles such as a finance manager or a manager of human resources. For this reason there is no single general or ideal executive or management structure that can apply to any institution. Rather, it is the responsibility of the leader to ensure that these arrangements are adequate within the context of the institution’s strategic and operational plans as approved by the governing body and appropriate within the financial constraints on the institution. In addition to having individuals in executive and management positions, leaders also need to establish committees that facilitate policy and administrative development and monitoring of activities across different management portfolios and ensure that they add value to the operations of the institution.

### **Executive and management operations**

The design of an executive-management support structure will vary according to the needs of the institution as well as the experience and capability of those in such positions. Whilst consistency and stability in such a structure are important, changes in internal and external requirements as well as changes in the personnel or their skills and experience may make it necessary to vary these arrangements. It is essential, however, that the positions and their roles are defined and that there is no duplication, and that taken together, the positions provide the necessary support for the effective implementation of the institution’s plans, meeting the governing bodies requirements and meeting other external reporting requirements. It is also

essential that the responsibilities, accountabilities and formal delegations accorded to these positions are documented, along with the expectations and measures of performance that are required of the incumbent. In larger institutions, the most senior roles are often scrutinised by the governing body or a sub-committee such as an appointments or remuneration committee. In many instances the senior support positions, like that of the institution's leader, have performance incentives and other non-salary rewards, although these vary considerably between institutions.

There is a broad literature on the nature of executive-management structures and their operation as it applies to commercial enterprises and public institutions. Two general points that often emerge for leaders to consider are a) limiting the number of direct reports, where possible, to a group that allows adequate attention to be paid by the leader to each individual and their responsibilities (ideally less than ten), and b) maintaining regular personal communication with each member of the team, individually as well as collectively.

### **Committee operations**

It is essential for the efficient operation of research institutions that senior executive and management staff meet to share information, work as a team to solve immediate challenges and monitor institutional issues and performance. Committees are often most valuable when considering issues arising in areas where different management portfolios intersect, such as infrastructure, staffing issues and institutional performance. Such cross-portfolio committees are also required to ensure that policies, systems and administrative processes are in place to support the functions of the institution and to mitigate identified risks to operations. An area of growing importance is the development of policies and procedures to deal with inter-institutional and international collaborations and contracts combining complex combinations of research, staffing, legal and regulatory factors. Naturally, these cross-portfolio committees also have an essential role in institutional planning and monitoring of performance against strategic goals and targets, as well as in promotion and advocacy of the institution.

Specialist committees, which often include executive, senior managers and other relevant representative staff, are also needed to consider operational and administrative issues such as finances, infrastructure, staffing profiles, staff promotions, incentives and rewards, misconduct, breaches of regulations and research integrity.

As described earlier, there is a vast management literature available that addresses the ideal frequency and working details of executive management committees. Suffice to say here that a balance must be struck between purpose, frequency and the effectiveness of the group. One of the most important drivers is the requirement for senior leadership and management to meet the requirements of the institution's governing body in a timely fashion. The operational features of the latter body will in large part determine the need for and operation of the executive-leadership team and its committees. These requirements are likely to change over time.

One feature of good committee practice that is often overlooked, both at the governing body level and the executive-management level, is the induction and training of committee members.

Too often new members are expected to “learn through experience”. It is important that all members of governing bodies and committees are apprised of the committee’s roles, responsibilities and accountabilities, as well as the expectations on members of the body or committee. Of particular importance is consideration of issues such as dealing with conflicts of interest, where awareness ahead of issues arising is essential to the proper function of the committee and decision making. At a minimum, induction of committee members should include a description of the purposes of the committee. Ideally, there should be a formal induction process allowing for discussion and clarification. Without adequate induction the members of the body or committee are unable to add full value to the work and challenges that they are asked to address.

## **Research management and administration**

Leadership and management in research institutions involves a very wide range of responsibilities and functions. Increasing demands from global collaboration and the internationally competitive nature of research have led to greater attention being applied to understanding the full range of activities that underpin effective research institutions. The UK’s Association for Research Managers and Administrators (ARMA) has a Professional Development Framework for their members, although only a high-level summary is publicly available (ARMA, n.d.). The summary breaks down functions into “operational”, “managing” and “leading” roles and has considerable overlap with the list of management and administrative tasks provided in the Table 1. Research leaders and managers are responsible for ensuring that these functions are adequately resourced and supported, along with any other institutional-specific research management functions. It is particularly important to ensure that there are appropriate and properly maintained information technology systems (hardware and software), as well as trained staff with operational and analytical skills to run these systems.

It is increasingly important to record the data necessary to meet the requirements of national performance-based funding, research assessment exercises and national and international benchmarking (Box, 2010; Butler, 2010; OECD, 2010a). Naturally enough these data also find their way into international performance rankings of institutions. Research organisations need staff with specialist skills and experience in areas such as bibliometrics and statistics are needed to administer these functions and analyse and interpret the data. Institutions can also acquire third party mechanisms for institutional data analysis and performance interpretation.<sup>32</sup> These activities and analysis are also under international scrutiny and subject to calls for further development (OECD, 2010a; OCED, 2010b; OECD, 2011b).

***Table 1. Typical activities in research management and administration***<sup>33</sup>

<b>Research support</b>	
<b>Primary activity</b>	<b>Related activity</b>
Identification of funding opportunities.	Advising potential applicants.
Identification of collaborative opportunities.	Advising researchers.

Supporting research proposals.	Mentoring, quality improvement, budget advice, compliance checking, identifying and liaising with partner organisations, providing seed funding to facilitate project development.
Liaison with granting agencies.	Advising on practicality and implementation of rules; responding to agency queries about active grants; communication on grant outcomes.
Promoting regulatory accountability.	Development and implementation of policies and procedures to assist researchers to meet regulatory requirements.
Supporting regulatory compliance.	Advising and assisting researchers with ethics approvals, safety requirements, compliance reports.
Record keeping.	Maintaining institutional databases of grants, publications, regulatory and ethics approvals, research outcomes, other recording requirements.
Milestone reporting (as required).	Ensuring contract requirements are met and reported.
Supporting inter-institutional and international agreements for collaborative research and co-use of infrastructure.	Developing, overseeing and recording documentation of agreements and their implementation and management.
Supporting research communication strategies.	Advising media and communications specialists on outcomes and achievements.
<b>Research translation/commercialisation</b>	
<b>Primary activity</b>	<b>Related activity</b>
Ensuring researchers are aware of opportunities and responsibilities for protection of intellectual property (IP).	Developing and providing information, policies and procedures; engaging and promulgating general advice on legal frameworks, including international obligations.
Identification and assessment of opportunities.	Recording research activities, surveying commercialisation activities and opportunities, identifying potential funding streams and establishing strategies and time frames.
Legal and commercial advice.	Co-ordinate advice on intellectual property and commercial linkages and opportunities.
Negotiation of agreements.	
Establishment and implementation of options, binding agreements, spin-offs, licence arrangements.	

Keeping records and contracts.	
<b>Financial management</b>	
<b>Primary activity</b>	<b>Related activity</b>
Costing and pricing research proposals and agreements, negotiating budgets.	Especially inter-institutional and international collaborative arrangements.
Accounting for direct and indirect research costs.	
Negotiating and checking contract agreements and commitments.	
Financial administration of payments.	Arranging international payments, advancing funds.
Record keeping and financial reporting.	Compliance requirements for grant acquittals, and data collection for institutional reports at operational and governance levels.
<b>Asset management</b>	
<b>Primary activity</b>	<b>Related activity</b>
Procurement and purchasing.	
Managing and maintaining equipment and facilities.	Developing and maintaining asset registers and maintenance schedules.
Assessing equipment lifetimes and replacement schedules.	Monitoring scheduled maintenance.
Provision and maintenance of IT systems, access and data storage.	Including access to off-site computing facilities.
Provision and maintenance of information and knowledge sources.	In conjunction with knowledge managers and on-line information repositories /libraries.
<b>Performance data recording and analysis</b>	
<b>Primary activity</b>	<b>Related activity</b>
Establishment and maintenance of publication databases.	Recording and verification of publications data.
Establishment and maintenance of thesis databases.	Recording and verification of thesis and awards data.
Establishment and maintenance of research funding data and contracts.	Liaison with financial management for performance reporting.
Analysis of performance data.	Reporting to executive on institutional, group and individual performance.

The amount of activity under each of the headings in Table 1 will vary with the number of disciplines and the extent of activity by discipline across institutions, as well as between institutions. Requirements will also vary in accordance with various national policies and legislative requirements. Activities are likely to vary from time to time as priorities and circumstances change at institutional and national levels. The growth in national and international collaborations in research, and the increasingly inter-disciplinary nature of that research, is affecting the balance of effort required in research administration.

One area of management operations that has particular relevance and importance in research is financial management. The rigour with which the typical accounting requirements of an institution and external funding agencies are met will have a large bearing on the reputation and credibility of the institution. The importance of such rigour cannot be overestimated. This applies in all areas of operations, but is particularly important when managing government funds and funds secured through charitable foundations, whether external charities or foundations associated with the institution itself. Institutional foundations can offer institutions greater financial flexibility and autonomy, but establishing and managing them requires experience and special skills in communication with benefactors, financial management and investment.

## **Theme 4: leadership of researchers in institutions**

National innovation systems are reliant on the education, training and preparation of individuals who are attracted to a career in discovery and intellectual inquiry. The foundation for these careers is established in universities and research institutes, and those that achieve their goals and meet the requirements can go on to find employment in those institutions and in industries that depend on innovation (Toner, 2011; OECD, 2011b, 2011c). The workforce requirements for innovation are the subject of strong government interest expressed through national policies for education and research. In Australia, for example, there have been several recent analyses of the workforce requirements for research and innovation in higher education and industry (Access Economics, 2010; Allen Consulting Group, 2010), and some suggested actions (Coates and Goedegebuure, 2010). The government response set a strategic direction for development over the next ten years (Australian Government, 2011). Similar activities have been undertaken in other countries such as the United Kingdom and the United States. Such analyses and responses have significant implications for the leaders of the higher education and research institutions responsible for preparing of the workforce for research and innovation. They also have to deal with the challenges of providing leadership to and management for researchers and research training.

The success of any research institution is primarily dependent on the performance of the creative, imaginative and somewhat independent individuals who have chosen research as a career. In the introduction to their publication *Herding Cats*, Garrett and Davies (2010) explain that “the staff of academic institutions ... and research institutes ... can require a set of leadership and management skills somewhat different from (but of course with many parallels to) those often considered more characteristic of the world of commerce, industry and finance.

The ‘carrot’ will certainly predominate over the ‘stick’, and the carrots will vary.” Later on, they say that “There is a place for guile and political acumen”, and further, that “it is this that leads to the metaphor of ‘herding cats’ – if you have to try to coordinate a very difficult situation, where people want to do very different things, you’re herding cats.” (Garrett and Davies, 2010).

The general conclusion Garrett and Davies and the wider literature offer is that leadership of researchers requires an “ability to co-ordinate activities, select people, assemble teams, motivate workers, resolve problems, create a supportive environment, communicate, and provide focus and leadership” (Garrett and Davies, 2010; see also OECD 2011c). Clearly these are all positive activities that can lead to positive outcomes for an institution. The challenge for leaders also lies in the opposite, and more difficult, direction, namely in having the “confidence to ‘kill’ ailing projects and the ability to manage complex relationships.” (OECD, 2011c)

All of the leadership and management activities described in the preceding themes will have an impact on the staff of the institution. This theme provides a summary overview of the major requirements for leadership of researchers that support their personal and career development and their satisfaction over the usual path of a career in research. All of these factors are fundamental to retaining and expanding staff expertise and productivity in research. It also presents other general activities in regard to staff satisfaction and development.

As with previous themes above, this information has been drawn from a wide variety of sources used throughout this report (see References) as well as the programmes examined in Part 1 of this OECD study (Appendix C) (further details can be found on the websites presented there). The recently released Researcher Development Framework (Vitae, 2010) has been particularly relevant and important.

## **Research students**

The early formative years of a research career usually occur just prior to a commitment to undertake a higher degree programme. During that period, and the earliest phase of the higher degree programme, research leaders need to assure potential researchers about the relevance and the quality of the research training systems and the research environment of their institution. Programmes need to be available for:

- induction to research, including research integrity and codes of good practice
- training in the identification and validation of research questions and feasible approaches to finding solutions
- training in research methods, including ethical and other regulatory approval processes; literature analysis; and report writing
- training and mentoring in grant application processes
- training and mentoring in management of intellectual property, publication and communication skills
- exposure to and training in entrepreneurial and business skills where appropriate.<sup>34</sup>

It is also essential that students can be assured of appropriate supervision, supported by induction and training. Some institutions have a registry of supervisors who have undertaken such preparation and quality control assessment.

Research leaders need to understand the attitudes and expectations of younger generations who are undertaking the early phases of a research career. The speed of modern developments in technology and the practices in information exchange is an area that often distinguishes the experience of younger researchers from their supervisors and leaders of their institutions. Being aware of intergenerational issues and addressing the infrastructure and training needs of both students and their supervisors is an essential component of leadership in the postgraduate experience (see for example JISC and British Library, 2012).

### **Postdoctoral and early career researchers**

Institutional leadership is most critical at this stage of research career development. Taylor (2006) regards many aspects of human resource development as important: staff appointments, staff development, conditions of employment and performance management. Taylor identifies the following elements of effective practice in a range of research-intensive universities.

- Staff appointments should
  - follow appropriate search strategies to identify the best candidates who can meet institutional requirements and fit the research profile
  - be based on achievement, potential, and international reputation
  - be confirmed after rigorous probationary procedures
  - be facilitated through flexible remuneration and support packages.
- Staff development programmes should address
  - preparation of research proposals
  - project management
  - postgraduate supervision
  - preparation of publications.

Strategies to complement these development activities often include mentoring by experienced researchers, staff appraisal systems and setting of performance targets, and consideration of flexibility in requirements for and recognition of contributions to other important activities such as teaching. Other complementary factors that influence research staff performance include the research environment (staff attitudes to co-operation, collaboration and quality, and infrastructure) and institutional settings and organisational structures that foster independence and responsibility (Boulton, 2010).

In an increasingly competitive research funding environment, provision of ongoing support for successful grant holders as well as for near-competitive applicants is essential. Overall, it is important for leaders to provide support during researchers' early careers when there are high levels of uncertainty, including some level of bridge funding if possible.

### **Established researchers**

Leadership of research in established institutions, as well as those with a growing reputation or changing circumstances, requires close attention to mechanisms that will support the natural aspirations of research staff to achieve higher levels of performance and reputation in their chosen fields. Mathieu (2003) states that leaders of research institutions are these days faced

with “more competition, often ferocious, among universities and between academe and private companies to attract the most promising candidates”. Consequently, “it has become more vital than ever before for universities to put in place reinforcement systems that are both fair and capable of motivating excellence and of attracting and retaining the best people”. Furthermore, “the current context demands a richer, more complex, more transparent and more diversified reinforcement system that will integrate a set of incentives that are more closely tied to current academic needs and faculty members’ quality of life.”

Selecting and applying the right recognition and reward mechanisms requires care. Some simple mechanisms, such as public recognition and congratulation provide invaluable intangible support. Mechanisms which involve tangible resource allocation can provide longer-term encouragement and benefit. These might include provision of additional infrastructure support, workload flexibility, non-salary benefits and opportunities for mobility and travel related to active or potential collaborations (Mathieu, 2003). In higher education institutions, workload flexibility across the teaching-research functions is an increasingly important issue that has significant implications for the institution and for individuals (see, for example, Kyvik, 2009). Separating or “unbundling” these functions can have an impact on organisational culture, structure and the provision of infrastructure (de Jonghe, 2005). The impact can be both complex and beneficial, and institutional leaders need to fully understand and balance the costs and the benefits.

In applying mechanisms such as these, it is important to ensure that the recognition and reward is commensurate with the level of achievement, and that the processes of selection are widely understood, applied transparently and involve peer review. The benefits of these sorts of programmes is quickly lost if the processes are regarded as unfair.

A strong driver of behaviour for all staff is the recognition and reward that comes with promotion. Most mature research institutions have well-established processes for applying and being assessed for promotion. These processes are usually based on clear performance criteria that cover all aspects of the research endeavour and are moderated according to the level of performance (in quantity and quality) expected for the position to which the applicant aspires. The areas of activity assessed vary but they usually include factors such as success with funding and collaborations, and outputs such as successful postgraduate student completions, publications, patents and other communications. It is essential that leaders of research institutions ensure that the criteria for promotion and career advancement are consistent with the goals and strategic direction of the institution as a whole. It is also essential that the processes involved are transparent and consistent.

## **All researchers**

Some important aspects of research leadership affect all research students and staff and their career achievements (Boulton, 2010). Some of these are routine, while others are less so. However, it is important for leaders to be aware of all these factors so as to be prepared for unexpected but necessary changes in the research institution.

An essential prerequisite for staff management is to ensure that all positions in a research setting are adequately defined and have clear descriptions of their respective roles, responsibilities and accountabilities. Leaders have a responsibility to ensure not only that these are in place, but that they are also consistent with the role and aspirations of the whole institution. Staff should always be fully aware of their job description.

Foremost amongst the general responsibilities of leaders is to ensure that new students and staff receive adequate and appropriate induction to the institution, regardless of their prior experience. It is important that researchers are apprised of the goals and aspirations of the institution and the expectations that are placed on staff in accordance with their position description and performance expectation. They need to be aware of the institution's policies and procedures on all aspects of their research, where to locate those policies, procedures and administrative details for reference, and where to find assistance from specialist advisers. These issues are particularly important in the regulation of research activities that require ethical and/or safety approval. Other important areas for staff awareness include the institution's policies and procedures for managing intellectual property and the recording of performance-related data.

While specialist managers are the appropriate people to implement the mechanics of these tasks, it is essential that the institution's leaders provide staff with the rationale and the overall policy direction that has been adopted by the governing body. It is essential for the culture and ethos of the institution that the leaders assume the responsibility of exemplifying the high level of institutional responsibility that accompanies any position within the institution.

### **Leadership of institutions**

Leading a research institution is a dynamic process that is often characterised by highlights coupled with significant challenges. Highlights arise from sustained efforts that result in major outcomes that advance research and innovation, no matter how significant. On the other hand, significant challenges arise when areas of work are in decline or external factors impinge on the capacity to maintain or grow certain activities.

Dealing with areas in decline or under constraint is perhaps the most difficult challenge for research leaders. Sometimes, research activities may no longer be consistent with the strategic priorities of the institution. Decisions to terminate activities in these circumstances must be objective and evidence based and communicated effectively and sensitively. Part of the challenge is to encourage redirection of effort to alternative areas wherever possible, depending on skills and experience. Where this is not possible, then difficult leadership decisions are required.

The global financial crisis of 2007-08 has had widespread impact on the operations of higher education and research institutions worldwide. As Middlehurst (2010) reports, some governments responded to the crisis by investing in higher education and research institutions, while others chose to impose financial constraints. Even in those countries where there was investment, other factors have since contributed to financial constraint. From her analysis of responses to the crisis in higher education institutions in the United Kingdom, Middlehurst

identified three groups of detailed management responses to financial constraint, namely “tactical”, “adaptive” and “generative”. Middlehurst matched UK institutions’ leadership practices to those recommended by the international corporate advisers PricewaterhouseCoopers and McKinsey. The responses, practices, and leadership qualities in the face of challenging circumstances were:

- honesty and awareness of the challenge
- strong leadership
- need to engage with the whole organisation and external stakeholders
- realistic and detailed plans to resolve the situation
- rigorous implementation (programme management arrangements)
- financial control and discipline
- confronting reality
- putting strategy centre stage
- transparency with employees
- communication with investors
- building and protecting the culture
- keeping faith in the future.

Another more positive aspect of leadership is identifying and supporting emerging areas of strength and advantage. Such areas often require timely and significant short-term assistance. As with other areas of leadership described earlier, it is important that opportunities for such support are open and that the processes for assessment and potential support are fair and transparent. In all these challenging areas, leaders must recognise that they are dealing with people and that personal respect and fair treatment are paramount in making difficult decisions.

## **Theme 5: management to support leadership of researchers**

The administration and management of research student enrolments and staff appointments is usually the responsibility of specialist units, such as a postgraduate research office and a human resources section. Tables 2 and 3 summarise the major functions for these administrative and management areas. As with Theme 3, there is overlap with the Professional Development Framework described by ARMA (n.d.).

**Table 2. Typical management and administration requirements for research students**

<b>Research student management</b>	
<b>Primary activity</b>	<b>Related activity</b>
Advising on and contributing to external policy settings.	Liaison with government officials and sector interest organisations.
Advising on enrolment requirements.	Developing institutional opportunities and requirements and disseminating them to prospective students.
Student induction to the institution.	Ensuring awareness of institutional policies and procedures, and regulatory requirements.
Supervision arrangements and training.	Developing and maintaining supervisor training and quality programmes; maintaining a register of approved supervisors (for larger institutions); ensuring independent sources of advice on supervisor arrangements.
Training programs for research methods, publication and IP management.	
Support for study interruptions and changes in supervision.	
Facilities and infrastructure requirements.	Minimum student facilities should be defined and provision monitored.
Support for travel and conference attendance.	
Support for appropriate study-related secondments to industry.	
Monitoring progress and support.	Assist with timely completion of candidature.
Examination processes.	Ensure timely completion of the examining process, and recording of outcomes.
Graduation confirmation.	

**Table 3. Typical management and administration requirements for research staff**

<b>Staff management</b>	
<b>Primary activity</b>	<b>Related activity</b>
Creating position descriptions, including performance expectations, responsibilities, accountabilities.	Ensure personnel records are complete and up-to-date.
Processes for recruitment, selection and appointment of staff.	In conjunction with leaders and discipline experts.
Contract arrangements.	Ensure details are complete and satisfactory.
Induction to the institution.	Provide advice on policies, procedures and sources of information and assistance.
Advising on research integrity.	Establishing and supporting official policies, procedures and training for personnel with institutional responsibility for dealing with research integrity and potential misconduct.
Advising on conflict of interest management.	Include in induction and training programmes.
Staff development.	Awareness and training for career development, mentoring opportunities, peer review and feedback.
Assisting and managing conflict resolution.	Providing independent mediation and supporting active resolution of conflicts.
Data analysis for trends in personnel profiles.	Developing and maintaining long-term data on age profiles, appointment level profiles and succession planning.
Supporting and managing staff surveys and feedback options.	Supporting institutional "wellness" surveys or similar.

Strategy and management support for workplace change.	Ensuring legal and other employment requirements are satisfied.
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## Theme 6: personal behaviours and qualities of research leaders and managers

There is an extensive literature available on the general attributes, qualities and behaviour of successful leaders. Although some of this literature is drawn from the experience of research leaders, the vast majority comes from the enterprise sector where leadership is paramount to the commercial success of the company and the satisfaction of shareholders.

There are many personal qualities and behaviours that leaders and senior managers of research and innovation need to demonstrate. Many of these factors align with those of the enterprise sector, while others differ because of the research environment in which these leaders operate. As described earlier, research staff are intelligent and creative individuals who have personal and professional aspirations and passions, and yet they must work within a collegiate atmosphere that is nevertheless highly competitive, especially between institutions.

Leaders and senior managers in research environments must earn and retain the respect of their colleagues. It is common for research leaders of research to bring to their role a significant background of achievement in research, which is one source of such respect. Similarly it is often the case that senior managers bring a wealth of experience to their roles. However, the extra dimensions of leading and managing others with similar backgrounds demands that they generate respect through their conduct and behaviour in office. No single development manual that will provide all the advice required to develop the skills and attitudes necessary. Much is learnt through experience. However, there are some fundamental principles that can be drawn from the experience of others. The following summary implies no order of priority or level of importance – they are all relevant.

*The leadership behaviour* that can have a positive influence on the attitudes of staff include:

- Set performance expectations for the institution and the senior leaders and managers with honest and regular appraisal.
- Establish acceptable, transparent and rigorous systems and programmes for incentives, recognition and reward.
- Provide feedback, and, where appropriate, congratulate and thank.
- Be transparent and consistent in decision making, and be ready to justify difficult decisions based on evidence and sound judgment.
- Be fair.
- Deal effectively and in a timely way with misconduct.
- Provide developmental opportunities and mentor senior staff.
- Reward and celebrate individual and team successes.
- Delegate, with authority, accountability and trust.
- Seek organisational feedback, report the outcomes broadly and provide avenues for change and improvement.
- Communicate and be available to counsel those seeking advice and assistance.

*The personal qualities of leaders* that complement and underpin leadership behaviour include:

- Accept fully the responsibility and accountability that comes with the role of being a leader.
- Demonstrate trust and loyalty to those whose roles support the leader.
- Recognise and appreciate teamwork in leadership and management.
- Activate and accept personal feedback on personal performance and the performance of the senior team.
- Communicate with empathy.
- Adapt to changing circumstances and adopt new approaches.
- Advocate with passion.
- Demonstrate honesty and integrity, always.

## **Conclusion**

This review of the knowledge and skills required for leadership and management of research and innovation reveals the complexity of the task that leaders and managers undertake.

Indeed, there are likely to be many variations on the themes that this review has adopted – perhaps as many as there are different research and innovation systems and institutions around the world. This is because every institution is different and is comprised of many different individuals. There are also different requirements for leadership of research in different disciplines.

Succession planning and leadership development for capable staff with aspirations for such career advancement are essential if research institutions are to achieve continuity and improved performance. In complex and large institutions leadership is required at various levels of the organisation and identifying and developing such personnel is an ongoing requirement.

There are many examples of good practice in leadership in research and there is an increasing literature on these issues in print and on the web. For individuals who aspire to these challenging positions, knowing how best to be prepared for such roles and how to undertake the role most effectively cannot easily be conveyed or taught. It is largely for this reason that mentoring figures so highly in strategies for leadership development, whether it be formal or informal through experiential opportunities. However, being aware of everything that is involved in leadership and management in these complex environments, and the human dimension of the influence these roles exert, is a good starting point. It is hoped that this review assists in this regard.

The objective of this study is to provide a basis for the development of programmes for leadership and management in research and innovation in emerging economies. These countries, have fewer available resources, lower scale and intensity of research, different cultures and less mature experience in research and innovation, which only adds to the challenge. However, shared knowledge and experience is available and international engagement in the challenge is to be encouraged for the broader good of the world society.

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<sup>1</sup> See for example the programmes listed in the ipHandbook of Best Practices website: [www.iphandbook.org/handbook/globallearning/degrees/](http://www.iphandbook.org/handbook/globallearning/degrees/)

<sup>2</sup> Australian Research Management Society: <http://researchmanagement.org.au/>.

<sup>3</sup> National Council of University Research Administrators: [www.ncura.edu/](http://www.ncura.edu/); Research Management Review available at [www.ncura.edu/content/news/rmr/index.php](http://www.ncura.edu/content/news/rmr/index.php)

<sup>4</sup> The Swiss Association of Research Managers and Administrators: <http://sarma.ch/>

<sup>5</sup> Association of Research Managers and Administrators: [www.arma.ac.uk](http://www.arma.ac.uk)

<sup>6</sup> The Association of Commonwealth Universities: [www.acu.ac.uk](http://www.acu.ac.uk)

<sup>7</sup> The Association of African Universities: [www2.aau.org](http://www2.aau.org)

<sup>8</sup> The Society of Research Administrators International: [www.srainternational.org](http://www.srainternational.org)

<sup>9</sup> Association of University Technology Managers: [www.autm.net](http://www.autm.net)

<sup>10</sup> ipHandbook of Best Practices: [www.iphandbook.org](http://www.iphandbook.org)

<sup>11</sup> Centres such as the LH Martin Institute in Australia ([www.lhmartininstitute.edu.au](http://www.lhmartininstitute.edu.au)) and the Leadership Foundation ([www.lfhe.ac.uk](http://www.lfhe.ac.uk)) in the UK (accessed August 2012).

<sup>12</sup> See, for example, this certificate in Clinical Research Management from the University of Massachusetts: [www.umassmed.edu/Content.aspx?id=63986](http://www.umassmed.edu/Content.aspx?id=63986) (accessed August 2012).

<sup>13</sup> The number of researchers in an institution who are unaware of this relationship is probably now quite low, given the interest of institutions in maximising public performance outcomes and funding agencies in assessing relative performance of individuals, groups and institutions.

<sup>14</sup> See, for example, *International research management: benchmarking programme*. A report to HEFCE by the Association of Commonwealth Universities 2006, available at [http://webarchive.nationalarchives.gov.uk/20100202100434/http://www.hefce.ac.uk/pubs/rdreports/2006/rd11\\_06/rd11\\_06.pdf](http://webarchive.nationalarchives.gov.uk/20100202100434/http://www.hefce.ac.uk/pubs/rdreports/2006/rd11_06/rd11_06.pdf) (accessed August 2012)

<sup>15</sup> See for example the OECD-TIP Smart Specialisation Project, <https://community.oecd.org/community/smartspecialisation?view=overview#/?tagSet=undefined> (accessed April 2013)

<sup>16</sup> These issues are discussed in other reports in the IHERD project.

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<sup>17</sup> See, for example, *Implementing Better Practice Grants Administration* (Australian National Audit Office, 2010)

<sup>18</sup> Australia's Cooperative Research Centres programme, for example, requires that any government funding is matched or exceeded by cash and in-kind contributions from the university and enterprise partners participating in the research program. See <https://www.crc.gov.au/Information/default.aspx> (accessed August 2012)

<sup>19</sup> See the Australia-India Strategic Research Fund: [www.innovation.gov.au/Science/InternationalCollaboration/aisrf/Pages/default.aspx](http://www.innovation.gov.au/Science/InternationalCollaboration/aisrf/Pages/default.aspx) (accessed August 2012) and the Australia-China Science and Research Fund [www.innovation.gov.au/Science/InternationalCollaboration/ACSRF/Pages/default.aspx](http://www.innovation.gov.au/Science/InternationalCollaboration/ACSRF/Pages/default.aspx) (accessed August 2012)

<sup>20</sup> EU Framework Programmes for Research and Technological Development

<sup>21</sup> See, for example, Research Councils UK ([www.rcuk.ac.uk](http://www.rcuk.ac.uk)), the Australian Research Council ([www.arc.gov.au](http://www.arc.gov.au)), the Canadian Institutes of Health Research ([www.cihr-irsc.gc.ca/](http://www.cihr-irsc.gc.ca/)) and the National Science Foundation of the US ([www.nsf.gov](http://www.nsf.gov)). All sites accessed April 2013.

<sup>22</sup> See, for example, The World Conferences on Research Integrity, [www.worldscientific.com/worldscibooks/10.1142/8102](http://www.worldscientific.com/worldscibooks/10.1142/8102); Canada's Tri-Agency Framework: Responsible Conduct of Research, [www.rcr.ethics.gc.ca/doc/Framework-CadreReference\\_eng.pdf](http://www.rcr.ethics.gc.ca/doc/Framework-CadreReference_eng.pdf); page on Research Integrity on the ARC website, [www.arc.gov.au/general/research\\_integrity.htm](http://www.arc.gov.au/general/research_integrity.htm) and the US Office of Research Integrity, <http://healthfinder.gov/FindServices/Organizations/Organization.aspx?code=HR2971>. All sites accessed August 2012.

<sup>23</sup> Mission-Based Compacts for Universities: [www.innovation.gov.au/Research/MissionBasedCompacts/Pages/default.aspx](http://www.innovation.gov.au/Research/MissionBasedCompacts/Pages/default.aspx) (accessed August 2012).

<sup>24</sup> In Australia, for example, funding for research can be provided through the government's independent granting agencies (the Australian Research Council and the National Health and Medical Research Council) and directly to government research agencies (CSIRO, AIMS, ANSTO) as well as separately for priority programs offered through the Department of Health and Ageing, the Department of Agriculture, Forestry and Fishing, and several other departments.

<sup>25</sup> The Royal Society (2011) provides a very comprehensive review of changes in international research patterns and activities as well as making high-level recommendations for future policy and action.

<sup>26</sup> See for example *OECD Investment Policy Reviews: Viet Nam 2009* (OECD, 2009)

<sup>27</sup> See for example Chapter 5 of WIPO (2004), <http://www.wipo.int/about-ip/en/iprm/pdf/ch5.pdf> and The WTO webpage on TRIPS (Trade-related aspects of intellectual property rights: [www.wto.org/english/tratop\\_e/trips\\_e/trips\\_e.htm](http://www.wto.org/english/tratop_e/trips_e/trips_e.htm) (accessed August 2012)

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<sup>28</sup> For example the European IPR Helpdesk: [www.ipr-helpdesk.org/](http://www.ipr-helpdesk.org/) (accessed August 2012)

<sup>29</sup> See, for example, Research Professional: [www.researchresearch.com/index.php?option=com\\_content&view=article&id=24&Itemid=24](http://www.researchresearch.com/index.php?option=com_content&view=article&id=24&Itemid=24) (accessed August 2012)

<sup>30</sup> See for example the University of Glasgow Research Map: <http://www.gla.ac.uk/services/researchmap/> (accessed August 2012).

<sup>31</sup> For example, numbers of publications are often used in funding formulae but such indicators can drive behaviour that may not always be consistent with the aspirations of an institution. For instance the institution might prefer to publish in high-impact journals.

<sup>32</sup> See, for example, Academic Analytics: [www.academicanalytics.com](http://www.academicanalytics.com) (accessed August 2012)

<sup>33</sup> Note that human resource management is described in Theme 5.

<sup>34</sup> See also, for example UK GRAD Programme (2001).

## **Chapter 4**

# **Case study: the effectiveness of research and innovation management at policy and institutional levels in Cambodia**

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Sideth S. Dy

## Preamble

Cambodia is a proud nation with a difficult history. It was a French colony from 1863 to 1953. The country is known to the world both for its ancient civilizations in Asia during the Angkor period (9th-15th centuries), and also for the killing fields during the Khmer Rouge regime (1975-79). Political turmoil and civil conflicts during the 1970s and 1980s meant Cambodia became one of the least developed nations in Asia. The Khmer Rouge period caused the vast destruction of human capital and socio-cultural structures, when over half of the educated population were killed or fled the country. During the Khmer Rouge regime, the formal education system was demolished. Universities and schools were closed, around 80% of teachers and educators were killed or fled the country, books and instructional materials were destroyed, and educational buildings were left to decay (MoEYS 2010). After the 1993 general election, sponsored by the United Nations, attention turned to reconstruction and the rehabilitation of all kinds of infrastructure, including human resources development. The early 1990s saw the establishment of many institutions critical to a democratic state, including a functioning and restructured education system.

Cambodia is now a liberal democratic and pluralistic country with a constitutional monarchy and has enjoyed full peace since 1998. Its population in 2011 was estimated to be around 14.5 million. The labour force participation rate is about 87%, and about 90% of all employment is in the agriculture sector (Cambodia National Institute of Statistics, 2012). The economy is expanding rapidly, with an average annual rate of growth of 11% over the period from 2004 to 2007, and an average annual growth rate of 6.7% over the period from 2010 to 2012.<sup>1</sup> Persistent strong growth rates over two decades have helped raise living standards and are enabling the more rapid development of physical infrastructure and basic social services. GDP per capita increased to USD 830 in 2010, from only USD 286 in 1999 and USD 934 in 2012. The population living on less than USD 1.25 per day was 22.8% in 2008 (ADB, 2012). However, a World Bank Regional Report<sup>2</sup> in 2012 still classified Cambodia as having the lowest GDP per capita levels in the Southeast Asian region, along with Lao PDR.

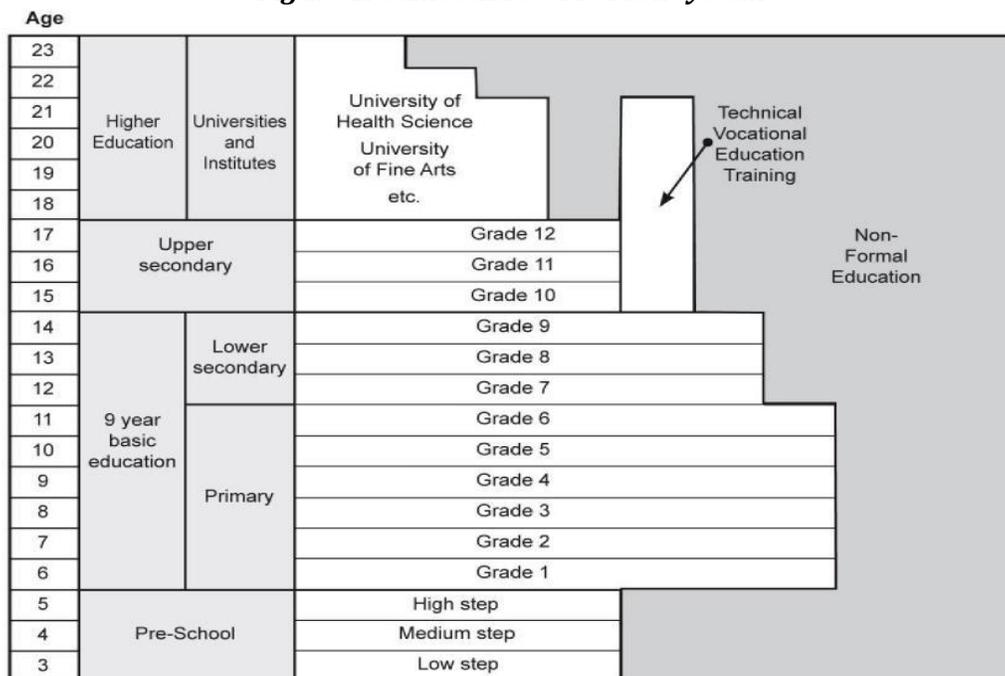
Cambodia lags well behind Thailand and Malaysia in the development of science and technology research. It has made progress during the past decade, but private-sector investment in research is negligible, and the government's views on research and innovation are not entirely clear. The country is in the process of preparing policies and legislation to enhance scientific research and development, with a view to keeping up with regional developments. The main challenge it recognises is the need to increase national productivity by adopting technology-based manufacturing and by developing the provision of services. Despite concerted efforts over the past decade by the government and its development partners, Cambodia's higher education institutions (HEIs) have consistently failed to deliver the necessary research capacity. Because of their limited financial circumstances, HEIs have largely concentrated on teaching and have neglected the development of research and consultancy services. Policies for the development of higher education have also tended to focus exclusively on the need to expand access and upgrade the

teaching infrastructure.

In its attempts to prepare capable human capital for the future economic growth, Cambodia needs to assess the human capital requirements not only of business, but also of research and development, innovation and business networks, and the capacity-building requirements of the government agencies including specialised ministries (UNDP, 2011). Balancing the contribution of higher education to equity and quality is complex. There are still need-based public scholarships for students at public HEIs. Quality teaching is needed more than research, and many HEIs prefer to commit more to teaching and expanding access than to facilitating their faculty members' involvement in research and development.

Cambodia adopts a 6 years primary, 3 years lower secondary, 3 years upper secondary & 4 years tertiary model for its education system (Figure 1) with children starting their primary schooling at the age of six. The school year begins in October and concludes in July, with national examinations upon completion of grades 9 and 12. Basic education is constitutionally defined as consisting of nine years of education; it covers the primary (six years) and lower secondary (three years) levels. Access to quality basic education remains a challenge; in particular many children have difficulty staying on in school beyond the completion of primary schooling. The 2010 National Socio-Economic Survey (National Institute of Statistics 2010) showed that only 5.2% of 15-to-64 year olds had completed secondary education, and only 2.1% had engaged in any form of post-secondary education, including higher education. This situation raises serious questions about the skills and the productivity of the current work force.

**Figure 1. Cambodia's education system**



Source: Ministry of Planning (2010)

Each additional year of either technical and vocational education and training (TVET), or of upper-secondary education after basic education, enhances productivity and creativity in the labour market (World Bank, 2012). Levels of access to post-basic education in Cambodia, however, are among the lowest in Southeast Asia. According to the Department of Planning in the Ministry of Education, Youth and Sport (MoEYS), the net enrolment rate for upper secondary education for the 2011/12 academic year was 19.6%, and the transition rate from lower secondary to upper secondary education was only 69.8%. The situation is worst in rural areas, where poverty is acute and where educational facilities are the least well developed. Over 80% of Cambodians depend upon subsistence agriculture and labour migration.

The modern Cambodian higher education system dates from the late 1940s when the French proposed a model for the system. It was not until the 1960s, however, that a university system became operational. At that time, eight public universities were established throughout the country. Six of these were located in Phnom Penh: the Royal University of Phnom Penh, the Royal University of Technology, the Royal University of Fine Arts, the Royal University of Agronomy, the Popular University, and the Buddhist University. Two were located in the provinces: the Royal University of Kampong Cham and the Royal University of Takeo-Kampot (RAC, 2003). As noted earlier, the system was destroyed during the late 1970s and was not redeveloped until the 1990s.

The higher education system has expanded significantly over the past ten years, primarily because of a surge in the number of private universities. According to the MoEYS Congress Report 2012, there are 97 higher education institutions in Cambodia, mostly located in the capital, Phnom Penh, but also in 18 of the 23 provinces. Of these institutions, 59 are private, and these are located predominantly in Phnom Penh. The number of high-school graduates is increasing strongly, up from 41 964 in 2007 to 92 236 in 2011, which is fuelling the demand for higher education, and especially the growth in the number of private universities. Those young people who do go on to higher education are less likely to be girls, and less likely to be from poorer backgrounds. In 2012, there were 207 666 students enrolled in bachelor degree programmes, of whom only 40% were female. Only 13% had been admitted under the government's scholarship scheme for poorer students.

## **Government leadership in R&I**

Governance of the higher education system in Cambodia is fragmented. The *National Strategic Development Plan 2009-2013* provides overall direction and leadership for all ministries. The plan is formulated for five years, the term of an elected government. However many different ministries and agencies deliver higher education services alongside private institutions, with limited overall co-ordination at the national policy level. The government's vision and policy on the development of the higher education sector is not yet clear. Senior appointments and promotions in public HEIs

are generally decided by the government following a process that lacks real transparency (Chet, 2009). The government has not yet succeeded in developing individuals capable of becoming leaders of research policy and administration, which is having an adverse impact on the current national development strategies. A challenge for the government is to augment the importance of the role played by research in economic development and to promote the role of researchers and innovators in the overall development of the sector.

A newly created Technical Working Group (TWG) for higher education is addressing issues of strategic planning for improving the higher education sector. This group consists of representatives of various development partners (UNESCO, the World Bank, the Asian Development Bank, etc.) and some of the relevant ministries (the Ministry of Economy and Finance, the Accreditation Committee of Cambodia, the Ministry of Labour and Vocational Training, the Ministry of Industry, Mines and Energy, etc.). It is co-ordinated by the Ministry of Education, Youth and Sport (MoEYS). The group will eventually help identify solutions to the current critical issues of quality and relevance in the higher education sector, including the enhancement of research and innovation in Cambodian universities.

At a policy level, Cambodia supports research and innovation. Article 28 of the December 2007 Education Law requires the promotion and support of scientific and technological research, development, innovation and production to meet the needs of the labour market and globalisation. It also emphasises human and institutional capacity development to advance research. A *Policy for Research and Development in Education Sector*<sup>3</sup> was subsequently developed in July 2010 to help strengthen research in HEIs. The policy's ultimate goal is to build a research culture in all universities with a view to linking research with national development and planning. The policy seeks to a) enhance the quality of higher education by transforming the institutions into research centres for the development and creation of new knowledge; b) increase opportunities for co-operation with national and international networks; and c) advance human resource capacity, creativity and innovation. Its core principles are focused on ensuring that a wide range of research is conducted in all disciplines, and increasing the national capacity for research. A more recent five-year master plan, developed in 2011 for the period up to 2015, also expressed the importance of developing research capacity to underpin planning and decision making, and sought to improve the research capacity of universities and individual faculty members.

## **Human resource development for R&I**

The Scientific Research Department is part of MoEYS. It has been active in developing policy and regulations for the management of graduate degree programmes for both public and private HEIs. The vision of MoEYS is to build human resource capacity in terms of knowledge, skills, ethics, creativity, innovation and entrepreneurship in order to maximise the national long-term development of the society and economy. Its policy to promote research and development emphasises the following core principles:

- ensure that a wide range of research is conducted in all disciplines

- improve the capacity of researchers and to develop the research capability of all HEIs
- promote respect for research ethics, protection of research achievements and dissemination of research results
- encourage the utilisation of research results to produce new knowledge and developments.

However, according to the MoEYS Congress Report for 2012, the situation with graduate studies in Cambodia is not comparable with that in neighbouring countries. The report highlights the following achievements:

- Of Cambodia's 97 higher education institutions, 34 offered master's degree programmes. Of these, 8 were public universities and 26 were private universities.
- About 3 000 students graduating each year with master's degrees.
- Two public universities and 15 private universities also provided doctoral programmes mainly in the fields of social sciences and business management.
- Between 2010 and 2011, there was a decline of 10% in the number of enrolments in master's degree programmes in public universities, but an increase of over 40% in enrolments in private universities.
- Female enrolments in master's degree programmes increased sharply in 2011, mostly in private universities, but only 24% of all master's students were female.
- From 2010 to 2011, there was a 50% increase in enrolments in doctoral programmes – from 36 candidates in 2010 to 54 candidates in 2011, including two female candidates.

To support the higher education sector, the World Bank, in co-operation with the MoEYS, provided USD23 million (50% grant and 50% credit) to fund the five-year Higher Education Quality and Capacity Improvement Project (HEQCIP) 2011-2015. The objective of this project is to a) improve the quality of teaching, management and research in the universities it supports; and b) the targeting of disadvantaged students for enhanced access and retention.<sup>4</sup>

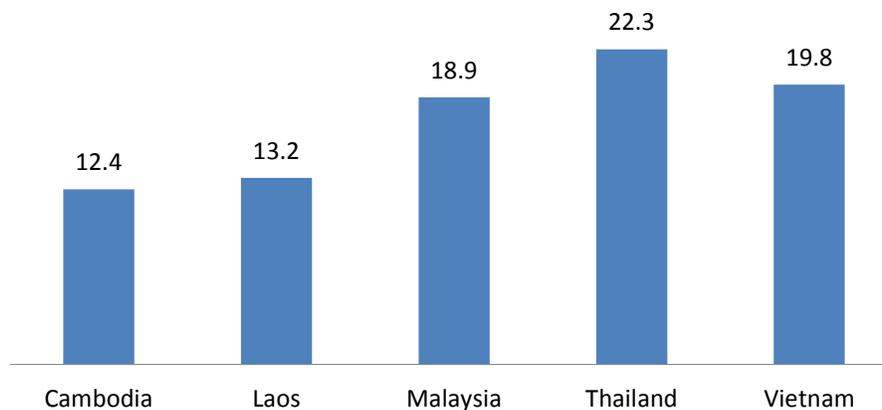
Key strategies to enhance quality of research and capacity development of researchers are as follows:

- Support the organisation of national and international conferences in Cambodia.
- Establish structures to facilitate meetings between researchers from many institutions and provide opportunities for them to present their findings.
- Allocate resources to enable the development of a multi-purpose scientific research journal and develop procedures to ensure articles are evaluated by panels of experts before publication.
- Encourage researchers to present their research findings at national and international conferences.
- Encourage researchers to study topics that are particularly relevant to Cambodia and to publish their findings in Cambodia.
- Support the establishment of electronic research journals on appropriate websites.

## Funding mechanisms for R&I

Budgetary allocations for public universities in Cambodia are constrained and arrangements for funding research and innovation are especially vague and bureaucratic. The rate of public expenditure on education as a percentage of total government expenditure is low compared with ASEAN partners, with the government spending only 12.4% of its budget in 2010 on education (Figure 2). This compares poorly with rates of 19.8% for Vietnam and 22.3% for Thailand. Over 70% of expenditure by MoEYS is on basic education, leaving only a limited amount for expenditure on higher education and research.

**Figure 2. Public expenditure on education as % of total government expenditure in selected ASEAN countries**



Source: UNESCO-EFA Global Monitoring Report 2012

In Cambodia, several ministries manage their own higher education institutions or research institutes, although under the technical co-ordination of the MoEYS. For example, the Ministry of Agriculture, Forestry and Fisheries supervises the Royal University of Agriculture and some other technical colleges and institutes. Agricultural researchers are mainly found at technical department levels or institutes of the ministry. The budgetary arrangements made by these ministries are not easily analysed, and it can be difficult to establish exactly how much budget is being allocated to research and innovation. There are also external assistance projects that conduct research with links to ministries and government agencies. Through the Department of Scientific Research, MoEYS channels funds from the government and development partners into 38 public higher education institutions. These funds are intended to assist with the development of science and technology education.

## Institutional leadership in R&I

There are guiding principles and mechanisms to promote research and development in Cambodia in response to global trends and issues. However institutional capacity is weak, as is funding support from the government. Co-ordination of research among ministries and HEIs is highly bureaucratic. Most of the research projects being carried out by HEIs and ministries are funded by external funding agencies like the United Nations Development Programme (UNDP), the World Bank, and the ADB. Against this backdrop, proposed measures to improve institutional leadership are:

- Funding support for a research office or unit in each HEI.
- Capacity building for staff and decision makers in the research office or unit;
- Recognition of the need for research and innovation (R&I), including seeking support for funding as well as partnership for professional development among local and international institutions.
- Leaders of HEIs and research institutions should participate in strategic meetings and workshops.
- Enhancing collaboration among universities in the country and the region, for example through the ASEAN University Network (AUN).
- Institutions should commit to seed funding in order to draw funding support from the government, industries and donors.
- Faculty members should be offered time away from teaching to get involved in research activities and training.

### A public university

The Royal University of Phnom Penh (RUPP) is an example of a public university in Cambodia. It is funded and managed by the MoEYS. It is one of the largest and oldest HEIs in the country and offers programmes across a diverse field of studies at levels from diplomas to master's degrees. It hosts more than 12 000 students, both scholarship and full-fee paying. It offers specialised degrees in the fields of sciences, humanities and social sciences, as well as professional degrees in the fields of information technology, electronics, psychology, social work and tourism. It also offers master's degree programmes in biodiversity conservation, chemistry, development studies, education, IT engineering, linguistics, mathematics, physics, clinical psychology and trauma treatment, sociology anthropology, social work, and Teaching English to Speakers of Other Languages (TESOL). The Institute of Foreign Languages offers diploma and bachelor degree programmes in English, French, Japanese, Chinese and Korean – as well as Khmer language programmes for foreigners.

The RUPP administers a Research Office. Its terms of reference require it to promote, lead, and conduct community-based research activities and develop research project proposals. Its additional roles are:

- engaging with joint research projects with other agencies and organisations inside and

outside the country

- publishing and dissemination research findings or papers
- planning and organising capacity-building workshops/seminars for faculty members with support and participation from external partners
- conducting research and devising strategies for faculty development
- monitoring all graduate degree programmes and developing graduate regulations in line with the MoEYS instructions
- contributing to the selection and evaluation process for graduate students
- keeping graduate records
- managing the printing house.

The RUPP has 497 full-time staff, of which 158 are women. Of the 350 academic staff members, 17 hold PhDs and 309 hold master's degrees. The university is comprised of faculties, institutes and centres. It has established co-operative programmes and links to a number of government agencies and international organisations (RUPP, 2012).

### **A government research institution**

The Royal Academy of Cambodia (RAC) is an example of a high-level research institution of the Royal Government of Cambodia. The RAC, which is under the management of the Office of the Council of Ministers, was created in 2000 with the following key objectives:

- To manage and expand research activities in Khmer studies and other fields of scientific and cultural studies in Cambodia.
- To establish co-operative research programmes with government ministries, public and private research institutions, and national and international organisations for mutual benefit and growth.
- To organise scientific and educational forums in order to help the country's development in all fields.
- To train researchers in master's and doctoral degree programmes.
- To disseminate innovative ideas and research findings in the national language for domestic audiences and to disseminate Khmer studies in foreign languages for international audiences.
- To collect publications and preserve research findings on Cambodia and abroad.
- To mobilise national intellectuals and researchers for dialogue into the country's development.
- To collaborate with research bodies at various government ministries.

## Challenges for research and innovation

The overall enrolment rate for higher education in Cambodia remains below 10%. Improving access to post-basic education has been a high priority for the government, which would also like to expand the higher education sector in order to widen access to higher education and meet Cambodia's need for highly trained personnel.<sup>5</sup> Public resources are tight, however, and so Cambodia's HEIs have to try to meet expectations regarding research and innovation with very limited budgets. Proper guidance and better regulations are needed to support their attempts to enhance the development of research and innovation.

The higher education system in Cambodia is expanding in size, but it remains small by regional standards. There are also some serious concerns about its quality. While various policy dialogues between the government and its development partners have discussed the importance of research, but limited follow-up actions have been taken. Most public universities do not yet have sufficient capacity to provide doctoral programmes. This is not only due to a lack of human resources such as qualified supervisors and technical staff, and physical resources such as laboratories, but also to the lack of a research culture and weaknesses in management and leadership. Private universities have taken a lead in providing graduate degree programmes, but these programmes are rarely backed up by a strong institutional commitment to research.

Most of the students enrolled in graduate degree programmes are public servants and professionals in both development organisations and private businesses. The graduate studies programmes offered by Cambodian universities in the fields of education, law, economics, business management and development studies are directed mainly at the needs of professionals upgrading their knowledge and skills for the purposes of professional effectiveness and eventual promotion. These programmes are constrained by the limited availability in Khmer of advanced scholarly literature, and by the fact that materials available in other languages may not be relevant to the context of Cambodia.

Within public universities there are no visible incentives for research by lecturers and there is no link evident between research achievements and either promotion or pay rises. A new policy on academic promotions is pending approval by the Office of the Council of Ministers, but it is difficult at this stage to see how this policy could address the many gaps that exist in Cambodia's research capability.

The gaps come in many forms. First, there is a lack of strong political commitment, which combines with a weak national research capacity to push the responsibility for research and innovation onto public universities and public research institutes. The level of understanding of the importance of research is not high among Cambodian political and institutional leaders. Policy decisions, for example, are more often than not based more on assumptions, values and personal experiences, rather than on systematically collected data. More broadly, there is not a sound appreciation of the

relevance of research and innovation to the future economic independence and prosperity of Cambodia. At present, it is easier to buy solutions for complex problems in agriculture and industry from abroad, rather than invest in the development of a strong national research capacity.

Second, the capacity for research and innovation in Cambodia is not yet well developed. Universities are commonly understood to be producers of research but across Cambodia's higher education system the faculty are under qualified. Of the 10 750 lecturers employed in 2012, only 1 510 held a master's degree, and only 192 (including only 20 females) had a doctoral degree (MoEYS 2012). Augmenting this capacity is a major challenge. There are limited opportunities in Cambodian universities for making research presentations, obtaining proper guidance from supervisors, or accessing research equipment and materials. Not surprisingly, most aspiring doctoral candidates prefer to do their studies abroad, whether self-financed or with the support of scholarships. Of the lecturers with doctorates, 172 graduated from foreign universities. Opportunities for study abroad are scarce, though, which limits the supply of developed research talent. Most senior and highly qualified full-time lecturers in public HEIs also teach part time in various private universities, which pay them on an hourly basis. The income they earn is a valuable supplement to their government salary of around USD 150-200 per month, which is not enough to support a family. There are no promotional or financial incentives for lecturers in public universities to conduct research and publish. Their major commitment is to teaching, and preparing for promotion to a management position.

Third, Cambodia continues to struggle with the idea of academic freedom. Cambodia's peace is fragile and there are sensitive topics (for example anything related to borders with neighbouring Thailand or Vietnam, or concerning government corruption) on which research is not generally encouraged. Furthermore, it is difficult to find any local peer-reviewed journals that published in the Khmer language. Articles or books published about Cambodia are mostly in English and are published outside Cambodia, often with joint authorships involving expatriates or individual Cambodian scholars.

Recent capacity development under the HEQCIP is resulting in a commitment of USD 3.2 million to facilitate and advance research capacity of both public and private universities in Cambodia. To date, the project has received 66 proposals from 22 HEIs, with 31 proposals eventually selected for funding. The results of these research projects will be widely documented in the Khmer language, and maybe even in local community languages. This kind of public dissemination of research findings will be new to Cambodia and may in some instances be somewhat challenging.

External development agencies and some of the government's policy advisory agencies are attempting to expand Cambodia's research capacity. The UNDP, World Bank, Asian Development Bank, and the Japan International Cooperation Agency have over the years invested significantly in research and development in Cambodia. The Supreme National Economic Council (SNEC), an official high-level think-tank, is playing a key role in drafting and advising on a national strategic

development plan. In doing so, SNEC is working closely with the Ministry of Planning and a number of key development partners to influence national policy and development. Partnerships to conduct research within government institutions and public universities have been sought for mutual benefits and with a view to building research networks and communities for knowledge management.

There is very little research co-operation between universities themselves, or between universities and either public or private enterprises. However, Cambodia's Development Resource Institute (CDRI), a non-government agency, has been providing valuable support for young researchers, especially for those fresh back from abroad. CDRI publishes the *Cambodia Outlook Brief*, in partnership with the ANZ Royal Bank. This publication is a key resource for many policy makers and decision makers in Cambodia. There are very few other instances of the skills of highly qualified persons being utilised in this way. In future, though, international and regional co-operation through networks such as the South-East Asian Ministers of Education Organization (SEAMEO), the University Mobility in Asia and the Pacific (UMAP) and the ASEAN University Network (AUN) will make it more likely for highly qualified Cambodians to become engaged in research-based collaborations with colleagues from other countries.

## Conclusions

The modern socio-economy, infrastructure and education systems in Cambodia were strongly influenced by the French during the 1950s to the 1960s, and by the Socialist Bloc of Eastern Europe, the Soviet Union and neighbouring Vietnam during the 1980s. These influences have largely faded as Cambodia has attempted to adjust itself to the trends and regulations of ASEAN when it became the tenth member during the late 1990s. Recent developments in the higher education sector have seen an increase in enrolments and an increasing number of graduates moving from the bachelor to the doctoral levels. The slowness of the government's approach to policy development and implementation regarding research and innovation is, however, a concern.

Building a research and innovation culture in Cambodia is likely to be a long-term challenge. Cambodia has had an Education Law since December 2007, a Policy on Research and Development in the Education Sector since July 2010, and the Five-year Master Plan for Research and Development since March 2011. This legal and policy framework aims to guide universities, researchers and research institutes to expand and commit to research and development towards turning Cambodia into a knowledge-based society.

It is commonly understood that research prepares the ground for reforms and for improvements in the quality and effectiveness of policy processes and implementation. Public universities need financial commitment from the government and external assistance agencies if they are to make any progress in developing their research and innovation capacity. While the government has made

some financial commitment to enhance research and innovation in Cambodia, it is difficult to trace exactly how large the commitment is. Against this backdrop, any donor-driven research investments need to be made conditional upon the publication of high-quality research outcomes.

The financial and political commitment to research and innovation in Cambodia is weak for various reasons. The government has little capacity to fund priority research areas and innovation. Furthermore, the government has little appreciation of the benefits of a knowledge society, or of evidence-based decision making. Research is most likely to be funded by development partners on a project basis. The World Bank's HEQCIP has continuously urged investment in and more public attention on research and development. Future policy must focus on the development of properly funded public research universities that are autonomous in their governance and management. Performance standards for lecturers in these universities should stress the importance of quality in both teaching and research.

The management of research and innovation in Cambodia is currently not very effective. This situation arises from a lack of understanding of and a lack of political commitment to expanding research and innovation opportunities, particularly in any areas deemed to be politically sensitive. Policies and legal documents expressing a commitment to research and innovation are not supported in practice. There are almost no incentives for scholars and other highly qualified persons to engage in research and innovation. Research achievements in universities do little to help staff climb the career ladder. Universities are required to play more of a role as business enterprises, delivering teaching services, to the detriment of research. They may also be producing graduates who lack the research skills needed for future national development or for the labour market of the future.

Public and private partnerships are not being sufficiently explored and developed. The private sector has a big stake in the quality of education and training, and could also be an important consumer of the research services if the universities were able to provide them. It should, therefore, be arguing for, and investing in, the development of a research and innovation culture and capacity in universities and research institutes. For the moment, however, its voice in Cambodia is subdued.

In order to promote research and innovation at a policy level in Cambodia some measures/strategies that should be considered are as follows:

- Adopting top-down co-ordination to deal with the fragmentation of responsibilities for R&I by various ministries and institutions.
- Formulating a national roadmap for the promotion and enhancement of science and technology in which research is key to this development.
- Bringing the concept of R&I into the mainstream through capacity building for policy makers through regional network meetings or workshops;
- Enhancing participation and initiatives in SEAMEO annual meetings.

- Seeking support from development partners or donors to revitalise R&I in the short run and preparing for a take-over of responsibilities by the government in the long run.
- Continued networking with regional development on R&I and advising HEIs to have professional society forums and exchange research outcomes.

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<sup>1</sup> Ministry of Economy and Finance [www.mef.gov.kh](http://www.mef.gov.kh)

<sup>2</sup> <http://www.worldbank.org/en/country/cambodia>

<sup>3</sup> <http://moeys.gov.kh/en/policies-and-strategies/73-policies/201-policy-on-research-development-in-the-education-sector.html>

<sup>4</sup> MoEYS website: [www.moeys.gov.kh](http://www.moeys.gov.kh) retrieved in December 2012

<sup>5</sup> MoEYS website: <http://www.moeys.gov.kh>

# **Chapter 5**

## **Case study: the effectiveness of research and innovation management at policy and institutional levels in Malaysia**

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## Preamble

Malaysia is a middle-income country in Southeast Asia with a multi-ethnic population of 28.3 million. In 2011, the Malaysian economy was the 3<sup>rd</sup> largest in Southeast Asia and ranked 30<sup>th</sup> in the economies of the world, with a gross domestic product (GDP) of MYR 853 billion (Malaysian Ringgit, equivalent to USD 284 billion, based on an exchange rate of USD 1 = MYR 3) and a growth rate of 5.1%. Its GDP per capita was MYR 29 404 (USD 9 801) in 2011 (Department of Statistics, 2012). Malaysia has transformed itself from a producer of primary products to a multi-sector economy based on services (48%), industries (40%) and agriculture (12%). Malaysia is a prominent supplier of tin, palm oil and rubber, and it is one of the world's largest exporters of semiconductor components and devices, electrical goods, solar panels, and information and communication technology (ICT) products.

The nation's vision is to become a high-income nation with an economy that is inclusive and sustainable (Malaysia, 2009). The goal is to establish a progressive and forward-looking society, one that is scientific and innovative. Thus, the Malaysian government is committed to harnessing, utilising and advancing science and technology in pursuit of its national development agenda. *The First National Science and Technology Policy (1986-1989)*, the *Industrial Technology Development: A National Action Plan (1990-2001)*, *The Second National Science and Technology Policy and Plan of Action (2001-2010)*, and the *Third National Science, Technology and Innovation Policy (2013-2020)* have formulated and implemented various initiatives and programmes to enhance the national capabilities and capacities of research and innovation (R&I), to forge partnerships between publicly funded research organisations and industries, to enhance commercialisation of research outputs, and to develop new knowledge-based industries (MOSTI, 2012).

As a nation with relatively limited resources, Malaysia has to ensure that every investment it makes in developing its science and technology achieves the desired results and earns a high rate of return. The allocation of resources is therefore closely aligned to its national priorities of transforming the country into a knowledge-driven economy so as to maximise economic and social returns. R&I is a key activity in enhancing the generation of new products, processes, services or solutions. The government needs to work closely with industry to invest in R&I and other technological development activities.

The following section presents an analysis of Malaysia's development in science, technology and innovation in terms of inputs, outputs and outcomes.

The gross expenditure on R&D (GERD) as a proportion of GDP has increased considerably during the past decade, though it remains low by international standards. The GERD/GDP ratio has increased from 0.22% in 1996 to 0.82% in 2008 (Table 1), lower than the Asian average of 1.6% in 2007 (UIS, 2010). The Malaysian government aims to increase this ratio to 2.0% by the year 2020 under its current national science, technology and innovation policy.

**Table 1. National R&D expenditure by sector, 1996-2008**

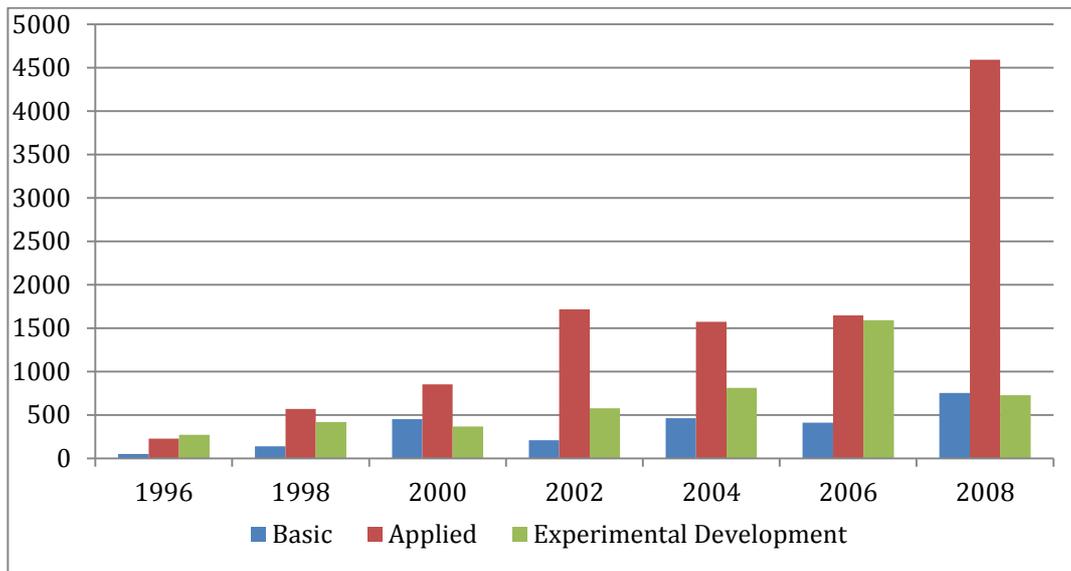
	1996	1998	2000	2002	2004	2006	2008
<b>R&amp;D Expenditure (MYR Million)</b>							
<b>Total GERD</b>	549.3	1 127.0	1 671.5	2 500	2 843.7	3 646.7	6 070.8
<b>Ratio GERD/GDP (%)</b>	0.22	0.39	0.50	0.69	0.63	0.64	0.82
<b>GRI</b>	108.7	247.3	417.5	507.1	296.9	189.5	603.1
<b>IHL</b>	40.4	133.6	286.1	360.4	513.3	360.8	1 188.3
<b>Business Enterprise</b>	400.1	746.1	967.9	1 633.1	2 033.5	3 096.4	4 279.4
<b>Proportion of R&amp;D Expenditure (%)</b>							
<b>GRI</b>	19.8	21.9	25.0	20.3	10.4	5.2	9.9
<b>IHL</b>	7.4	11.9	17.1	14.4	18.1	9.9	19.6
<b>Business Enterprise</b>	72.8	66.2	57.9	65.3	71.5	84.9	70.5

Source: MOSTI (2012), *National Science, Technology and Policy (2013-2020)*, MOSTI, Putrajaya.

In 2008, GERD stood at over MYR 6 billion; 9.9% of which was accounted for by government research institutes (GRIs), 19.6% by institutions of higher learning (IHLs) and 70.5% by business enterprises. That represents a decline in investment by business enterprises as a proportion of the total from 84.9% in 2006, although the volume of expenditure on research and innovation (R&I) increased by 38% over the period. A large proportion of this expenditure was by government-linked companies (GLCs). Small and medium-sized enterprises (SMEs) contributed only a very small extent to the growth (MOSTI, 2012).

Out of the total GERD in 2008, only 12.4% was devoted to basic research;<sup>1</sup> the rest was spent on applied research<sup>2</sup> (75.6%) and experimental development (12.0%) (Figure 1). Most of the basic research activities were undertaken by public universities and government research institutes.

**Figure 1. Expenditure by type of research in Malaysia, 1996-2008**



Source: MOSTI (2012), *National Science, Technology and Policy (2013-2020)*, MOSTI, Putrajaya.

The number of R&I personnel increased significantly from 24 588 in 2006 to 40 840 in 2008 (see Table 2). Similarly, the number of researchers per 10 000 of the labour force rose impressively from 17.9 in 2006 to 28.5 in 2008. However, this figure is relatively low when compared with the OECD average of 62.7 researchers (NationMaster, 2012). Almost 85% of the country’s research personnel are in the public sector (in IHLs and GRIs) (MOSTI, 2012).

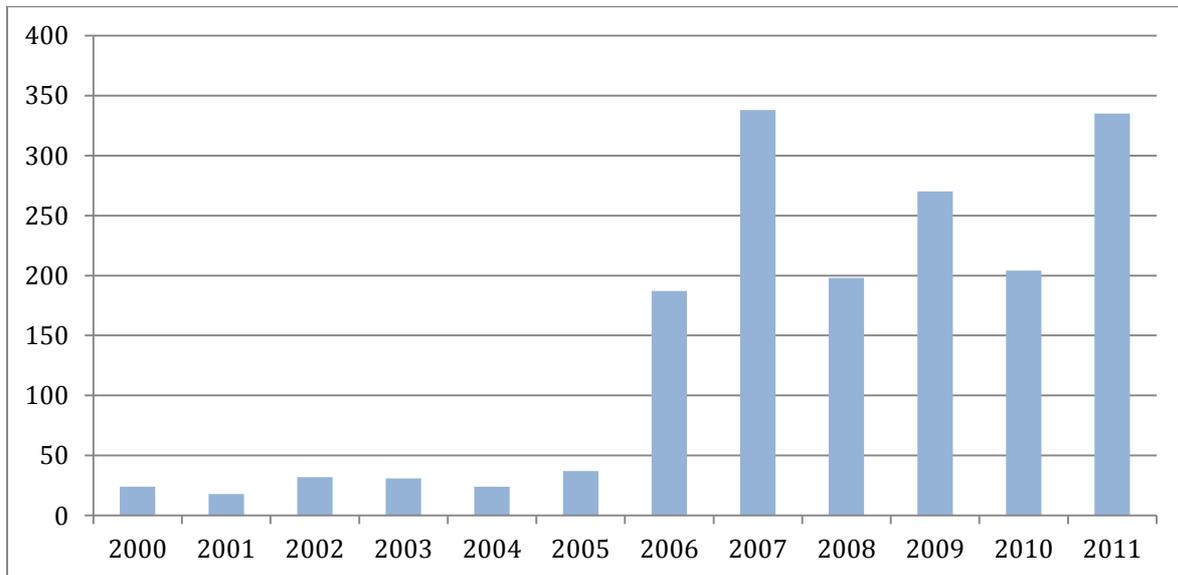
**Table 2. Ratio of researchers (national head count and full-time equivalent) to labour force and population, 1996-2008**

<b>Human Resources in R&amp;D</b>	<b>1996</b>	<b>1998</b>	<b>2000</b>	<b>2002</b>	<b>2004</b>	<b>2006</b>	<b>2008</b>
<b>Total Population (Million)</b>	21.17	22.18	23.27	24.53	25.62	26.64	27.70
<b>Total Labour Force ('000)</b>	8 616.0	8 883.6	9 616.1	9 886.2	10 856.0	10 628.0	11 028.1
<b>Researcher (Headcount) per 10,000 Labour Force</b>	5.1	7.0	15.6	18.0	21.3	17.9	28.5
<b>Researcher (Headcount) per 10,000 population</b>	2.0	2.8	6.5	7.3	9.0	7.1	11.4
<b>Total R&amp;D Personnel (Headcount)</b>	9 233	12 127	23 262	24 937	30 983	24 588	40 840
<b>Total FTE of R&amp;D Personnel</b>	4 437.3	6 656.33	10 059.67	10 730.95	17 886.55	13 415.9	22 287.29

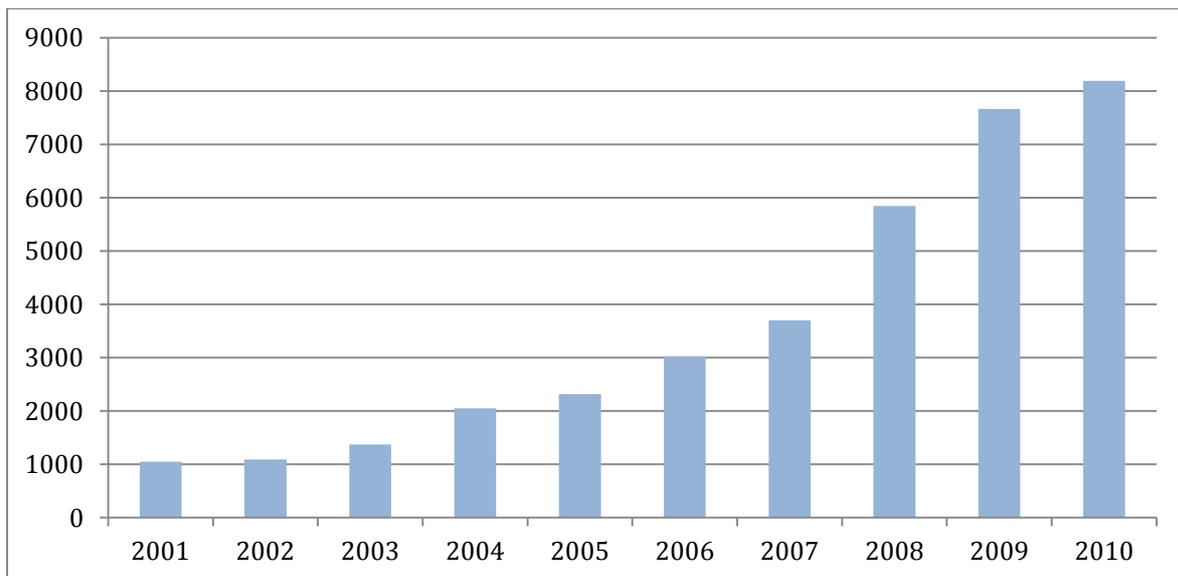
Source: MOSTI (2012), *National Science, Technology and Policy (2013-2020)*, MOSTI, Putrajaya.

Figure 2 shows Malaysia's performance with publications and patents. Malaysia was ranked 48<sup>th</sup> in the world in publications, with a cumulative total of 28 796 articles published from 1996-2008.<sup>3</sup> This places Malaysia below Singapore, which ranked 31<sup>st</sup> with 81 836 publications, and Thailand, which ranked 42<sup>nd</sup> with 41 637 during the same period (MOSTI, 2012). One area of concern is the low proportion of papers published in high-impact publications. For example, for the period 2001-09, only 2% of the papers were published in journals with impact factors of 2.0 and above (MOSTI, 2012). Malaysia's record with patents is also poor when compared with other developed countries (Table 3).

**Figure 2(a): Malaysia's R&D output in terms of patents 2000-11**



**Figure 2(b): Malaysia's R&D output in terms of patents, 2001-2011**



Source: MOSTI (2012), *National Science, Technology and Policy (2013-2020)*, MOSTI, Putrajaya.

**Table 3: Patents Granted by US Patents and Trademarks Office 1963-2000**

Country	No. of patents granted
China	9 473
Germany	334 440
Japan	806 181
<b>Malaysia</b>	<b>1 307</b>
Singapore	5 136
South Korea	78 400
Sweden	43 205
Thailand	372
USA	2 728 424

Malaysia's innovation capacity is in line with that of other middle-income countries in the Southeast Asian region, but shows a significant gap with high-income countries (Table 4). While Malaysia ranked second behind Singapore in Southeast Asia in most of the indicators, its global ranking was 21 out of 142 surveyed countries.

**Table 4: Malaysia's global ranking for innovation capacity, 2011-12**

	Rank		Score	Mean Score
	Global	South-East Asia		
<b>Capacity for innovation</b>	19	2	4.3	3.2
<b>Quality of scientific research institutions</b>	24	2	4.9	3.7
<b>Company spending on R&amp;D</b>	13	2	4.7	3.2
<b>University-industry collaboration in R&amp;D</b>	21	2	4.9	3.7
<b>Gov. procurement of advanced tech. products</b>	4	2	4.9	3.6
<b>Availability of scientists and engineers</b>	22	2	4.9	4.1
<b>Utility patents per million population</b>	32	2	7.2	-

Source: World Economic Forum (2011), *Global Competitive Report, 2011-2012*, World Economic Forum.

Despite making progress, Malaysia has a long way to go to catch up with its competitors. The Ministry of Science, Technology and Innovation (MOSTI, 2012) has identified the following challenges to be addressed systematically and urgently:

- public sector orientation and national focus
- sound institutional framework but weak management
- poor linkages and collaboration

- weak dissemination and weak attention to absorptive capacities
- lack of focus
- concern over the effectiveness of educational investment and brain drain.

These challenges are not insurmountable. The following section examines the national policies, strategies and mechanisms that have been put in place to address them.

## Theme 1: leadership by government

### National policies on R&I

Under the *National Science, Technology and Innovation Policy (2013-2020)*, Malaysia is seeking to strengthen and mainstream science, technology and innovation in all sectors and at all levels of the national development agenda. Important measures include:

- *Adequate funding for R&D in science and technology* – Malaysia aims to increase its ratio of GERD/GDP to 2.0% by 2020, which would mean that the country's R&I expenditure level would reach MYR 36.0 billion (USD 12.0 billion) by 2020, which will be almost a six-fold increase from the 2008 expenditure level.
- *Setting research priorities* – Research priorities will focus on those sectors where the nation is already strong and where opportunities for growth and leadership are highest. The following key industry sectors are being targeted: advanced manufacturing, advanced materials, electronics, ICT and multimedia technology, biotechnology, energy, aerospace, nanotechnology, photonics, and pharmaceuticals.
- *Striking a balance in funding support* – The emphasis of R&I funding in Malaysia has been on applied research, which was about 76% of expenditure in 2008 (Figure 1). R&I expenditure is also highly skewed towards information and communication technology, at about 62.7%. There should be a balance in funding all aspects of the research spectrum. The government has decided to fund both basic research and market-driven research equally. Similarly, research in other areas such as technological feasibility, market studies, the social sciences and humanities will be given support (MOSTI, 2012).
- *Improving funding mechanisms* – Over the years, Malaysia has introduced a wide range of research funding schemes for both the public and private sectors. However, there are too many organisations involved in managing these funding schemes, creating confusion among applicants and resulting in a number of inefficiencies such as difficulty in identifying suitable funds, long bureaucratic delays in approval and disbursement of funds, and lack of rigour and transparency in fund approval. To address some of these concerns, the government plans to set up a central mechanism to manage all major R&I funding schemes.
- *Harnessing traditional knowledge, natural endowments and promoting inclusive innovations* – Malaysia hopes to harness indigenous knowledge and exploit its rich biodiversity, as well as to promote innovations for disadvantaged groups so as to raise their productivity and to improve their livelihood and welfare.

- *Strengthening infrastructure to support R&I and innovation activities* – R&I facilities and infrastructure have been enhanced over the years with the creation of centres of excellence in science, and the establishment of an Academy of Sciences Malaysia, the Malaysia Super Corridor and the Malaysia Biotechnology Corporation. There are also many national laboratories operating in universities and government research institutes. Despite these developments, much needs to be done to further strengthen science, technology and innovation infrastructure in Malaysia. The current priority is better sharing of infrastructure and facilities among universities and GRIs and encouraging public institutions to collaborate with industry.

## **Governance of R&I**

The government has designated the National Science and Research Council (NSRC) as the lead organisation to co-ordinate publicly funded R&I schemes so that research efforts are aligned with national priorities and that the country acquires the necessary capabilities in emerging technologies. The government will also formulate and implement Inclusive and Innovation Roadmap and Strategies to meet the needs of excluded, disadvantaged, and low-income groups (MOSTI, 2012).

Working in collaboration with MOSTI, the NSRC, which consists of 20 experts from academia, the private sector and GRIs, has formulated the *Third National Science Technology and Innovation Policy (2013-2020)*. With the help of the New York Academy of Sciences (NYAS), it has carried out a review of public research assets by assessing the research productivity and efficiency of all GRIs and research universities (RUs) in the country. It is now assessing the quality of science, technology, engineering and mathematics (STEM) education in Malaysia. It is also in the process of drafting a “National Science Act” that will establish a central focal point for public funding for R&D and innovation, similar to the National Science Foundation in the United States.

With limited resources, the government sees the need to prioritise research areas and to identify emerging areas of research. For this purpose, myForesight, the Malaysian Foresight Institute, was established as a strategic engagement platform to facilitate the understanding of the problems, goals and development options that are expected to emerge in the future. The Malaysian Industry-Government Group for High Technology (MIGHT) is a membership-driven organisation established under the Prime Minister’s Department to oversee the activities performed by *myForesight*. To identify international trends in research and best practice in research management, the government has tapped international expertise through the Global Science and Innovation Advisory Council (GSIAC), comprised of renowned scientists, captains of industry and senior public officials.

Malaysia is keenly aware of the importance of R&I in contributing to national economic growth, improved productivity and socio-economic development. Besides investing in R&I, identifying international trends in research and adopting best practices in research management, the push now is towards the commercialisation of research and the raising of the country’s competitive index in the various sectors. National resources are being channelled not only to economic

development but also to the socio-cultural and political development of the Malaysian society. For example, collaborative research across various line ministries is being conducted to develop a localised gross national happiness (GNH) index.

### **Human resources development in R&I**

In the area of human resource development, Malaysia plans to enhance its institutions, mechanisms and programmes so as to ensure the continual development of a talent pool engaged in R&D and innovation activities. The starting point is to improve the quality of science, technology, engineering and mathematics (STEM) teaching in schools. It aims to increase the ratio of S&T to humanities students to 60:40 at both the secondary and first-degree levels.<sup>4</sup> At the same time, the government has launched programmes to expand the pool of scientists and researchers in S&T-related subjects through postgraduate awards and scholarships. The Innovation Fund for Innovative Human Capital Development (IHC) is one of such initiatives (MOSTI, 2012).

Science, as an international activity, requires local scientists and researchers to foster more international collaborations and linkages. The current state of international collaborations among higher education institutions and public research institutions in Malaysia is unsatisfactory. The low ranking of Malaysian universities in international league tables is partly due to their weak international linkages. Malaysian universities need to strengthen their internationalisation activities by connecting with world-class universities, attracting foreign talent as well as foreign students, and supporting brain-gain initiatives such as the Distinguished Visiting Scientist Programme and the Returning Malaysian Scientists Programme. To assist these initiatives, the government has established TalentCorp to co-ordinate the Residence Pass-Talent initiative and Returning Expert Programme.<sup>5</sup>

Furthermore, Malaysia, through the Ministry of Higher Education and 20 public universities, also has an extensive plan to develop human resources. *The National Higher Education Strategic Plan* (MOHE, 2007) aims to develop a critical mass of 100 researchers, scientists and engineers (RSE) for every 10 000 people in the workforce and to produce 100 000 PhD holders by the year 2020. To implement these aims, programs such as MyPhD, MyMaster and MyBrainSc were introduced to fund Malaysians pursuing postgraduate education domestically and abroad (MOHE, 2012). In addition, some GRIs and private higher education institutions have staff development programmes that provide scholarships for researchers to enable them to undertake postgraduate studies.

Malaysia faces a number of challenges in its R&D and innovation systems. These include low productivity, limited technological capabilities and limited institutional capabilities (public and private), all of which suggest the need for strong institutions and programmes to foster, build, nurture and retain the talent pool in science, technology and innovation (STI). Malaysia needs to improve the education system and its reserve of human talent and skills by attracting more talent and by strengthening the knowledge and skill generating institutions. To develop human resources in R&I, the government is directing more effort towards the development of higher-

order cognitive, analytical, creativity and entrepreneurial skills among school children and tertiary level students through STEM education (MOSTI, 2012).

### **Funding mechanisms for R&I**

Currently there are a number of agencies that disburse public funds for R&I activities in universities and public research institutes. These agencies include line ministries, such as the Ministry of Science Technology and Innovation (MOSTI), the Ministry of Higher Education (MoHE), the Ministry of Agriculture, the Ministry of Natural Resources and Environment, the Ministry of Health, the Ministry of Defence, and the Economic Planning Unit in the Prime Minister's Department. As a result, there are various research grant schemes supported for different purposes by the various ministries. Examples of government research grant schemes include: (Krishnan, 2006; MOHE, 2012)

#### Research grant schemes sponsored by **MOSTI**:

- The *Science Fund* provides grants to support R&I projects that can develop new products or processes for further development and commercialisation in specific research clusters, including include ICT, biotechnology, industry, sea to space and science & technology core.
- The *Industry R&D Grant Scheme (IGS)* has been administered by MOSTI since 1996, and is intended to mobilise Malaysian companies to achieve their technological capabilities and innovate. It also aims to foster public-private partnerships.
- The *Multimedia Super Corridor R&D Grant Scheme (MGS)* was launched in 1997 mainly to promote the development of ICT and multimedia products of commercial value.
- The *Technology Acquisition Fund (TAF)* was also introduced in 1997 and seeks to facilitate the acquisition of strategic and relevant technology by Malaysian companies so as to enhance their technological capacities and production processes. The TAF program has benefitted many SMEs that have recognised the need to keep abreast of new technologies in order to compete globally.
- The *Demonstrator Application Grant Scheme (DAGS)* is managed by the Malaysian Institute of Microelectronics (MIMOS), an ICT-related R&I organisation that advises the government on technologies, policies and strategies relating to ICT development. The DAGS funds short-term projects that have an IT and multimedia focus and local content.
- The *Commercialization of R&D Fund (CRDF)* was introduced in 1997 to enable the commercialisation of research and is managed by the Malaysian Technology Development Corporation. It provides grants to conduct market surveys and research, design processes and products, and to conform with standardisation requirements, including in the area of intellectual property rights.

#### Research grant schemes sponsored by **MoHE**

- The *Fundamental Research Grant Scheme (FRGS)* allocates funds to public universities for basic research in priority areas such as pure sciences, applied sciences, technology and engineering, medical sciences, social sciences and humanities, literature and the

liberal arts, natural sciences and natural heritage, defence and security, information and communication technology, and clinical and health sciences.

- The *Exploratory Research Grant Scheme (ERGS)* funds exploratory or experimental research where the findings are expected to be extended through applied research, i.e. answering the questions of what and where. The research areas are the same as those listed under FRGS.
- The *Long Term Research Grant Scheme (LRGS)* funds fundamental research that will take between five and ten years to execute. Its fields of research are global warming, tropical medicine, health care, energy safety and water, food security, advance manufacturing with added value, and information and communication technology.
- The *Prototype Research Grant Scheme (PRGS)* produces research products that will be ready to be commercialised.

In addition, MoHE disburses block grants to the five designated research universities (RUs) in the country. In 2012, each RU received a budget allocation of MYR 400 million (USD 133.3 million) per year for research and innovation. MoHE also provides Research Allocation Grant Schemes (RAGS) to all the other public universities to encourage and enable research and innovation. To encourage collaboration between RUs and non-RUs, MoHE initiated another grant scheme in 2011 known as RACE – which aims at building capacity in research and innovation among the non-research public universities.

Most of the research grant schemes managed by MOSTI are disbursed through competitive bidding from both the public and private sectors. MoHE, however, allocates its funds to universities through block grants although the funds are disbursed within universities through competitive bidding. Very often, the Economic Planning Unit (EPU) in the Prime Minister's Department provides block grants to various government agencies to carry out top-down directive research. For example, the EPU is providing the Malaysian Agriculture Research Development Institute (MARDI) with block grants amounting to MYR 86 million in 2013 and MYR 60 million in 2014 to conduct specific research on food security, agri-technology, climate change and value-added agriculture.

The government is encouraging the private sector to play a more active part in research and innovation. Initiatives include:

- *Tax incentives* To encourage the private sector to carry out R&I, the government offers various types of incentives for R&I activities including Pioneer Status and an investment tax allowance, as well as other R&I deductions and allowances under the 1967 *Income Tax Act*.
- *Loans and venture capital* Over the years, the government, through various ministries and agencies, has helped SMEs by providing financial assistance in the form of business loans, especially to entrepreneurs and business owners of specialised industries. Venture capital is another form of financing. In 2009, the Securities Commission of Malaysia introduced new tax incentive guidelines whereby venture capital companies could be eligible for a five-year tax exemption if they invest at least 30% of their funds in seed capital, start-up and/or early-stage financing.

In addition, there are fiscal incentives for R&I in the form of a double deduction on non-capital expenses incurred undertaking R&I activities. Under the national plans, funds have been channelled to various government-linked venture companies to promote and finance innovation, technology acquisition and commercialisation of R&I findings. Recently the Mudharabah Innovation Fund was formed to provide risk capital to government-backed enterprises (OECD, 2011).

As mentioned earlier, there is an urgent need to establish a centralised grant system for financing R&D and innovation activities in the country. There is a need for the private sector to do more R&I, for the multinational corporations to transfer technology, and for SMEs to commercialise research outputs from local research institutions. Research funding from local philanthropic foundations is virtually non-existent while Malaysian research institutions lack the skills and networks to compete internationally for funding. Much of the international collaborative research that does take place is either the result of connections among the individual researchers or bilateral agreements between the government and other governments. There is also a need to move to a greater reliance on competitive bidding at the national level so as to strengthen accountability and transparency in the management of research funds.

## **Communication**

Information on the various R&I funding schemes is made available to the research community on the funding agencies websites. For example, the official portal of the National IT Council Malaysia (NITC) has a list of IT financing and funding schemes offered by the state, with the objectives, eligibility criteria, target groups and addresses for application clearly stated (NITC, 2012).

Most of the public universities have research management units within their administrative structure. Their main purpose is to monitor and account for the public funds allocated by the state to universities for research purposes. Staff members from these units meet annually to share experiences and co-ordinate matters pertaining to research procedures in each of their universities. These feed into general guidelines and uniform administrative policies that apply to all researchers in public universities. Apart from the annual meetings, staff are in regular contact with one another for the purposes of implementing standardised research management procedures and to solve various administrative problems involving researchers, research assistants, funding agencies and the university bursary (Mohammed Yusoff et al., 2004).

Despite these institutional structures and co-ordination mechanisms, weak communication and co-ordination at all levels has led to a failure to realise the potential of this institutional framework. As a result there is needless duplication, poor implementation capacity, a lack of focus and less than satisfactory achievement of deliverables (MOSTI, 2012).

Another area where communication is inadequate is in the dissemination of research outputs, inventions and innovations from local research institutions to industry for the commercialisation of research. Much of this kind of dissemination and communication is done

through the business arms of the public research institutions (including the universities). Methods used include websites, exhibitions, conferences, open days, news bulletins, journals and other kinds of publications.

### **National innovation strategy**

Malaysia's national innovation strategy has three thrusts: a) to strengthen the building blocks of innovation, b) to switch on the enablers, and c) to shoot for the stars (Agensi Inovasi Malaysia, 2012). The building blocks include school leavers, graduates, a workforce with the right attitude and skills, intellectual capital for wealth creation, and a seamless funding pipeline. The enablers include use of ICT technologies, lifelong learning, interaction and collaboration between industry, academia, society and government, and the creation of entrepreneurs. "Shoot for the stars" involves developing world-class GRIs and centres of excellence (COEs) in niche areas such as wood-based industries, the halal food industry and eco-tourism. The goal is to move from a resource-based economy to an innovation-led economy with a balanced approach to market-driven and technology-driven innovation. The roles of the government would be a) to mitigate risk by assisting the private-sector drive for market-driven innovation; b) to expand the incentives and grants for entrepreneurs to acquire technology; c) to adopt new venture capital; and d) to conduct programmes in collaboration with universities and industries covering entrepreneurship, innovation risk management, and mindset change (Muhani, 2009).

### **Research ethics**

Malaysia has a National Ethics Committee taking care of issues such as bioethics and stem cell research. The Ministry of Health established a Medical Research and Ethics Committee in 2002 to provide independent guidance, advice and decisions on health research, involving specific protocols for research involving human subjects that is conducted by ministry staff or involves the ministry's facilities (MoH, 2012a). It has also established a National Committee for Clinical Research (NCCR) which developed the *Malaysian Good Clinical Practice Guidelines* as well as the *Guidelines on the Use of Human Biological Tissues for Research*, and *Guidelines for the Ethical Review of Clinical Research*. The aim is to protect the rights and well-being of human subjects. These two committees have adopted the research ethics guidelines outlined by the Helsinki Declaration agreed by the World Medical Association and Council for International Organizations of Medical Sciences (MoH, 2012b). In addition, each public university has its own research ethics committee.

In short, Malaysia has various policies and committees to ensure compliance with regulations and procedures related to the consideration of research ethics. A recent study has suggested, however, that the ethical review process in Malaysia may still fail to provide meaningful protection to mentally incapacitated adults (Kaur, 2010).

## Theme 2: leadership of research in institutions

Research in Malaysia is sponsored and conducted by ministries, universities and public research institutions, as well as by companies in the private sector. In the sections that follow, data from case studies of a representative ministry, university and GRI have been used. The three entities were:

*The Ministry of Higher Education (MoHE)* is one of the key line ministries with the responsibility of managing research and innovation in Malaysia (Appendix D). It manages all the research carried out in public universities. As stated in the *National Higher Education Strategic Plan for 2007-2020* (NHESP), one of the main goals of MoHE is to enhance research and innovation by producing a critical mass of researchers, developing a knowledge corpus and supplying sufficient R&D resources (MoHE, 2007). To achieve this aim, MoHE has established five research universities (RUs),<sup>6</sup> allocated research funds under various grant schemes, established Higher Institution Centres of Excellence (HICoEs), and promoted the commercialisation of R&I products.

*The Universiti Sains Malaysia (USM)* is one of the five RUs. It is also the only university in Malaysia granted Accelerated Programme for Excellence (APEX) status by MoHE (Appendix E). APEX status is given to a Malaysian university that is most likely to attain world-class status based on a given set of criteria. USM has been given the mandate to carry out research in the fields of natural sciences, applied sciences, social sciences, humanities and education, medical and health sciences, pharmaceutical sciences, building sciences, and technology. To date, USM has a total enrolment of approximately 28 000 students in undergraduate and postgraduate programmes across 26 schools and 24 research institutes, centres and units.

*The Malaysia Agriculture Research and Development Institute (MARDI)* is one of 33 GRIs in Malaysia (Appendix G). It is one of the biggest and most established GRIs in the country. Its mandate is a) to conduct research on the production, utilisation and processing of all crops (except rubber, oil palm and cocoa), livestock and food; b) to serve as a centre for collecting and disseminating information and advisory services pertaining to scientific, technical and economic matters related to food, agriculture and agro-based industry; and c) to serve as a centre that provides expert services to food, agriculture and agro-based industry, such as consultancy services, laboratory analysis, quality assurance and contract research and R&D. Currently, MARDI has more than 3 000 staff, of whom more than 500 are research scientists deployed at 32 research stations all over the nation. MARDI research findings have been beneficial to farmers, breeders, entrepreneurs and the private sector, leading to increased yields and quality productions. Its areas of focus are research implementation, development and technology transfer, technology commercialisation, and competency development.

### Awareness of R&I settings

Research leaders at the institutional levels are aware of research trends, funding settings and policy settings, more so at the national level than at the international level. The government has established specific GRIs to focus on research areas of national interest such as agriculture,

fisheries, oil palm, rubber or forestry.<sup>7</sup> Their mission is to boost the Malaysian economy through research and innovation and their research priorities are always aligned with national research priorities because public research funding is allocated on the basis of these priorities. For example, the research priorities of MARDI are food security, agri-technology, climate change and value-added agriculture. On the other hand, the research focus of the universities is more on fundamental research covering a wide range of fields as determined by the Ministry of Higher Education.

The leadership in each research institution has institutional research policies that take into account of the whole ecosystem of research, that is, from research, development and commercialisation to entrepreneurship. MARDI has institutionalised the concepts of “From Farm to Table” and “From Bench to Market”. Every research institution is under pressure to commercialise research outputs so that public funds used for research are accountable. The aim is to commercialise at least 10% of the research outputs. While USM is still trying to achieve this target, MARDI has reached 14.3% in recent years. This has been achieved with the assistance of the CRDF and TAF research funds provided by MOSTI, which help to absorb the risk of investing in new technologies by private companies.

Leaders of research institutions are keenly aware of the national funding landscape. On top of regular block grants for research from the Ministry of Finance, ministries and GRIs work very closely with the Economic Planning Unit (EPU) of the Prime Minister’s Department which commissions research of national interest, such as in the use of nuclear energy, the setting up of rare earth plants, national integration, and other such topics. Universities and GRIs seek contract research from the private sector through their business arms, such as USAINS in USM and MARDITECH in MARDI (see below for more details). However, funding from the private sector to these research institutions could be further improved. The same can be said of international funding. While individual researchers in USM bring in most international research funding, MARDI has developed better institutional mechanisms to seek international funding. These institutional mechanisms include bilateral governmental agreements, memberships of international organisations such as the Asian Vegetable Research and Development Centre (AVRDC) and the International Rice Research Institute (IRRI), and by working with agricultural attachés from various embassies. Networking and the ability to generate international collaborations and funding opportunities definitely represent a skills gap in the management of R&I in Malaysia.

Malaysian universities are also weak in inter-institutional collaboration within the country. Although there are specific research grant schemes, such as RACE, which require inter-university collaboration, Malaysian universities tend to work in silos, partly on account of the increasingly competitive climate among universities. MoHE encourages collaborative inter-university research and the sharing of expensive research facilities and equipment with the aim of each university developing its own specific research niche. MoHE also forms research clusters drawing on expertise from a number of university in order to carry out evidence-based policy research on various aspects of higher education which covers topics related to higher education policy, such as access and equity, lifelong learning, teaching and learning, delivery systems, academic needs and other areas. MARDI forms research teams that include experts

from other research institutes and universities to bid for specific research grants, such as from the Science Fund and TAF.

### **Institutional governance of R&I**

Research advisory committees are common features of many public research institutions. Besides its governing board, MARDI is advised by a scientific council with a membership that includes senior management and representatives from industries, academia, commerce and government officials. MoHE also has an advisory committee to provide guidance to the RUs on the direction of research and policy settings. In USM, there is the USAINS Industry Council (USIC), comprising of representatives from academia and industries, which advises USAINS on industry norms and provides leads to possible contracts and collaborations with the private companies.

### **Strategic planning for R&I**

A common practice among research institutions is strategic planning to establish a broad framework for the development and future operations of the institution. All three case-study institutions have developed some form of strategic plan for R&I.

MoHE has prepared the *National Higher Education Strategic Plan, 2007-2020*. One of its main thrusts is to enhance research and innovation. The objectives of this thrust are “(i) to develop a critical mass of researchers and knowledge corpus capable of elevating Malaysia to the global level of technology creation and innovation; and (ii) to ensure that HEIs acquire sufficient R&D resources to support the national innovation system, which will help the nation to become more competitive” (MoHE, 2007, p.79). To achieve these objectives, the strategies suggested are:

- increase the number researchers to realise a critical mass of 100 RSEs per 10 000 workers
- intensify R&D and commercialisation activities and develop an intellectual property management system in the HEIs to support the national innovation system
- enhance the efficiency of governance in research activities
- ensure that HEIs continue to generate more research funding from within and outside the country
- upgrade the infrastructure, facilities and equipment in HEIs for R&D&C activities (MoHE, 2007, p.80).

The USM was given APEX status by MoHE based on a submission entitled “Transforming Higher Education for a Sustainable Tomorrow” (USM, 2008). This APEX strategy states the university’s commitment to the idea of sustainability within a context of globalisation. and to the use of a blue ocean strategy to help the “bottom billions” to transform their socio-economic well-being. The APEX strategy has been translated into a “Transformation Plan” to guide the implementation process. This will bring about changes at several levels, including “autonomy, accountability, talent management, sustainability and global relevance” (Dzulkifli, 2010). In concrete terms, the university's research priorities are diversity, environmental protection, social justice and cultural dignity; incorporating education for sustainable development into the

curricula of various educational programmes; and making the USM campus green and healthy. Unfortunately, the APEX strategy was a top-down exercise with little input and consultation from internal stakeholders, so it has encountered problems gaining acceptance or an understanding of the vision by both the academic and administrative staff.

MARDITECH, the business arm of MARDI, has come up with various strategies to commercialise MARDI research. These strategies are joint ventures, licensing, technology and business services, and project management (MARDITECH, 2013).

### **Establishing a research culture and ethos**

Leaders in nearly all research institutions have put in place policies to promote and facilitate a research culture among their professional and academic staff. In USM, the Deputy Vice Chancellor for Research and Innovation and her team has institutionalised a research incentive scheme that provides different types of research grants, recognition for research success and monetary rewards to those who publish in high-impact journals. Her office also plays a part in encouraging network development between researchers in USM and external parties, such as research funders, industry and various governmental agencies. Collaborative research among research teams and inter-institutional collaboration are also encouraged. The increasingly active role of her office has seen tremendous progress made in developing the research culture in USM, from one in which only 20% of researchers and academics held research grants to the current situation in which 85% hold them.

In MARDI, internal revenue generated from the sale of agricultural products, royalties and technical licensing are being used to fund short-term research grants for new officers; every officer must have at least one research project. Each research officer is required to spend 70% of their working time on research and the rest of the time on technology transfer. Every officer is also encouraged to publish research findings because publication is one of the criteria for promotion.

The research culture among academics in the non-RUs needs boosting. The same is also true for academics in private higher education institutions. To promote research culture, MoHE has introduced programmes to induct academics in comprehensive universities, including private universities, to a research culture. These “hand holding” and mentoring programmes are spearheaded by the RUs. Many of the newer universities have yet to establish proper codes of conduct and research integrity, especially with regards to plagiarism and corrupt practices in the use of research grants. The senior management of universities should institutionalise policies and procedures to ensure international codes and practices in research integrity.

## Theme 3: R&I management at institutional level

Each of the case study institutions have appropriate management structures in place to support the research leadership. This section considers their executive and supportive structures, as well as the research management and administrative, research commercialisation, research personnel management, research student and research information management structures.

### **Organisational structure**

#### ***Ministerial level***

At the ministerial level, MoHE has three units that handle various aspects of R&D. The Higher Education Department (HED), the Planning and Research Division and the Malaysia Higher Education Leadership Academy (AKEPT).

The HED is responsible for allocating research funds to higher education institutions. It provides both block research grants and competitive research funds through its various research grant schemes. Its management of research funds involves disbursing funds to successful grant applicants and seeking funds from various state agencies such as the Economic Planning Unit in the Prime Minister's Department. Grant applicants are vetted by review panels consisting of experts from universities and other research institutions. Currently, HED is decentralising the vetting process to the respective universities. Similarly, monitoring and evaluation processes for research projects have been devolved to the institutional level.

The Planning and Research Division conducts evidence-based policy research focused on the seven main areas in the NHESP. These are: a) widening access and increasing equity; b) improving the quality of teaching and learning; c) enhancing research and innovation; d) strengthening higher education institutions; e) intensifying internationalisation; f) creating a culture of lifelong learning; and g) reinforcing the delivery systems of MoHE. These are fast-track (rapid-fire) research projects geared towards immediate and urgent policy requirements.

AKEPT was founded in 2008 as an academy for training leadership in the universities. Its training for research and innovation includes short courses in areas such as finance and budget management, human resource management, and the creation of research opportunities and networks. It also addresses opportunities for international collaboration. Besides short courses, it also organises conferences, seminars and workshops on topics such as publications, research leadership, the commercialisation of research, entrepreneurship and personal growth. There is a training programme in the pipeline to certify academics to vet applications for the various research grant schemes.

#### ***University level***

Nearly all the public universities in Malaysia have a Division of Research and Innovation to support the Vice Chancellor in the leadership of research at the institutional level. These divisions are usually led by the Deputy Vice Chancellor for Research and Innovation and consist of a Research Creativity Management Office (RCMO). RCMOs are one-stop centres in the universities that a) formulate policies and create processes for the management of research and

innovation throughout the universities; b) promote a research culture in the campuses; c) generate research opportunities; and d) deploy and manage research projects. The RCMOs in the RUs are more effective than those in the non-RUs, which are lacking in the knowledge and skills needed to manage research projects.

In the case of USM, the RCMO is tasked to streamline the processes of reporting, monitoring and evaluating research projects, and to put in place an information management system for monitoring and evaluation. Its director is assisted by one senior and six other administrators who have responsibility for the Policy, Strategy and Monitoring Unit, the Grant Management and Research Development Unit, and the Fund Management Unit.

Besides the RCMO, USM has established an Innovation and Commercialisation Office. Its primary function is to evaluate the viability and potential of research outputs to be patented or commercialised. This office also handles logistical arrangements for researchers to promote their research outputs at international and national exhibitions. It provides seed funds to assist researchers to translate those products that the exhibitions suggest have commercial potential identified by the exhibitions. The office is headed by a director, a professor, who is assisted by a senior administrator, a patent evaluation officer, a commercialisation/intellectual property officer, three research officers and a designer.

USM also has a holding company by the name of USAINS. It was established in 1998 to function as the corporate arm of the university and to generate revenue for it. One of its major R&I functions is to undertake an active role to commercialise products deriving from the work of researchers in USM. Patents and intellectual property (IP) developed by USM are licensed to USAINS, and USAINS licenses them to industry. This is one way for the university to reduce the risk involved when entering partnerships with industry.

Apart from these centralised offices, USM has also established seven research platforms. A Research Dean, assisted by administrators, leads each research platform. The primary role of the research platforms is to co-ordinate research activities within its area of specialisation. The seven research platforms are: a) biomedical and health sciences; b) clinical sciences; c) engineering and technology; d) fundamental sciences; e) information and communication technology; f) life sciences; and g) social transformation. As the existing role of the research platforms focuses primarily on the administrative functions of monitoring and managing research projects, there are plans in the near future to streamline the seven research platforms into five Centres for Research Initiative (CRIs). Besides consolidating overlapping areas of specialisation, the new setup will shift the administrative responsibilities to the RCMO, and the CRIs will focus on developing the research agenda and its related policies, as well as enhancing national and international collaborations and linkages. This move is intended to plug the knowledge gap of international trends concerning research activity in the various fields, emerging areas of research, international funding settings, and opportunities for inter-institutional research collaboration.

### ***Government research institute level***

The GRIs were established through legislation to carry out research on specific fields of enquiry. For example, MARDI was established in 1969, through the *MARDI ACT* (Act 11), to conduct research and development in the field of food and agriculture. Its organisation consists of a corporate structure at the headquarters and 32 research stations spread throughout the country. The corporate structure has three divisions, a) research, b) technology transfer and commercialisation, and c) operations. The research division has seven research centres that conduct research in food technology, strategic resources, strategic livestock, horticulture, rice and industrial crops, mechanisation and automation, and biotechnology. The technology transfer and commercialisation division has five centres and two units, the technical services centre, the promotion and technology development centre, the economic and technology management research centre, the business development unit, and seed, the planting material and the livestock breed production unit.

In addition, MARDI has a business arm, MARDITECH Corporations, which commercialises technologies and the expertise of MARDI researchers for target clients. MARDITECH's strategy is to facilitate technological innovation and to impart professional management experience (tacit knowledge) in order to develop successful agro-based businesses. Each of the research stations focuses on specific research areas. For example, the research station at Seberang Perai conducts research mainly on paddy.

### **Research management and administration**

Much of the research management and administration at the institutional level involves the disbursement of research funds received from the state as block grants to various schools, research centres, research clusters and individual researchers through competitive bidding within the institutions. At the operational level, research managers have internal as well as external responsibilities. Within the institution, they are responsible for disseminating information about various grant schemes and their criteria for application to internal stakeholders, developing guidelines for grant applications, vetting grant applications, administering research grants, and monitoring and evaluating research projects. Research managers also have to identify both funding and collaborative opportunities and liaise with external granting agencies.

As mentioned earlier, MoHE has devolved much of the vetting of grant applications and the monitoring and evaluation of research projects to the institutional level. However, MoHE carries out an annual research assessment on each of the RUs, based on an instrument known as *Malaysia the Research Assessment (MyRA)*.<sup>8</sup>

At the institutional level, research project leaders are responsible for individual research projects. They form the research team, lead the research, manage the budget, submit progress reports and ensure that the project meets specific deadlines. However, the hiring of contract research staff, the disbursement of research funds, and the procurement of equipment are all handled by the central administration, following institutional rules and regulations. In the universities, research grants are used to procure smaller and cheaper items of equipment,

whereas more expensive equipment and research facilities are provided by the development fund under the various Malaysia Development Plans. The university RCMOs are responsible for the monitoring and evaluation of research processes for research projects. In the case of MARDI, the headquarters audits the regional stations twice a year, and each regional station also monitors and evaluates the implementation and outcomes of each research project.

Unfortunately, monitoring and evaluation of research projects is one of the weaker areas of many of the research institutions in Malaysia. Management of risk is another weak area, although many research project proposals include some form of risk analysis. For example, the financial reporting of research projects commonly lacks any "value management" in the procurement of equipment. On the positive side, many of the more established research institutions have established online information management systems to monitor the progress of each research project (and even each research officer in the case of MARDI). They have established and maintain databases of research funding and contracts and record and analyse performance data such as publications, thesis, patents and intellectual property. However, these kinds of databases are not available in many of the newer universities where the RCMOs act only as a "post office", without adding much value to the process of research management due to lack of capacity of their staff.

### **Commercialisation of R&I**

At all levels and in every research institution, the pressure to commercialise research outputs is intensifying, on the grounds that public funds invested in R&D should be accountable. Malaysia is weak in the area of commercialisation of R&I. Its SMEs are not ready to invest in any new technologies due to the high costs and risks involved while the multinational companies (MNCs) conduct their R&D activities outside Malaysia. That is why the government provides grants such as TAF and CRDF to enhance the capacities and technologies of SMEs by commercialising some of the new technologies and products developed in the local research institutions. The government also provides tax breaks for private companies to do R&D work, as well as loans and venture capital to start-up companies.

Public research institutions have a better success rate than universities in commercialising their research products and outputs. MARDI has a good record, commercialising 14.3% of its products. It has a division for technology transfer and commercialisation that provides technical services and scales up the new technologies it has developed. MARDI collaborates with private companies, undertaking contract research and providing test beds to entrepreneurs. its Entrepreneur Development Programme has involved 200 SMEs, helping them to develop businesses based on agri-technology. MARDI distinguishes between two different types of technology. For "public good" technologies it charges no licence fee, whereas "industrial good" technologies bring in royalties.

Unlike the government research institutes, Malaysian universities are still experimenting with ways to commercialise their services and products. In USM, the two main units involved are USAINS and the Innovation and Commercialisation Office. Both of these units rely on team efforts because no single individual possesses all the knowledge and skills required for the

commercialisation process. It requires business and marketing skills, and understanding of the legal and financial aspects, as well as the subject matter of relevant disciplines. The Innovation and Commercialisation Office has a team that includes a lawyer, a biologist, an engineer and a technologist to work with the academics, and a specialist patent lawyer to process IP applications. *Ad hoc* committees are set up to assess the commercial value of various research products. USAINS helps to commercialise the services and expertise of USM through various marketing strategies, such as registering with ministries to bid for projects in competition with other consultancy firms. USAINS also provides space and facilities to private companies to set up incubators. These efforts have brought about some level of success for USM when compared with other universities, but much needs to be done to change the culture and mind-sets of the academics so as to meet the demand for fast turnaround times from the private sector.

### **Management of research personnel**

Because of the complexity of managing research and innovation, research institutions rely on committees to make decisions and teams to implement the decisions. In the case of MoHE, most staff members are generalists and administrators, so the ministry has to rely on the expertise of researchers and academics from the universities to help in managing research and innovation in general, and in establishing research foresight and vetting research proposals. Much of the high-level policy making is based on decisions and inputs from technical committees and advisors. Inter-ministry co-ordination of the commercialisation of research, especially between MoHE and MOSTI is carried out through joint working boards and joint technical committees.

In USM, the research administrators at both the RCMO and Innovation and Commercialisation Office are recruited from the central pool of university administrators. They usually do not have much experience in managing research and innovation, and they are required to learn the skills related to information management, IP tools and IP management on the job, as well as negotiation and liaison skills.

As for the recruitment of researchers and academics, the universities have no problem in attracting high-calibre young PhD holders because of the recent increase in the salary scheme for new lecturers and a significant increase in the domestic supply of PhDs. However, the situation is quite different in GRIs like MARDI, which hires about 80-100 new recruits annually. Because of the constant change in national research priorities, MARDI has to utilise cross-functional teams and hires according to discipline-based knowledge, such as in breeding, agronomics, pest and disease control, and post-harvest technology. MARDI has a closed-service system and so the rate of staff turnover is very low and it does not have a succession plan for replacing retired leaders. As a result MARDI encounters problems finding high-quality staff. Most of its newly-hired graduates have very narrow and specialised training. They do not possess a sound knowledge of agriculture in general, nor good communication skills in English. MARDI runs a six-month mentoring programme for its new recruits in order to improve their knowledge base and equip them with skills in writing research proposals, data analysis, and presentation skills. Once staff members have been employed by MARDI for three years, they are entitled to apply for financial assistance to do their postgraduate studies.

In terms of capacity building, one of the missions of AKEPT is succession planning through the development of a talent pool of people to replace university leaders. To achieve this mission, AKEPT has established a number of platforms, such as AKEPT Young Researcher Circle (AYRC), AKEPT Young Global Leaders Caucus (AYGLC), AKEPT Young Global Educators Caucus (AYGEC), and AKEPT Young Entrepreneurs Network (AYEN). However, most of the top university leaders in Malaysia are political appointees. Therefore, it is essential that effective processes and procedures are firmly established so that the management of R&I can be carried out in spite of the lack of sweeping leadership change.

### **Management of research students**

Postgraduate education has expanded dramatically in recent years in Malaysian universities. Nearly all the public universities now have postgraduate programmes. At USM, the Institute of Postgraduate Studies (IPS) has been established to manage research students enrolled with the university. Its administrative responsibilities include registering new graduate students, monitoring their progress and setting up viva examination processes. The IPS has databases of all the registered students and completed theses and provides personal support systems and mentoring for postgraduate research students. It provides a number of formal training courses to equip postgraduate students with the relevant knowledge and skills for research. The Postgraduate Academic Support Services (PASS) provides help with statistics and with editing for postgraduate students. Furthermore, PASS also includes the Personal and Professional Development (PPD) programme that focuses on the development of personal skills such as presentation and communication skills, as well as professional skills such as how to write a research proposal and develop a curriculum. In addition, IPS provides training for new lecturers in the supervision of graduate students. It also manages student grants, scholarships and fellowships. A point to note is that the management of research students in the RUs is better than in the non-RUs in Malaysia.

## **Theme 4: Management of R&I at group level**

In both the universities and GRIs, the administration, management and monitoring of R&I are usually carried out centrally, by the central administration of the university, or the headquarters of the GRI. The actual research and innovation activities take place at the research institutes/centres/units and schools in the universities, or the research centres and regional stations in the GRIs. This theme concerns the knowledge and skills required in the management of R&I at the research group level.

USM has a school system instead of the traditional faculty system, which provides an interdisciplinary approach to producing multi-skilled graduates. R&I is a major part of the key performance indicators (KPIs) at the school level. Academic staff and schools are assessed in terms of the number of publications, the number and value of research grants, and whether grants are external or internal. Most of the research grants are obtained through competitive bidding. Administratively, R&I in the schools is led by the Dean and assisted by the Deputy Dean of R&I. Although the organisational structure of all schools is similar, the ways in which and the

extent to which R&I is managed varies according the leadership styles of the deans and deputy deans. While some schools tend to be more *laissez-faire*, there are also schools that tend to be more authoritarian in managing R&I. The *laissez-faire* management style encourages academics and researchers to participate in R&I activities. For example, young researchers are encouraged to seek advice and guidance from more experienced researchers, and experienced researchers are expected to know their responsibilities to conduct research and publish. Conversely, the authoritarian style tends to focus on the number of publications, number of grants and amount of the grants, and to use these statistics as yardsticks to measure the KPIs of academics and researchers. These indicators are being used to compare academics and researchers within a school, creating some form of "peer pressure" to publish and produce. Driven by the culture of auditing and KPIs in many public universities, this authoritarian style is increasingly being adopted at the school level to urge the academics and researchers to apply for grants, conduct research and publish.

Schools have introduced a variety of strategies to increase research productivity and encourage their academic staff to do R&I. For example, some schools organise committees internally to help academic staff with grant applications, as well as organising writing workshops and getting more experienced academics to share their experience of publishing in high-impact journals. In the sciences where laboratory-based research is common, academics are discouraged from taking on graduate students if they do not have a research grant that can support the research of the postgraduate students. Usually, some form of mentoring is provided by more experienced researchers to younger ones, so as to develop the know-how for grant applications and research project management.

USM has 24 research institutes, centres and units that focus on a wide range of research topics. Each of these was established to cater for a particular area of specialisation and is managed and administered in different ways. Of the 24 entities, 2 are recognised by MoHE as Higher Institution Centres of Excellence (HICoEs). One is the Centre of Drug Research (CDR) and the other is the Institute for Research in Molecular Medicine (INFORMM). As HICoEs, these two research institutes receive direct research block grants from MoHE.

CDR is also recognised by the World Health Organization (WHO) as a significant analytical laboratory in the region. Since its establishment in 1979, its research focus has evolved into drug discovery and development, biomedical analysis, epidemiology, behavioural science and, more recently, blood-brain barrier research. Along with this evolution, the needs of researchers have changed. To address this change, CDR recruits new researchers and funds them to pursue doctorates in emerging areas of research. CDR is funded by a wide range of grants from MOSTI, MoHE and companies such as BioTech Corporation, as well as international bodies such as UNICEF and WHO.

INFORMM was the first research institute within a Malaysian university to develop and commercialise a research product. INFORMM brands itself as a fundamental and translation research institute in priority areas of molecular medicine. The centre focuses on rapid diagnostics for typhoid, paratyphoid, cholera, filariasis, tuberculosis, pharmacogenomics and novel therapeutics with the development of personalised medicine, with the long-term goal of

translating research into products and services on neglected diseases for the bottom billions. Apart from the HICoE grant, INFORMM is richly funded by grants from MOSTI, MoHE, the Malaysia Technology Development Corporation (MTDC) and BioTech Corporation, as well as international bodies such as the Islamic Development Bank, WHO and European Union Commission. At INFORMM, there are currently about 100 research students, about 15% of whom are international students. Within a relatively short period of time, the leadership of INFORMM has developed a systematic approach to managing R&I. The institute has been awarded ISO 9100 recognition for the quality of its standard operating procedure for work instruction. Internally, INFORMM has a committee that oversees grant applications and monitors the status of research projects funded. This arrangement ensures that grant applications submitted by INFORMM are of high quality. The arrangement is also a valuable source of mentoring for younger staff, and it gives funding agencies confidence that their funds are being well applied.

## Conclusions

Malaysia has made impressive strides in developing the management of R&I over the past two decades. Gaps remain, however. Funding for R&I is low compared with amounts invested in developed economies, but the GERD/GDP ratio has risen from 0.22% in 1996 to 0.82% in 2008. Malaysia aspires to achieve a ratio of 2.0% by 2020. Most research funding currently comes from the public sector. The private sector needs to be encouraged to play a more active role. Much of the research funding is allocated to applied research, focused on developing new products, processes, services and solutions.

Government granting agencies are being expected to fund projects in areas of high national priority, in which commercialisation is possible. These projects are also expected to address the needs of Malaysian industry, to encourage collaborative effort across research institutes and enhance R&D linkages between the public and private sectors. Despite this, the commercial impact of the research in terms of take-up by Malaysian industries is not all that strong. The commercialisation of R&D is one of the weakest links in the Malaysian research environment. There are challenges in identifying potential research products for patent applications, in overcoming the reluctance of Malaysian companies to invest in R&I, and in achieving flexibility and responsiveness to market demand among researchers. On balance, GRIs seem to perform better than universities in commercialising their research products.

Most public research funds are allocated as block grants, such as the research funds transferred from MoHE to the research universities. More competitive grant schemes would instil transparency and accountability in fund allocation, as well as ensuring quality research aligned with national research priorities. Research institutions in Malaysia are particularly weak in competing internationally for research funds, and they do not engage much in inter-institutional collaboration.

Malaysia still lacks sufficient trained researchers. Although the ratio of RSE per 10 000 members of the workforce has increased from 17.9 in 2006 to 28.5 in 2008, this figure remains

well below the OECD average of 62.7. The national aim is to develop a critical mass of 100 RSE per 10 000 members of the workforce by 2020. To achieve this, STEM education is being reviewed at all levels, postgraduate education is being expanded and more financial aid is being provided to enable higher degree candidates to complete their studies in Malaysia or abroad. Malaysia's performance in the area of publications and patents is poor when compared with developed countries. Much needs to be done to make the management of R&I in the country more effective.

Policy makers should continue to review the national priorities for R&D, to restructure organisational and governance arrangements for R&D in light of national priorities, to refine their research-funding mechanisms, and to appreciate both the opportunities and the threats to nationally significant R&I activity. Institutional leaders should ensure that they are properly acquainted with research trends, policy settings and funding settings so as to be better able to plan strategically and develop the necessary executive and other institutional support mechanisms to progress valuable R&I activities. Research managers and administrators at both the national and the institutional levels need more training in vetting research proposals, and managing finance, staff and assets and need to do more to monitor and evaluate research projects to ensure timely and effective completion.

At the institutional level, it is important to note that this case study has concentrated on data collected from two top research institutions in the country (USM and MARDI) and the findings may not reflect the situation in other government research institutes and universities, especially newly established public universities and private universities where the focus is mostly on teaching rather than on research. Gaps in knowledge and skills can be found at all levels, leadership, management and operational. University leaders may not be aware of research trends, policy settings and funding options both within and outside the country. Usually new universities will lose out to the more established universities in competing for research grants. Although AKEPT has leadership training courses for university personnel, it is barely three years old and so many of the university leaders have not yet had the opportunity to go through these courses. Moreover, AKEPT is still in the process of developing a range of courses to meet the diverse needs of the universities. Nearly all the top leadership posts in public universities are politically appointed and training in R&I management is definitely not a prerequisite for these appointments.

In addition, many of the research management offices in the new universities still have to establish the mechanisms and processes to disburse research funds, vet research projects and monitor and evaluate research projects. Some still have yet to establish an effective information management system to collect data on the research projects going on in their universities. More importantly, these universities have yet to establish a research culture in the campus because many of the academics are either young and inexperienced or retirees from the more established universities. Furthermore, many of them are still in the process of developing their postgraduate study programmes and so their offerings are either limited or of poorer quality. Needless to say, many of their researchers have yet to establish networks locally and internationally.

To conclude, the success of R&I in Malaysia could be further improved if there was less waste of resources and a change in the work ethics of the researchers. Countries with far fewer resources than Malaysia appear to fare better in terms of their research outputs. Thailand, for example, is much better in the agricultural sector; Vietnam is better in the life sciences; and Cuba is better in the medical field. It is the hard work of researchers who make efficient use of their limited resources that results in great strides in R&I. Researchers in Malaysia also need to expand their international networking and improve their writing skills in English so that they can publish in high-impact journals. The use of monetary incentives to encourage researchers to publish in high-impact journals can be quite limiting because, more importantly, the researchers themselves must possess the internal motivation and ambition to excel with their research.

Currently, the balance between basic research and applied research in Malaysia is lopsided. About three-quarters of all research funds are devoted to applied research, and not enough is spent on basic research. Applied research needs to be based on sound and vigorous basic research, no matter the field of study. Although the MoHE provides funds for fundamental research through the FRGS, the allocation and disbursement of these funds could be better managed. More often than not, these funds are managed by administrators, rather than by disciplinary experts. Even where academics from local universities are invited to sit on review panels for grant applications, there are often conflicts of interest between the reviewers and the applicants because of the small number of specialists in the country in some fields of research. Therefore it is essential to include international expertise in the review panels when it comes to emerging fields of research. Furthermore, funding agencies in Malaysia tend either to allocate small amounts of funding to many research projects or give huge amount of funding to just a few projects. Neither approach is very effective because small projects cannot produce a great deal and very big projects are often very difficult to manage. There should be more medium-sized research grants that encourage inter-institutional collaboration. There is much that remains to be done to improve further the management of research and innovation in Malaysia.

## **Comments and recommendations from the workshop**

The following comments and recommendations are the results of a consultative group meeting comprising policy makers from EPU, MoHE and universities held during the workshop on “Effectiveness of Research and Innovation Management at Policy and Institutional Levels” in Kuala Lumpur on 27 Feb – 2 March 2013 (Appendix A).

- It is important to note that Malaysia spends quite a large amount of funds on R&I when compared with other countries in Southeast Asia region (with the exception of Singapore) but the outcomes are far from satisfactory. Malaysia may have good policies but the implementation of these policies needs to be further improved. Moreover there is a large difference in R&I performance between the research universities and the non-research universities.
- One barrier to effective R&I management in Malaysia could lie with the national agenda which focuses very much on economic development, resulting in a heavy emphasis on the commercialisation of research outputs. There is an urgent need to re-conceptualise

the result of research outcomes to include both the “hard” and “soft” innovations, as well as a need to invest in more long-term fundamental research.

- The training needs at the policy level should include:
  - Raising the awareness of policy makers about the broader concept of social returns of R&I.
  - The need to carry out performance audits of research on the higher education institutions.
  - The need to put in place an information management system on the different types of research done and their impacts for both the funders and researchers.
- More immediate follow-up action plans would include:
  - Adopt the typology of knowledge and skills for R&I management to assess the gaps that exist in Malaysian universities.
  - Carry out a study on the social rates of return on R&I in Malaysia.
- Training needs at the institutional level would include:
  - Ministerial officials to gain more exposure to the nature of R&I.
  - Researchers need information on national policy settings, funding opportunities and institutional policy to ensure that they are engaged in relevant research.
  - Training on research proposal writing, project management (financial, asset and staff), monitoring and evaluation of projects, and report writing.
- It is also recommended that a network of national training institutes in the region be established so that there can be regional co-operation in the design of training courses and programmes, and the sharing of various training resources.

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<sup>1</sup> Funds for basic research in Malaysia are directed to research universities through the Fundamental Research Grant Scheme which covers areas such as pure science; applied science; technology and engineering; clinical and health sciences; social sciences, arts and applied arts; natural sciences and national heritage; and information and communication technology.

<sup>2</sup> Funds for applied research are managed by the Ministry of Science, Technology and Innovation through the Science Fund which covers priority areas such as information and communication technology, biotechnology, industry, sea to space, and science and technology core.

<sup>3</sup> These publications are based on international journals indexed by Scopus.

<sup>4</sup> Currently the ratio of science to arts students is roughly 32:68, very much in favour of the humanities.

<sup>5</sup> The aim of TalentCorp is to attract Malaysian experts who are working overseas to return to Malaysia, and also to establish collaborative linkages with the Malaysian diaspora.

<sup>6</sup> Malaysia has 20 public universities, 53 private universities and 6 foreign university branch campuses. Out of the 20 public universities, 5 are designated research universities, including 1 APEX university.

<sup>7</sup> Examples of GRIs are Rubber Research Institute (RRI), Fisheries Research Institute, Palm Oil Research Institute of Malaysia (PORIM), Forest Research Institute of Malaysia (FRIM), Institute of Medical Research (IMR) and others.

<sup>8</sup> The eight assessment criteria of MyRA are: a) quality and quantity of researchers (25%), b) quality and quantity of research (30%), c) quantity of postgraduates (10%), d) quality of postgraduates (5%), e) innovation (10%), f) professional services and gifts (7%), g) networking and linkages (8%), h) physical resources and system (5%).

## **Chapter 6**

# **Case study: the effectiveness of research and innovation management at policy and institutional levels in Thailand**

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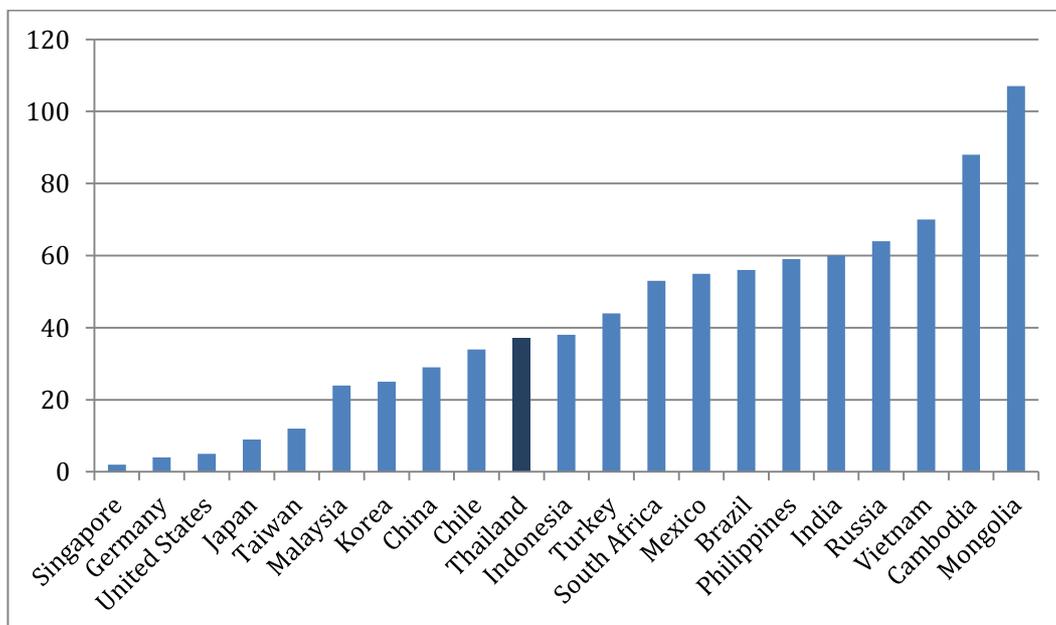
Charas Suwanwela

## Preamble

This country report is based on a review of documents including reports from a number of agencies involved in the country's research and innovation development, articles and documented interviews, together with interviews with eight senior administrators who have had experiences in the management of research. The report is based on the typology of knowledge and skills for effective research management developed for the overall project and described in Chapter 3. Drafts of the report were circulated among the members of the research group for comment and review. The basic goal of the report is to be critical and it looks for gaps or shortcomings rather than achievements. Its ultimate purpose is to contribute to improving the national competitiveness of Thailand in an innovation-driven world. The report is informed by a number of recent studies which provide relevant factual information as well as valuable insights. One is the report entitled *Reforming Thailand's Research System* (Boon-Long, 2012). Others are the OECD's *Review of Innovation System in Southeast Asia, Country Profile 2012* (OECD, 2012), and Spance's (2012) discussion paper, *The Organization and Practice of Research and Development in ASEAN Countries*.

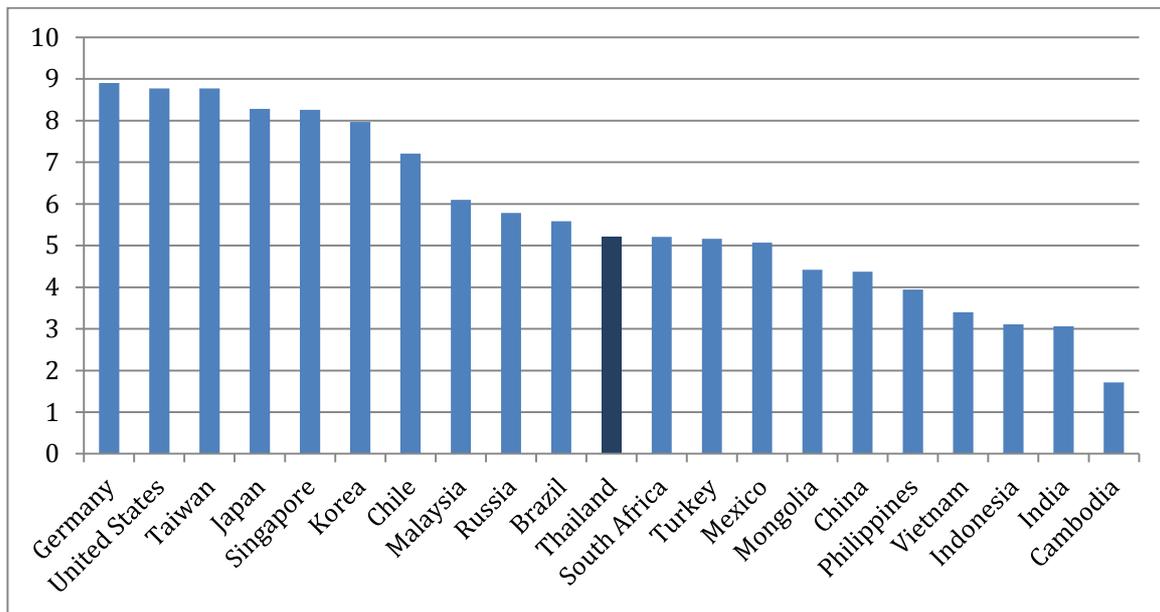
Thailand is a middle-income country in Southeast Asia with a population of 66.8 million in 2012. Its economy ranks third among the Association of Southeast Asian Nations (ASEAN) countries. In 2012, its gross domestic product (GDP) per capita was USD 5 700, compared with USD 51 200 for Singapore, USD 10 300 for Malaysia, USD 1 500 for Vietnam and USD 1 000 for Cambodia.

**Figure 1. Global competitiveness ranking according to the World Economic Forum**



Source: World Economic Forum (2013)

**Figure 2. Knowledge Economy Index (KEI)**



Source: World Bank (2012)

Thailand's gross expenditure on research and development (GERD) as a proportion of GDP is low by international standards. The ratio of GERD to GDP has been holding steady at around 0.25% for at least the past two decades. This ratio is very low when compared with an Asian average of 1.62% in 2009. GERD per capita increased from USD 13.5 in 2001 to USD 18.1 in 2006 compared with USD 1 341.8 for Singapore in 2007, and USD 79.9 for Malaysia in 2006. The proportion of investment on research and development (R&D) coming from the private sector was 36.8% in 2002 and significantly increased to 48.7% in 2005. By comparison it was 59.8% for Singapore in 2007 and 84.7% for Malaysia in 2006.

Previously, almost all funding for R&D came from the government. Most businesses and industries depended on imported technology. Some big industrial companies contracted laboratories in developed countries for their R&D. This situation has changed during the past decade. Big industrial enterprises have started to support R&D in universities and research institutes in the country. It is estimated that in 2010 private expenditure accounted for 38% of national R&D funding. However small and medium-sized enterprises (SMEs) mostly do not participate in R&D activities.

The ratio of basic to applied research is difficult to ascertain because of the mix of budget allocation to various agencies. Basic research projects are carried out both at the universities and at research institutes.

The number of R&D personnel in Thailand was 20 506 in 2005, or 311 per million population. The figures for Singapore were 27 301 and 6 088 per million in 2007, and 9 694 and 372 per million for Malaysia in 2006.

In Thailand, the number of Internet users per hundred people increased from 3.69 in 2000 to 26.5 in 2008.

According to the Knowledge Economy Index, Thailand ranked 66 out of 145 countries, with a score of 5.21, behind Singapore, which ranked 23<sup>rd</sup> (8.26), and Malaysia, which ranked 48<sup>th</sup> (6.1).

Thailand was ranked 42<sup>nd</sup> in the world for publications with a cumulative article output of 41 637 publications for the period 1996-2008. This places Thailand below Singapore, which was ranked 31 with 81 836 publications but ahead of Malaysia which ranked 48<sup>th</sup> with 28 796 publications during the same period. During the period from January 1999 to December 2009, Thailand produced 26 896 scientific papers with 188 759 citations (7.02 citations per paper).

Singapore led in the number of patents registered with the United States Patents and Trademark Office (USPTO), increasing from 274 in 2000 to 540 in 2004, while Thailand increased from 25 in 2000 to 56 in 2006.

## Thailand's national research system

### Structure

The development of scientific research in Thailand can be said to have begun in 1956 with an Act of Parliament that created the National Research Council (NRC). It was during the Cold War, when insurgency was active in Thailand. The government realised the need for national development as a counter-insurgency measure, and thus created three agencies as infrastructures for development: the National Economic Development Council, the National Education Council and the National Research Council. The NRC originally had six sections: physical sciences and mathematics, medical sciences, chemistry and pharmacology, biological sciences, agriculture and forestry, and engineering and industry. Later, social sciences and humanities were added to cover the full range of academic disciplines. Each section had a committee of scientists to allocate the funds provided by the government through the NRC, but these funds represented only a small proportion of the national research budget. Through the years, the NRC has served as the central policy agency for the promotion and management of research. It was also given the task of screening research projects before budget allocation.

Since the establishment of the NRC, many other agencies have been created, in some cases with overlapping functions. In 1963, for example, the Thailand Applied Science Institute was established as a public enterprise for undertaking certain R&D projects. It was changed in 1979 to become the Thailand Institute of Scientific and Technological Research (TISTR), which until now has been working in several areas of R&D for industry. Owing to its small size, however, its activities have been limited.

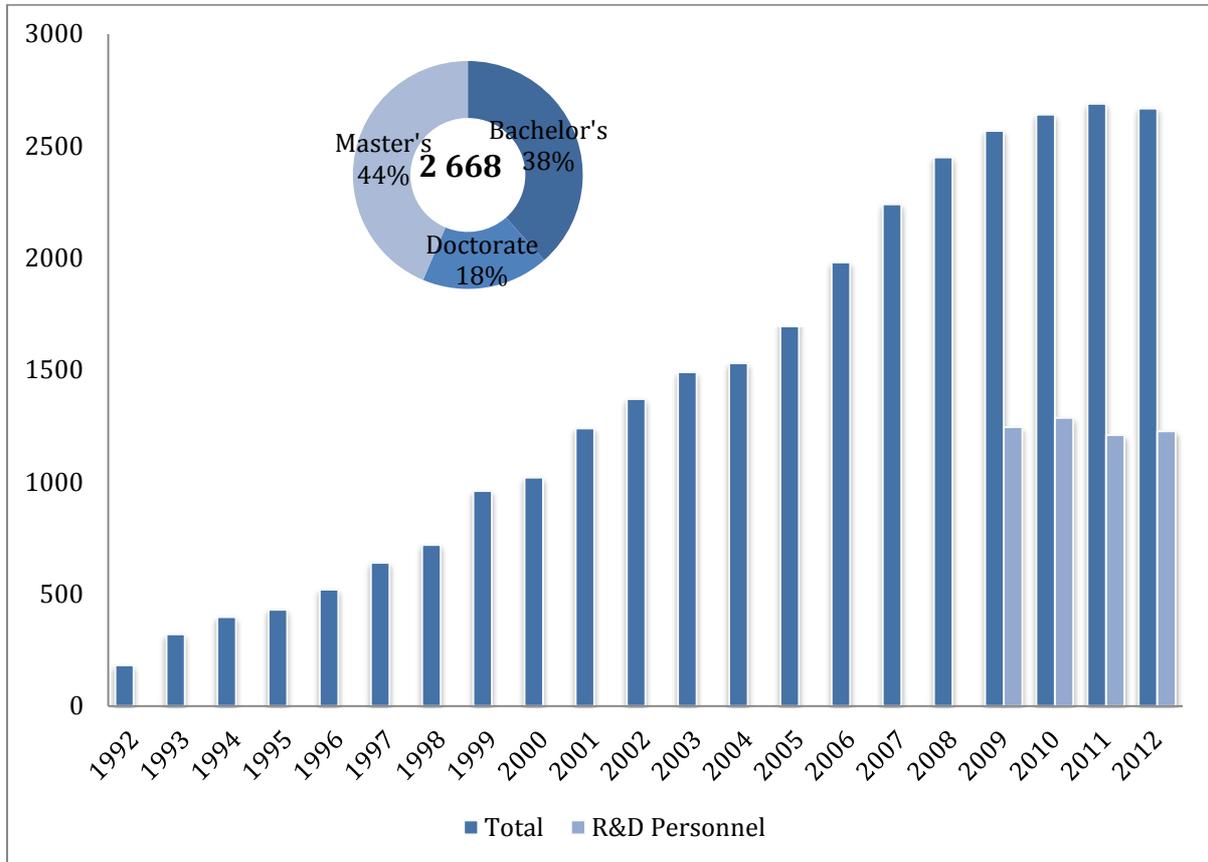
Even though universities in Thailand have been in existence for about 100 years, they were mainly teaching universities. Research became a university mandate only in the past 60 years,

with academic publications included in the consideration of academic ranking. Since then, there have been many strategies regarding research, development and innovation covering research grants, graduate education, centres of excellence, research centres and institutes, and intellectual property management. In 2008, a selected number of universities were designated as National Research Universities and additional funds were given for their accelerated development.

Many departments within ministries have undertaken research as needed, funded directly from the departmental budget. Notably, the Ministry of Agriculture has agricultural, rice and technical departments responsible for much research, development and incremental innovation, as well as many agricultural stations throughout the country that do field testing, extension and outreach work. The ministry is responsible for the country's remarkable agricultural development. For industrial development, Thailand has depended mainly on imported technologies. Indigenous R&D is a recent development, but has been rapidly growing. Some big national corporations, such as Siam Cement Group and PTT Group, have internal research units and support research in universities.

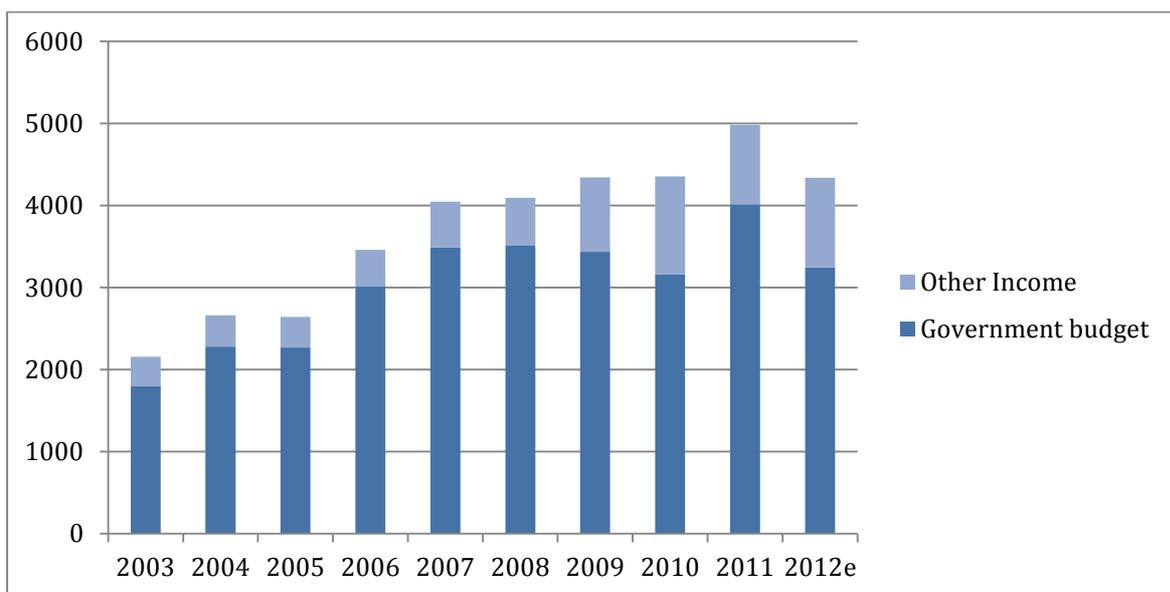
The National Science and Technology Development Agency (NSTDA) was created in 1991 to take over activities started by the Science and Technology Development Board which was set up with a loan from the United States, to emphasise the importance of science and technology in national development. It is an autonomous agency under the Ministry of Science and Technology. Its mandate encompasses four missions: research and development, technology transfer, human resource development and infrastructure development. The NSTDA is responsible for the development and implementation of the *National Science and Technology Plan*, which seeks to keep up with the dynamic surge of the national social and economic condition. The *Strategic Plan Alliance II for 2011-2016* identified strategic clusters of integrated R&D programs in accordance with challenges, to be carried out by NSTDA centres, as well as other agencies. The plan listed agriculture and food, energy and the environment, health and medicine, resources, communities and the underprivileged, and manufacturing and services industries, as critical to the economic and social development of Thailand. The number of NSTDA staff have steadily increased from its beginning in 1991 to reach around 2 500 for the period 2009-12. Of these, more than half were R&D personnel with 18% holding doctorates and 44% master's degrees (Figure 3). Its budget has mainly come from the government (Figure 4). Its outputs in terms of number of publications and number of patents applied for have shown a steady increase (Figure 5).

**Figure 3. NSTDA personnel distribution, 1991-2012**



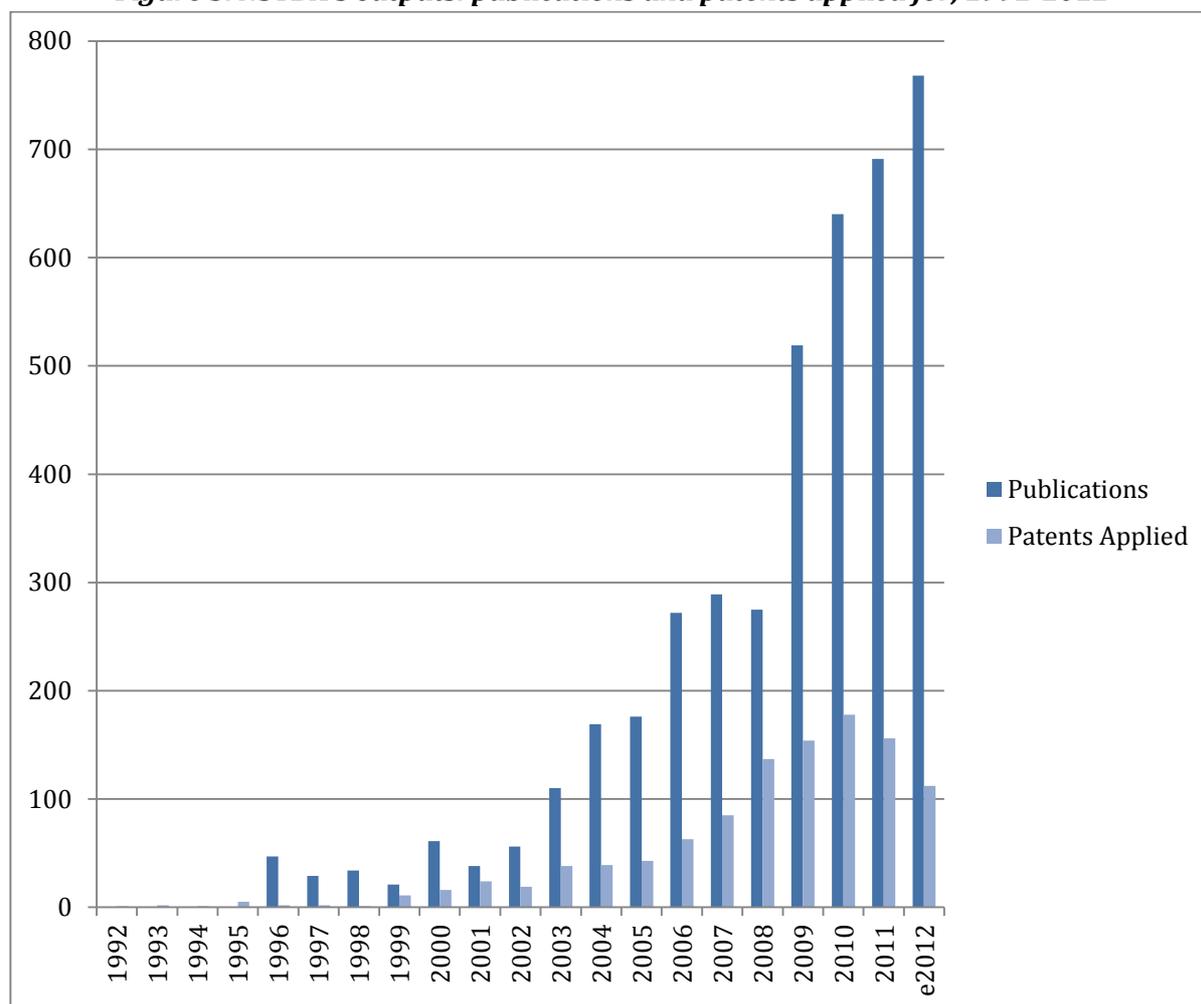
Source: OECD Estimates based on NSTDA (National Science and Technology Development Agency) (2012), *NSTDA at a Glance*, NSTDA, Bangkok.

**Figure 4. NSTDA budget, 2003-12**



Source: OECD estimations based on NSTDA (2012), *NSTDA at a Glance*, NSTDA, Bangkok.

**Figure 5. NSTDA's outputs: publications and patents applied for, 1992-2012**



Source: OECD estimations based on NSTDA (National Science and Technology Development Agency) (2012), *NSTDA at a Glance*, NSTDA, Bangkok.

The NSTDA has a board responsible for policy and four national R&D centres: the National Center for Genetic Engineering and Biotechnology (BIOTEC), the National Metal and Materials Technology Center (MTEC), the National Electronics and Computer Technology Center (NECTEC), and the National Nanotechnology Center (NANOTEC). Each centre serves as the core mechanism for co-ordinating and drafting a national strategic plan in its specific technological field, as a part of the National Economic and Social Development Plan. Laboratories in the centres carry out R&D to serve the country's need for economic development, social harmony and national security. In-house R&D activities at the centres are supplemented by grants for related R&D by external researchers. In addition, the NSTDA Technology Management Center (TMC) serves as a bridge between academic research and the innovation requirements of industry. The Thailand Science Park (TSP) was created under the management of NSTDA in 2002 with the aim to promote private-sector industrial R&D activities. It consisted of 140 000 m<sup>2</sup> of usable space on 80 acres of land, in close proximity to BIOTEC, NECTEC and MTEC, as well as Thammasat University and the Asian Institute of Technology. TSP leases space to suit private R&D requirements, including long-term leasehold land, wet and dry laboratories,

pilot plants and retailing areas. Its first phase was completed in 2007 with leases to over 50 private companies, both Thai and foreign. It is expanding in its second phase, expecting more than 150 companies.

Over the same period, two other agencies also started to broaden the country's research efforts beyond science and technology. One is the Thailand Research Fund (TRF), created by the 1992 Research Endowment Act. TRF is a granting agency, with no in-house research capability of its own. It operates outside the government's bureaucratic system to allow freedom in the promotion and management of research grants to serve the needs of a knowledge-based and wisdom-driven society, both at the national and local levels. It has a broad scope. Its latest strategic research issues include food safety and security, energy, water resource management, education reform, the environment, the economy and the ASEAN Economic Community. Its "Area-based Collaborative Research" aims at strengthening the mechanism of integrated development at community levels. Its R&D grants for niches in the national research efforts aim at encompassing scientific, technological, social and humanistic knowledge. It also provides grants for the promotion of basic research in sciences and social sciences, as well as the humanities. In 1996, the TRF launched the Royal Golden Jubilee PhD Program to address a severe shortage of highly qualified researchers, especially in the field of science and technology. It expected to produce 5 000 PhD graduates in 15 years. The programme was successful and has been continued by the Higher Education Commission.

The second agency is the Health Systems Research Institute (HSRI), an autonomous state agency established in 1992 at about the same time as the TRF and the NSTDA. Its goal is to achieve better knowledge management for the attainment of a more equitable and sustainable health system, and it supports health policy and health system research. The HSRI has been instrumental in the formulation and implementation of a number of national health policies, including the universal coverage of health care and the healthcare services accreditation. It supports both in-house research and provides external grants.

In 2003, as an aftermath of the country's severe economic crisis, the government recognised agriculture as the likely economic driving force for the country's recovery and competitiveness. It also identified a need for more agricultural research to serve accelerated agricultural development. An Agricultural Research Development Agency (ARDA) was created as an autonomous body with an initial endowment fund of THB 3 billion (Thai Baht, approximately USD 100 million). It is stipulated that 60% of its grants for research should be for agriculture with commercial potential, while 30% goes to those projects that might benefit agriculture in general. The remaining 10% is to support policy. Special attention is given to agriculture and agricultural products in SMEs.

Also in 2003, a National Innovation Agency (NIA) was established by the Ministry of Science and Technology as an autonomous public organisation under the supervision and policy guidance of the National Innovation Board. Its objectives include the acceleration of national innovation capacity by providing support for innovation development and the promotion of an innovation culture and awareness at all levels of Thai society. Currently, the NIA is supporting three

strategic areas for innovation development: bio-business, eco-industry, and design and solutions.

In 2008, the government recognised that the country's responses to challenges of competitiveness were fragmented, and its national policies and plans for innovation were inadequate. It promulgated the *National Science, Technology and Innovation Act* of 2008, creating a National Commission chaired by the Prime Minister. An autonomous National Science, Technology and Innovation Office (STI) was made responsible for the formulation of national policy and plans concerning innovation, as well as serving to establish collaborative mechanisms across a range of agencies and between the public and private sectors.

From this historical account, one can see that Thailand's research system has developed haphazardly and as a consequence of whichever vision national policy makers have had at the time. Inadequate structural planning has resulted in an imbalanced, fragmented and redundant structure, with serious gaps in the structure for a real innovation platform and for adequate mechanisms for innovation development. The autonomy given to various agencies, while contributing to their success, has also made co-ordination more difficult. There have been many recommendations to reform the system but weaknesses in the political system have left many of the problems unresolved. These weaknesses include an inadequate commitment to research, development and innovation, as well as frequent changes of government.

## Problems

In 2011, the National Research Council commissioned the Knowledge Network Institute of Thailand (KNIT), a research arm of the Commission of Higher Education, to undertake a study of the research system reform for Thailand (Boon-Long, 2012). Professor Piyawat Boon-Long was the principal investigator, heading a team of 14 leading academics. The study concluded that external pressures and internal weaknesses meant that reform was urgently needed for Thailand's research system. It saw the country as facing many challenges, including globalisation, the transition to the ASEAN Economic Community, and climate change. It envisaged that in the future national competitiveness would rely more on having a knowledge-based economy and society. An effective research, technology and innovation system would be a prerequisite to this. Better preparation for and management of known risks would require effective investment in the generation and utilisation of knowledge.

It classified problems in the research system in Thailand into three groups. First, efficiency problems, including inadequate mechanisms and inappropriate processes in the management and co-ordination of the research system, from policy to strategy, grant management and operation. Second, the mechanisms for the oversight and regulation of research units and projects were inadequate because there were insufficient quality standards. Quality evaluation mechanisms such as peer review were in need of strengthening, and a culture of critical review had not been adequately established. Third, the career structure for researchers was not sufficiently succinct and firm. Incentives for research were not attractive enough, because the

level of compensation for researchers was lower than alternative options in businesses and industries, and the opportunity to be creative was limited by regulations and related practices.

Thailand's national research system appears to be restricted to national concerns, and it has a limited global or regional outlook. While the results of international rankings of universities have led concern in some circles, the national response has been inadequate. Even though the implementation of the ASEAN Economic Community is closely approaching, preparation for regional competition and collaboration among universities appears to be piecemeal. The politics of tradition prevails, and change is difficult to achieve. The structure of the system prevents true development and constrains necessary actions.

## **Complexity**

As has been seen, at the national level, multiple agencies have been created over the past 60 years to promote and manage R&D and innovation. Each agency has a specific mandate, but there are many overlaps and boundaries are vague. Their forms of governance and levels of autonomy vary, as do their strategies and their ability to push for funding. The individual pieces of legislation forming these agencies and different degrees of political support from changing governments are barriers to harmonisation. With each new awareness of problems and fresh political will, new agencies are created on top of existing organisations. Confusion exists about roles and responsibilities. For instance, the NSTDA was established in recognition of the urgent need for national policy, strategies and actions in science and technology in order to serve the country's economic development. Then, when the importance of innovation was recognised, the STI was established with a duty to set a new national innovation policy and plan. There have been many attempts to harmonise the National Research Council, and the five national agencies responsible for the management of the research budget but with limited success. Gaps exist, as well as imbalances, in the national policy, strategies, development and funding, perhaps because of redundant structures.

In the management of research, the demands are much more than the existing capabilities can support. Infrastructure and human resource development have for many years dominated the research and development scene. However, gaps in the scrutiny of granting activities are being closed, and more effective oversight of research processes is beginning to be put in place. Publications, citations and patents have become key performance indicators, but internal quality control and evaluation requires further strengthening. Big gaps exist beyond these outputs to make them marketable and utilised with economic and social impact.

## **Leadership by government**

Theme 1 of the typology covers leadership in research and innovation (R&I) by government (see Chapter 3). This is a complex area and requires changes beyond training to address the gaps in Thailand. These gaps are:

*The lack of strong and sustained national leadership for science and technological innovation.* This gap relates to the political system and requires political reform. Rational policy formulation, implementation and evaluation has to become evidence-based. Policy research on research and innovations needs urgent strengthening. The government needs to recognise universities as an important resource for the country's innovative capacity. While there are clearly social and economic returns for investment in research and innovations in Thailand, especially in the fields of agriculture and medicine, they need to be substantiated in order to convince policy makers and the public.

*Inadequate structural planning.* This has resulted in an imbalanced, fragmented and redundant structure, with serious gaps. There is no real innovation platform and the mechanisms for development are inadequate. Recommendations for reform of the system at the national level should be taken seriously.

*Insufficient co-ordination among agencies.* Mechanisms for effective co-ordination require leadership and skills among top managers. Senior executive training programmes could lead to a broader national perception, encouraging leaders to go beyond their agencies, and improve the skills of top managers for interagency collaboration.

*An inadequate financial support system and inadequate funding mechanisms.* This includes funding, budgeting, investments, promotional incentives and monitoring, especially correction and reform. Training for budget bureau personnel, and Parliament's budget scrutiny and budget supervision commissions would be helpful as they are responsible for budget allocations. This could give them an awareness of the role and importance of research and innovation in national development. The level of funding for research and development, at 0.25% of GDP is, very low. Governments have repeatedly stated their intention to provide more funds for research and development, aiming for a level of 2%. It remains to be seen whether it will ever be achieved.

*Inadequate quality control and assurance.* This includes inadequate incentive systems for quality and relevant research, and for the utilisation of results, as well as an inadequate system for intellectual property management. There is insufficient knowledge and skills among those responsible for the management of research, development and innovation. Many types of training activities would help. There is a large gap between research results and utilisation and commercialisation. Translating research results into marketable products carries high risks, and may require high levels of investment. It also requires a change in mindset among decision makers. They would also need training in intellectual property.

*Inadequate understanding of the innovation process.* This includes awareness and understanding of the essential enabling elements, which has led to gaps in the structure and mechanisms to support innovation. Knowledge and understanding of innovation processes, as well as skills in the nurturing of innovation, require intensive training and development.

*Inadequate private-sector participation.* This is due to gaps in the implementation of already existing incentives and promotional provisions. In order to improve the existing tax incentives

and investment promotion provisions, training regarding knowledge and understanding of the programmes, and skills for effective communication, would help.

## **Chulalongkorn University**

Chulalongkorn University has been selected as a case study of a Thai university. It is the oldest university in Thailand and represents the upper echelon of research universities in Thailand's higher education system.

### **Structure for research administration**

For the first 60 years of its history, Chulalongkorn University, which was founded in 1917, concentrated on teaching. Then, research gradually became more and more prominent. A policy of transforming undergraduate education to learning by inquiry, and a concentration on research-based graduate education, was launched in the early 1970s. In 1980, an Office for Research Affairs was established in the central administration and a Vice President for Research Affairs was appointed. Deputy deans for research affairs were appointed in all faculties. Regular meetings for the planning and management of research started. Research units, centres of excellence and research institutes began to proliferate. Five-year strategic plans for research development were developed collegially, with full consideration given to both external and internal forces.

Since 2007, the university has created research clusters to plan and co-ordinate multidisciplinary research activities in accordance with the country's perceived needs. Senior executive training programmes for vice-presidents and deans have been organised, as well as for deputy deans and heads of department. These programmes were not restricted to research and innovation. Participation in strategic planning and problem-solving meetings have also served to provide administrators with experiential training.

### **Human resource management for research**

Research commitment and achievements now feature prominently in human resource planning and management. Academic promotion, career tenure and remuneration all take account of research capability and performance. The university's autonomous status allows it to determine rules, regulations and guidelines for academic staff management that permit active and productive researchers to climb the academic career ladder more rapidly, and to acquire financial benefits as a consequence of their research productivity. Individual staff members get a large proportion of any financial returns from the exploitation of their intellectual property and from patents. They are also recognised and rewarded for quality research outputs such as publications and citations.

### **Research programme planning and management**

Senior administrators at the university are well aware of research trends, policy settings and funding opportunities for research, both within and outside Thailand. Thailand is still

establishing legislation and restrictions on and requirements for some types of research activity, but the university is contributing to their development and its administrators and major researchers are well aware of them. Researchers at large, however, have different levels of awareness. The implementation of financial auditing, compliance, and performance reporting needs more rigour and scrutiny although the requirements are understood. The university exercises its autonomy by having committees responsible for formulating research policy, mechanisms and for implementing research evaluations.

Strategic planning for research and innovation has been in operation for many years, but the rigour of its implementation varies. Even though the university has been working towards becoming a significant research institution for the past 30 years, it will take more time for it to fully establish a real research culture and ethos. Its risk management processes concerning research and its products have only been initiated during the past four years and are still limited. It has had a goal of university-industry collaboration for several years, but this remains largely at the policy level, with not many significant instances of implementation. Collaboration would require different mindsets and expectations from both sides – academics aim at excellence and perfection, while industrialists base decisions on utility and profits. The university would have to build trust with private sector over its ability to deliver in a timely fashion and the quality of its research outputs.

The university has increasingly active channels for communication internally and with external stakeholders, as well as with the public at large, with a special office responsible for this area. The efforts of this office appear, however, to lag behind the rapid rate of change and the growth in new opportunities. The University has a popular radio station, for instance, with a capacity for broadcasting programmes over the Internet, but now it must look at the prospect of having to develop a multimedia television station.

Chulalongkorn University has had a Research Equipment Center since 1975 to support large-scale research requiring expensive research equipment in addition to that provided by faculties and departments. Free online access to licensed databases is also available for staff and students. The university's Academic Resource Center keeps databases of completed theses and seeks to provide access to global knowledge networks.

## **Research funding**

During the fiscal year beginning October 2009, expenditure for research (excluding personnel expenses) amounted to THB 1 377 million (approximately USD 45 million), or 15.2% of the total university expenditure. Of the funds allocated to research, 83% (THB 1 145 million) came from outside the university in the form of grants and contracts. Leaders need broad-based and up-to-date information about the opportunities and regulatory requirements for grants as the funding scene both nationally and internationally is so complex and dynamic. The university does not currently fully exploit global and international sources of research funding. Staff would benefit from training in proposal writing, costing and budgeting, as well as in negotiation skills.

Since 2004, Chulalongkorn University has been designated by the government as a National Research University, and as such is entitled to access a special grant for infrastructure investments and for the operation of research programmes. It also receives additional funding from the "Strong Thailand" scheme to develop R&D infrastructure and management.

### **International collaboration**

As of 2010, Chulalongkorn University had collaborative agreements with over 500 institutions in 44 countries and 57 international agencies. There were also many research collaborations and joint research projects, but there are still many more opportunities to be exploited. The university should pay more attention to overcoming barriers to staff understanding of the rules, regulations and collaborative practices. Staff also need and better-developed skills in the management of international research collaborations.

### **Research commercialisation**

In 1992, the university created an Intellectual Property Institute that sits under the Chulalongkorn University Intellectual Property Foundation. The institute is responsible for applications for patents and administering patents, licenses and joint-venture agreements concerning innovations created in the university. It also periodically provides training for research managers and researchers in IP management. An innovation holding company was established to oversee a number of joint venture initiatives. There have been successes and failures. Some university academics have been found to possess a strong entrepreneurial mentality, though they are a minority. For example, a computer-engineering graduate and his friends pooled a few million baht to fund the establishment of a small software company. It remained stagnant for a few years, but then was changed into a joint venture with a furniture company, creating a THB 80 million enterprise with credit loan from banks. Now the company is listed on the Thailand Stock Exchange and is thriving. This example illustrates how many computer-engineering students form companies but it remains to be seen how widely this process can be spread to other fields. Mechanisms to support university-industry linkages remain at a conceptual level, or are implemented on a grant-by-grant basis. Truly collaborative ventures need further exploration to suit the local conditions and culture. Researchers, inventors, engineers, manufacturers, marketing experts and investors, as well as users, all have different points of view which need to be distinguished, and a culture of teamwork needs to be developed.

### **Research students**

During the 2010-2011 academic year, there were 39 533 students enrolled at Chulalongkorn University, 14 755 at graduate levels and 2 540 at doctoral level. Of the doctorate students, 1 021 were in sciences and technologies, 902 in social sciences, 449 in health sciences and 168 in humanities. Individual academic faculties are responsible for the curriculum, learning experiences and dissertations produced by these students, while a central Graduate College oversees quality control, including regulations, protocols and ethical guidelines. Recently, the Graduate College has been promoting mechanisms to curb plagiarism. The university has a fund

to provide scholarships for doctoral students, as well as to support teaching and research assistantships for master-degree students.

### **Gaps at Chulalongkorn University**

There are a number of gaps in both institutional leadership and research management in Chulalongkorn University. Research and development is fairly well addressed, but innovations need more emphasis. Frequent changes in administrators mean that the skills for the implementation of strategies need to be constantly developed. Research management training must be an on-going activity. There needs to be a concerted effort to develop the rules, and guidelines for good research practice that are appropriate for the local conditions. International collaboration could be further strengthened with new knowledge and skills. A big gap exists in relation to the scaling up of research and innovation to a commercial level, as well as in marketing and entrepreneurial activities. In particular these gaps include:

- Inadequate breadth and depth of knowledge regarding the sources of fund for research, development and innovations, both inside and outside the country, as well as weaknesses in skills to access and exploit them. Addressing this gap would enhance the productivity of the research resources within the university, and enhance research outputs and outcomes.
- University staff do not have the knowledge and skills needed to commercialise research results and innovations, particularly about the steps to take, regulatory barriers and the investment in the process that is needed. More collaboration with outside agencies, both private and public, would expand the activities of the university. Better co-operative efforts would mean that businesses could contribute much more to the activities of the university.
- University staff lack the skills to recognise the marketability of products from research, and whether innovative processes might be patentable. Many processes are either published in academic journals, or even left unpublished. Developing the entrepreneurial skills of academic staff and students would be helpful, and could be done through collaboration with private businesses.
- Improved skills in writing grant proposals for a variety of different research funders would enhance the university's research, development and innovation efforts.
- Improved skills in writing research reports would make the university's research output more widely available, especially if they were written in English for international distribution. Many research results are reported in Thai and in national journals, even though they would have been suitable for international publication.
- Researchers lack the skills to transform routine work into research. A lot of innovations emerge from routine academic work and services, and could add to the university's

research output. Innovations from case studies and success stories are often not properly documented.

The extent of these gaps would, of course, be even greater in the case of less research-intensive universities in Thailand. In general, there needs to be more recognition of research management as a required set of knowledge and skills, and the need for training. Formation of an association or grouping of research leaders and managers might be helpful.

## **National Metal and Materials Technology Center**

The National Metal and Materials Technology Center (MTEC) of the National Science and Technology Development Agency has been in operation for 21 years and has gone through many review phases. The following analysis focuses on the current stage of its operations. This research institution would be among the most developed of its type in Thailand.

### **Structure and scope**

MTEC consists of nine research units covering a wide range of research interests, from ceramics to polymers and biomedical materials. The scope of the research that is undertaken ranges from basic research on metals and materials to design, engineering and material characterisation. The director of the centre is a distinguished researcher who also has well-developed administrative experience. The director was appointed after a nationwide search and the appointment was based on merit, with no political interference. MTEC employs many PhD-qualified scientists, some of whom have worked abroad. They are all very well equipped with research skills. Formal and informal on-the-job training is provided, and scholarships are provided to support advanced training in Thailand as well as abroad. There is a career structure provided for researchers, who also participate in the planning of research projects and who are well informed about research trends. The career structure for researchers was developed by the NSTDA and has, over the years, been adjusted to suit the needs of the researchers. The facilities, information and communication technology (ICT) infrastructure and environment, as well as the system for intellectual property management, are all very well organised. Legal frameworks, tax incentives, industrial promotion incentives, joint ventures and exploratory initiatives are available. The management system for science, technology and innovations is satisfactory, especially for the initiation and support of research development and innovation, including the monitoring of progress.

MTEC has a number of active international collaborations with private corporations, public R&D agencies, universities, and multinational agencies. Collaborative research programmes, technology transfers and staff exchanges have helped it keep up with advanced trends, and to disseminate research results.

The government is the main financial supporter of the centre. Its budget has been adequate to date. Expenditure of the budget is subject to satisfactory scrutiny, mainly by internal mechanisms. However further expansion would probably require an external source of funds. It

would be useful for centre staff to have training in the preparation of research protocols and other aspects of seeking competitive funds. There is a big gap between research outputs and innovation and their commercial exploitation. There is inadequate awareness and recognition of the complexity of this part of the chain. Politicians and policy makers do not generally recognise the high risk of failure. The centre has a management scheme for scaling up innovations under the NSTDA. It provides a start-up fund, granted for an initial three years. Success so far has, however, been limited. There needs to be further development of the knowledge and skills needed to manage commercialisation, as well as more broadly on entrepreneurship.

MTEC has a specific mandate for research, development and innovation in metals and materials, an area of high strategic importance for Thailand. It is an organisation that has very well-developed mechanisms for enhancing its infrastructure, developing its human resources, and obtaining grants. Its operational system provides it with a good deal of flexibility in terms of programme implementation. However its mechanisms for quality control of outputs and for the evaluation of commercial potential of innovations require further strengthening.

MTEC generally satisfies the need identified by Theme 4 regarding the development of researchers seeking to play a leadership role. The centre recognises that training is important, and that it needs to be ongoing and focused on the complex relationship of research and innovation. Researchers do need better training in quality assurance and techniques for the commercialisation of innovations.

### **Gaps at the National Metal and Materials Technology Center**

In general, gaps at National Metal and Materials Technology Center are similar to those at Chulalongkorn University but to varying degrees.

- Attempts are being made to translate R&D results into marketable products, but with limited success. Staff have inadequate knowledge and skills to scale up research results and innovations, including not knowing what steps to take, nor understanding the necessary infrastructure and investment needed in the process. The centre would benefit from better knowledge and skills in the strategic management of intellectual property, including licensing, incubation, start-ups, joint ventures, and other commercial alternatives.
- MTEC lacks sufficient breadth and depth of knowledge about sources of funding for research, development and innovations, whether private or public. It also lacks adequate skills to access and exploit them. Addressing this would enhance the productivity of the research resources within the centre, and enhance output and outcome. Skills in writing proposals for research grants from different sources could be improved and should also enhance its research, development and innovation efforts.
- Improved skills in communicating and disseminating research results, especially for lay business and industrial entrepreneurs, would enable the centre's research outputs to be more readily exploited.

- MTEC lacks the knowledge and skills needed to transform routine consultancy services into research and innovation. A lot of knowledge and innovations can emerge from problem-solving consultancy and services but case studies and success stories are not fully exploited to create research initiatives.

## Discussion

Thailand, as a developing country that has long recognised the need for research in support of national development. For many years it has been developing its universities and research institutes, but with inadequate financial and human resources, and with inappropriate structures and mechanisms. Although the higher education system started about a century ago, its research function came late, starting with the creation of the National Research Council in 1956. Inadequate structural planning has resulted in an unbalanced, fragmented and redundant structure. There are serious gaps in the country's innovation platform and a lack of adequate mechanisms for innovation development. Spending on R&D is low compared with international statistics and very low when compared with developed and other emerging Asian countries. Private-sector investment in R&D is also very low. While the shortage of R&D personnel in Thailand is recognised as a problem, it will take a long time to remedy.

Thailand needs to reform its research system if it is to meet the challenges of a more competitive world and if research, development and innovation are to play their part in national competitiveness. It also needs to improve the quality of its research management. Senior executive programmes for high-level policy makers would improve policy formulation and implementation, including financing and human resources development. These should place particular emphasis on the sources of funding and how to mobilise them. Even though granting agencies, universities and research centres have developed their research managers, middle managers still need additional training to enable them to take on a broader range of functions, including funding mobilisation and quality measures. Improving the quality of research processes and outputs will require standards and appropriate flexibility. Quality evaluation of research results and innovations, both by peer review and by other stakeholders, must be strengthened. The need for training of research managers must, therefore, be recognised and actively pursued. It is also crucial to offer researchers a career structure.

Scaling up and commercialising research results and innovations is complex, involving many steps. It needs supporting infrastructure and investment in the process. Training would improve knowledge and skills in the strategic management of the utilisation and marketing of innovations as well as intellectual property matters, including licensing, incubation, start-ups, joint ventures, and other commercial alternatives. Collaborations between universities and industry and between individual academics and entrepreneurs collaboration would benefit from sensitive development.

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# **Chapter 7**

## **Case study: the effectiveness of research and innovation management at policy and institutional levels in Vietnam**

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Pham Thi Ly

## Preamble

Vietnam is one of South East Asia's fastest-growing economies.<sup>1</sup> It has experienced consistently high annual rates of economic growth during the past two decades which have helped to raise living standards and have enabled the more rapid development of infrastructure. The World Bank now classifies Vietnam as a "lower middle-income" economy. Measured in terms of purchasing power parity, its gross national income per capita in 2011 was USD 3 260, which was higher than Cambodia's (USD 2 260), but lower than Thailand's (USD 8 390) or Malaysia's (USD 15 190) (World Bank, 2012). According to the World Economic Forum's *Global Competitiveness Reports* (2012), Vietnam is making significant economic progress because of its efficient labour market, its impressive innovation potential given its stage of development and its large internal market – it has a population of about 90 million. It is also rapidly developing a strong export sector. Economic progress is constrained, however, by inflationary pressures with inflation reaching almost 20% in 2011, an excessively restrictive regulatory environment, restraints on the freedom of international trade, and the poor quality of the country's capital infrastructure, particularly its roads and ports. It also has low education enrolment rates at the upper secondary and tertiary levels, and corruption is described as being "frequent and pervasive" (World Economic Forum, 2012). Like Cambodia, its economy is factor-driven, that is, reliant mainly on low-skilled labour and natural resources.

The Communist Party of Vietnam is constitutionally "the force leading the State and Society" (Article 4 of Vietnam's Constitution of 1992, as revised in 2001). The constitution also makes explicit reference to the development of science and technology as "a primary national policy", playing "a key role in the country's socio-economic development" (Article 37). Resolutions approved at Party Congresses, held at five-year intervals, express national priorities and provide guidance to the government. Ever since 1986, these congresses have affirmed the national importance of the development of science and technology. Party Congress VI (1986), for example, identified science and technology as being a key momentum to progress the comprehensive renovation of the nation. Party Congress VII (1991) confirmed that science and technology were the foundation of industrialisation and modernisation. Party Congress VIII (1996) and Party Congress IX (2001) considered science and technology as the top national priorities and the foundation of industrialisation and modernisation. Party Congress X (2006) emphasised the important role and momentum of science and technology in a knowledge-based economy. Party Congress XI (2011) opened pathways to promote the capacity of science and technology in playing a key role in the modernisation of national production and in achieving the fast and sustainable development of the country. Most recently, *Resolution No.20-NQ/TW*, dated November 1, 2012, "On the development of science and technology to serve industrialization and modernization country under conditions of socialist orientated market economy and the international integration", identified the reasons for weaknesses in scientific research activities, namely leaders' insufficient awareness, inadequate investment, lack of effective policy development and monitoring mechanisms, loose connections between state agencies, and so on.

Indeed, Vietnam's performance in scientific research and technological development has been unspectacular. Compared with neighbours such as Thailand and Malaysia, Vietnam lags a long

way behind in all areas of research and innovation. Vietnam's research and innovation capacity is limited by various factors, including:

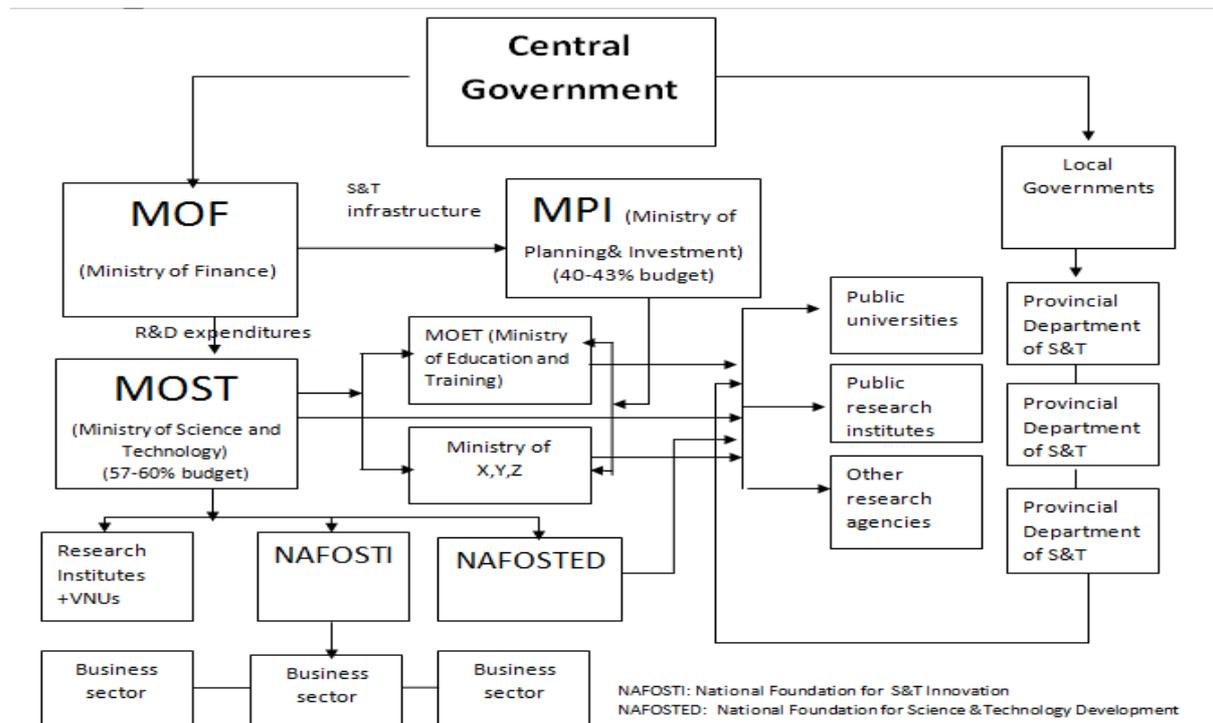
- The relatively small proportion of university lecturers who are qualified at PhD level – only 14.4% of all higher education lecturers in Vietnam have doctorates.<sup>2</sup>
- The bureaucratically fragmented and cumbersome mechanisms used to allocate research funds.
- The fragmented provision of research services – by 2011, Vietnam had more than 1 600 science and technology research institutes and centres, nearly all of them quite small and unconnected to any national co-ordinating body.
- A shortage of world-class scientists – according to the Ministry of Science and Technology (MOST), Vietnam has a shortage of talented scientists who are able to head large international or even national research projects.
- Lack of co-operation between leading scientists in research institutes and universities.
- Continued separation between research and teaching – which has led to a waste of resources and limited the training quality in universities and research institutes.

There are various laws that relate to science and technology in Vietnam. These include the *Law of Science and Technology 2000*, which provides a legislative foundation for the public support of research and innovation in Vietnam. There is also the *Law of Intellectual Property* (revised in 2009), the *Law of Technology Transfer 2006*, the *Law of Standards and Technical Regulations 2006*, the *Law of Product and Goods Quality 2007*, the *Law of Nuclear Power 2008*, the *Law of Hi-Tech 2008*, and the *Law of Measures 2011*. Recent important additional documents include the Party's Central Committee *Resolution on the Development of Science and Technology for serving the Industrialization, Modernization and Global Integration (Resolution No. 20-NQ/TW, Nov 2012)*, the *Strategic Plan for the Development of Science and Technology 2011-2020*, the draft revision of the *Law of Science and Technology* (to be submitted to the National Assembly for approval on May, 2013), and a Ministry of Science and Technology (MOST) *Proposal for the Development of Science and Technology, serving the Industrialization, Modernization, and Global Integration, 2012*.

Budget allocation arrangements for research and innovation in Vietnam are complex and bureaucratic. Although the Ministry of Science and Technology (MOST) is designated as the governmental agency responsible for research and innovation, the Ministry of Planning and Investment (MPI) and the Ministry of Finance (MOF) both play additional important roles because of their shared responsibilities for allocating the national budget for scientific and technological research. Two other ministries, the Ministry of Education and Training (MOET) and the Ministry of Internal Affairs (MOIA), also play a role, as do the 58 provincial and 5 municipal governments across Vietnam. Currently, about 2% of the state budget is allocated to science and technology – about USD 650 million. MOST manages 57% to 60% of this budget (Figure 1). The balance is independently managed by MPI, which allocates funds directly for infrastructure investment. MOST's share of the budget is heavily committed: by agreement with MOF, it must allocate funds to other ministries for expenditure on salaries for research staff members as well as for the support of ministry-supported research institutes and centres. MOET, for example, which has responsibility for 54 universities and colleges, receives its

research budget in this way.<sup>3</sup> It then allocates a research budget to the universities and colleges for which it is responsible. Though MOST is held accountable for expenditure of the state budget on science and technology, it is left with only about 10% of that budget to allocate in support of national research and innovation initiatives.

**Figure 1. Funding of research in Vietnam**



The effects of this form of budgeting are readily apparent. The lack of a single co-ordinating authority and the way funds are dispersed across so many ministries and local governments means that accountability processes for the expenditure of the national science and technology budget on national priorities are weak. Funds not spent on scientific and technological research are routinely reallocated for use on other priorities, particularly at the provincial and municipal level. Unspent funds are also routinely refunded to the state. In 2007, for example, MOST refunded USD 6.25 million to the state, rising to USD 16 million in 2011.<sup>4</sup> This situation has occurred repeatedly over recent years. According to the MOF, annual financial plans for science and technology are normally later than other expenditure plans, which leads to the slow budget allocation. In addition, in some cases research organisations are not ready to spend the budget they are allocated and government agencies have to wait for substitutions of research projects. Some provincial and municipal governments are unable to spend their budgets within a fiscal year, as required, and they are not allowed to carry forward unspent balances to the following year.<sup>5</sup> This kind of rigidity is maintained from year to year, despite protests, and nothing appears to change.<sup>6</sup>

There are also anomalies in the patterns of allocation of research funds to different kinds of institutions. According to a former rector of the National Economics University, Prof. Le Du

Phong, the Hanoi University of Science and Technology, which is a "key" university with a significant record of research achievement, received a research budget of only USD 875 000 in 2011-12, whereas the General Labour Union of Vietnam, which is not a research agency, received a research budget of about USD 1 million. Similarly, the General Shipping Corporation of Vietnam, a state-owned business enterprise, received more for research (USD 650 000) than many large key universities, including the Hanoi University of Agriculture (USD 590 000).<sup>7</sup>

Vietnam clearly lags behind other countries in region in research funding. Nguyen and Pham (2011) report that investment in science and technology (S&T) development in Vietnam in 2006 was USD 428 million, or 0.17% of GDP. In 2012 the figure increased to USD 650 million, or 0.27% of GDP. Though this proportion was higher than for Indonesia (0.05% of GDP) or the Philippines (0.12% of GDP), it was much lower than for Thailand (0.3% of GDP or USD 1.79 billion), Malaysia (0.5% of GDP or USD 1.54 billion) or Singapore (2.2% of GDP or about USD 3 billion). In terms of returns on investment, Vietnam produced eight publications in international peer reviewed journals per million dollars (US) of investment. This productivity rate is the same as Thailand and Indonesia, and a little higher than Malaysia, but it is much lower than Singapore (13 publications per million dollars (US) of investment)<sup>8</sup>. Ca and Hung (2008) report that in universities in Vietnam the majority of funding comes from international sources. One of the ambitious aims of *Resolution 14/2005* was to increase funds generated by scientific research and related services to 25% of total higher education revenue by 2020. Given the fact that revenue generated by scientific research in universities counts for only 3.4% at present, it seems this ambition has been set without any strong evidence base (Wilkinson and Chirot, 2010).

With regard to the research funding, in an interview dated Sept 23, 2012, MOST's Minister, Nguyen Quan, has stated: "The most challenge is [that] the majority of research funding is from the State budget. In developed countries, non-state budget accounts for a large number, usually 3-5 fold, or even 10-fold, but in Vietnam, 70% from the State budget whereas only 30% from the private sector".<sup>9</sup> He also expressed concern that "although the budget is limited, almost half of its allocation is often misused or mis-managed". In addition, research funding and financial procedures in Vietnam remain largely rigid, as it takes around more than one year to receive a research budget. Former minister of MOST, Dang Huu, said: "Such a bureaucratic mechanism and rigid financial procedure generally makes researchers unhappy. Everything must be planned and registered in advance resulting in a blockage of creativity".<sup>10</sup>

Public funding of science and technology in Vietnam is slowly increasing as a proportion of GDP, from 2001-05, it accounted for 0.53% of GDP, and from 2006-10 it accounted for 0.67%. Private investment expenditure on science and technology is much more limited – around 30% of public expenditure. As a consequence of recent increases in the state budget for science and technology, the value of government-funded research projects has increased. At the same time, the number of sub-projects designated by the state has also increased, so there never seems to be sufficient funds to achieve significant research outcomes. Furthermore, research funds are contingent on compliance with detailed expenditure guidelines and financial accountability mechanisms, with researchers expected to collect and provide all official invoices (known as "red" invoices) if they want to complete their research, however small the amount. Indeed, the state agencies responsible for research are often seen as paying more attention to strict

adherence to financial procedures than to the research outcomes. It is not uncommon for researchers to complain that the system of public funding of research in Vietnam is rigid and over-regulated.<sup>11</sup>

The future looks more promising. The government plans to increase public expenditure on science and technology. It intends to achieve a level of 1% of GDP over the period from 2013 to 2015, rising to 1.5% to 1.7% over the period from 2016 to 2020. A draft version of the revised *Law of Science and Technology* proposes more reliance on competition to distribute research grants and a more restrictive approach to the provision of research funds. Institutions will be favoured if they can demonstrate that they are capable of doing research and achieving technology transfer, or that they can effectively administer significant research funding packages. This is likely to benefit organisations such as the National Foundation for Science and Technology Development and the National Foundation for Technology Innovation. In addition, business enterprises are being strongly encouraged to participate in research and innovation by being given land leases as well as credit loans from the Development Bank of Vietnam. They may also be permitted to make use of high-tech equipment available from national key labs and incubation hubs. It is also proposed that business enterprises should reserve a certain proportion of their budget for research and innovation. The concern here, though, is that most business enterprises in Vietnam are small to medium in size, and will have only modest funds available to support research and innovation are likely to be modest.

Although the draft *Law of Science and Technology of 2012* appears more advanced than the *Law of Science and Technology of 2000*, four ministries will continue to be responsible for science and technology. MOST is primarily in charge of the state management of science and technology across Vietnam. MPI is in charge of planning and submitting financial expenditure in line with recommendations from MOST, as well as having a voice in approving investments in infrastructure of science and technology. MOF is in charge of proposing and submitting financial expenditures for science and technology on the basis of recommendations from MOST on the structure and ratios of the state budget for science and technology. MOIA develops personnel plans for science and technology in co-ordination with MOST. Other ministries, and all provincial and municipal governments, must co-ordinate with MOST in developing and implementing their research plans. The absence of a single co-ordinating body is evident.

The effects of low levels of funding and high levels of regulatory control may be seen in Vietnam's relatively lacklustre research performance over the past decade. Table 1 shows the number and rate of growth of scientific publications from the period 1991-2000 to the period 2001-2010 across ten ASEAN member countries. Vietnam consistently lagged well behind Singapore, Malaysia and Thailand, although during the past decade it has moved ahead of Indonesia and the Philippines in terms of total number of publications. In terms of global competitiveness, Vietnam's research and innovation capacity remains quite restricted. For example, Pham D. Hien (2010) estimates that the total number of publications from Vietnam in peer-reviewed journals in 2004 (403 articles) was less than the total number from just one university in Thailand (Mahidol University with 465 articles).

Vietnam's areas of strength have been mainly confined to mathematics and the sciences. Emerging fields of research are astronomy, biomedicine, environmental sciences, ocean, nano-chemistry and nuclear power. Areas emerging as being important from the point of view of technology transfer include agriculture, forestry, fisheries, natural resources, environmental management, information technology, transportation, construction and health.

**Table 1. Publications by ASEAN countries**

<b>Country</b>	<b>1991-2000</b>	<b>2001-2010</b>	<b>Rate of increase</b>
<b>Vietnam</b>	2 398	8 220	3.43
<b>Cambodia</b>	97	880	9.07
<b>Laos</b>	41	375	9.15
<b>Thailand</b>	6 673	28 148	4.22
<b>Myanmar</b>	189	546	2.89
<b>Malaysia</b>	5 366	21 203	3.95
<b>Indonesia</b>	2 638	5784	2.19
<b>Brunei</b>	210	345	1.64
<b>Philippines</b>	2 630	4 956	1.88
<b>Singapore</b>	18 220	56 101	3.07
<b>Total</b>	38 462	126 558	3.29

Source: (Nguyen Van Tuan, 2012)

Vietnam's scientific outcomes seem more promising when it comes to the quality of research as measured by average citations and H index (Table 2).

**Table 2. Average citations and H index**

<b>Country</b>	<b>Number of papers 2000-2001</b>	<b>Total citations 2001-2006</b>	<b>Average citations</b>	<b>H Index</b>
<b>Vietnam</b>	675	6 576	9.74	33
<b>Thailand</b>	2 590	23 550	9.09	50
<b>Malaysia</b>	1 810	11 681	6.45	37
<b>Indonesia</b>	954	9 036	9.47	36
<b>Philippines</b>	717	6 688	9.33	32
<b>Singapore</b>	7 605	70 393	9.26	75

Research projects are currently evaluated via the so-called "inspection and approval" approach which is similar to that used in engineering projects and not in line with international standards. Furthermore, there are no official statistics on how many approved and assessed research outputs are ever put to use, though it is widely accepted that around two-thirds of them are put away in drawers. Procedures for assessing research outcomes appear highly complicated and evaluation pays little regard to the production of international publications - only the National Foundation for Science and Technology Development (NAFOSTED) counts an international peer-reviewed publication as a primary outcome. In general, the quality of research output is not a matter of great concern, and the application of research and the acquisition of patents are not specifically considered.

The National Foundation for Science and Technology Development (NAFOSTED) was recently established with a view to approaching international standards for the funding and evaluation of research. It is difficult for young researchers to obtain these grants because success often requires the involvement of senior and more experienced researchers whose names and titles lend credibility to the research applications - even though these same researchers may do little or nothing to implement the research.

A concern that directly affects the quality of research outcomes is academic freedom. Although the *Higher Education Law of 2012* stipulates that "higher education institutions have freedom in organization, personnel, finance, property, training, science and technology, international cooperation, and quality assurance" (Article 32), academic freedom, especially in the social sciences, is limited and not much emphasised (Bauer, 2011). Regardless of the fact that activities of science and technology are set to "create knowledge, technology, new solutions for the development of science and education, contributing to the socio-economic development of the nation" (Article 39, section 3), "sensitive" issues in the social sciences, as well as critical feedback from scientists, are not generally welcomed. The state's orientation towards research in social sciences is often considered to be closer to the notion of "maintaining sustainability for development", which is in line with Confucian thinking, rather than "promoting development for

sustainability”, as is seen in many developed countries. The importance of the research outcomes is not taken into account, and scientists may be subject to reprimand if their thoughts appeared not to be in line with state policy. Accordingly, decisions are often made on the basis of state management and political will, rather than on rationality and statistics as would be expected from independent investigations.

Tuan Nguyen found that the other barriers to advancing quality research activity include: a lack of mechanisms to encourage peer-reviewed publication; confusion between basic and applied science in terms of place of publication; academic promotion criteria do not emphasise scientific publications; and that most research studies are descriptive and too simplistic, and are of poor scientific quality. Over a 10-year period between 1996 and 2005, Vietnamese professors on average published only 0.58 papers each and postgraduate students are not up to international standards - in some situations in China, PhD students must publish up to two papers in ISI or SCI journals during candidature.<sup>12</sup>

In terms of Houghton’s (2005) characterisation of changes in the nature of research activity, changes in the nature of research activity in Vietnam appear at a slow pace. The transformation from Mode 1 to Mode 2 science is at a very early stage of development. The emerging interrelationship between universities, industry, and the state has recently been emphasised, but the connections remain loose.

The rest of this report consists of a case study involving an extensive literature review and in-depth interviews with key informants. Various legal documents related to research and innovation policy, and to national strategic planning, were analysed. Other sources were academic articles in Vietnamese journals, conference papers and media reflections on the issues. The key informants were persons currently holding positions of high national status in Vietnam. They were experienced and knowledgeable in research leadership and management. They included a senior member of the central government, the director of a public research institute in the social sciences and a senior academic manager at a research oriented university in science and technology. There was also an eminent president of a leading university in Vietnam, who is also a politician and a member of the National Council for Science and Technology Policy – a consultancy body that directly serves the Prime Minister for science and technology (S&T) policy development. For reasons of confidentiality, and to preserve some measure of anonymity, further details about the informants are withheld.

In addition, interviews were conducted with various retired public officials, some of whom once held appointments at ministerial level. The purpose of the interviews was to build a comprehensive overview of the current situation of research leadership and management in Vietnam, and to determine how it fits into the typology provided in Chapter 3.

In the literature, no single publication was available on the topic of this paper. The issues have been partially addressed in several reports and book chapters. Le Xuan Thao (2002), Le Thi Bich Ngoc (2005) and Tran (2006) have described broadly the research and innovation system in Vietnam. Pham (2010), and Nguyen and Pham (2011a,b), have provided bibliometric analyses of research outputs in Vietnam. Fatseas (2010) summarised the legislative framework and

current situation regarding collaboration between research institutions and industry. She reflected on the effectiveness of Hi-Tech Parks and other local government initiatives. Spoo and Dao (2010) pointed out the challenges of intellectual property (IP) protection in Vietnam. Harman and Le (2010) pointed out the need to integrate teaching and research. Most recently, a comprehensive paper written by Dao et al. (2012) addressed contemporary issues of scientific research in Vietnam. In aggregate, these observations provide an overall picture of the research and innovation situation and management mechanisms in Vietnam, but they do not provide insights about the knowledge and skill requirements for effective research and innovation leadership.

The typology in Chapter 3 identifies six key themes. These have been divided into sub-headings to allow for the elaboration of important elements within these key themes.

## **Theme 1: leadership by government**

### **Awareness of the importance of research and innovation**

At a national policy level, Vietnam's government shows a strong interest of promoting research and development (R&D). As already noted, statements about the importance of R&D to national economic growth, improved productivity and socio-economic development can be found among resolutions of the Central Communist Party in 1996, 2002 and 2007, and especially in *Resolution 20* issued in 2012. Policy makers have committed to spending 2% of the state budget on S&T activities. However, the interviewees highlighted three points. First, the concept of research expenditure being used in Vietnam might be different from the perception of R&D in other countries because it includes both R&D and infrastructure development (accounting for 42-46% of the total), and is largely spent on staff salaries rather than research activities. Second, a large amount of national R&D expenditure is allocated to provincial governments and managed by their S&T departments, but the research projects initiated by these departments may not be entirely consistent with universally accepted concepts of research. Moreover, these departments might spend their research budget on other local government activities. Third, because of the bureaucratic complexity of research funding procedures, among other reasons, part of the budget for R&D is not used and has to be returned to the government.

As a result the actual level of state expenditure on R&D may well be much lower than the budgeted amount reported in official documents and comparisons with other countries may not be entirely reliable. Interviewees did not have a great deal of confidence in the official figures, and there is also confusion about them. There is also a nearly complete lack of knowledge about how much additional R&D expenditure is undertaken by private-sector businesses, provincial governments, universities and public research institutes.

All the same, there is some confidence that the management of R&D is progressively becoming more specialised and professional. Interviewees referred especially to the activities of NAFOSTED, which provides competitive grants for research, especially in basic fields, based on requirements and assessment procedures that meet international standards. It was also

observed that public research institutes are now considering integration with universities, thereby increasing the prospect of a better synergy between research and teaching.

### **Collaboration between different institutional sectors**

Interviewees expressed a variety of viewpoints about collaboration between different institutional sectors undertaking R&D. The government clearly supports this collaboration, as indicated by a decree (*NĐ-119*) that commits the state to meeting 30% of the total expenditure by private-sector corporations when they undertake R&D projects in collaboration with universities. However this collaboration occurs only at the instigation of private-sector corporations to meet specific needs, most of which are for applied studies and for studies intended to improve the quality of products. These projects might appear to be undertaken as public-private collaborations, but in fact they are very often collaborations between individuals, except where the private sector is simply making use of university laboratories or other forms of infrastructure. In the social sciences, these collaborations are much less common.

The extent of collaboration between different sectors is limited in scope. The reasons include: a) the corporate sector does not trust the quality of research in Vietnam – it does not think research institutes can help it resolve its problems or make innovation possible; b) most Vietnamese corporations are small and do not want to invest in research – they would prefer to copy and apply ready-made products rather use research to make necessary innovations; and c) there is almost no formal research collaboration between public universities and public research institutes because they do not want to share resources. More generally, research capacity in Vietnam is weak. Research funding, management procedures, research implementation and research assessments are not consistent with internationally accepted standards. While private-sector corporations may have motivation to work with research institutions, they are also constrained by limited resources.

In the interviews, however, instances of progress were reported. The leader of a research-oriented university provided evidence that his institution was working closely with provincial S&T departments and with businesses to get funding for research. He also mentioned interdisciplinary research being undertaken at his university, which required collaboration between researchers in different fields.

### **International collaboration**

The government is fully aware of the need for international research collaboration. There is some improvement evident in this area. Vietnam is moving from simply receiving international funds for research projects that are mostly monitored by foreign partners to the position of being an equal investor in some projects. Vietnam even proactively proposes international collaboration research projects that address national issues.

## **Policy development and communication**

Senior policy makers in Vietnam are very often individuals who used to be researchers. They are often very knowledgeable in a particular discipline but not across a range of disciplines, nor are they aware of research practices across different institutions. They usually get caught up in administrative operations rather than concentrating on policy development. Therefore they often adopt a consultative mechanism during policy-making process. Drafts of policy documents are circulated across institutions for comments and contributions. They are also sent to functional departments within universities, such as finance and planning offices and research offices, and responses mostly come from these bodies.

Another mechanism for collecting ideas for policy development is through workshops or seminars. Draft policy documents can be discussed by a small group of senior researchers invited by the policy makers for that purpose.

Few scholars are professionally engaged in policy development. There is very little sense of ownership of policy documents among the research community, although researchers can easily access the documents. Draft policy documents are available on the MOST website, and there are routine calls for contributions from managers and researchers, but in reality researchers make very few contributions. As a result, communication between policy makers and the research community is almost always one way, that is, top down.

## **Research output assessment and analysis**

The government tends to monitor research outcomes and productivity by identifying successful cases. At the national level, however, there is no systematic assessment conducted regarding publications and patents. There are annual summary reports that document research inputs, including for personnel (number of research staff and the growth in these numbers), investment (how much was spent for S&T infrastructure, laboratories), and R&D expenditures, but there is very little or no assessment and analysis of research outputs.

## **Compliance**

Vietnam has very detailed guidelines about how research funds can be spent and claimed. However, there are problems with this process. Specifically, budgets are allocated and reported on an annual basis but the implementation of the research might not be completed within an exactly one-year timeframe. In addition, budget estimates are regarded as being fixed – there is no room for adjustments. More broadly, the compliance procedures are so complicated that one interviewee speculated that they must have been created for the purpose of discouraging researchers. NAFOSTED is, however, making significant progress in streamlining compliance procedures and at the same time strengthening assessment criteria.

## **Research workforce and research management training**

Most researchers learn research skills and methodologies through coursework during their postgraduate programmes. For the research workforce, every ministry, including MOST, had to

create a strategic plan for human resource development in 2010. However, due to the lack of any study into research activities assessment and analysis, such planning is not supported by strong evidence. The first generations of research leaders and managers were those trained in research management in former Soviet countries. The National Institute for Science and Technology Policy provides a training programme in alliance with Vietnam National University Ha Noi. Interestingly, only two of the interviewees knew about these programmes.

## **Research ethics**

There is no stable and well-regarded national framework for addressing ethical issues in research. The exception is the field of medical research, which has research ethics guidelines which are set by the Ministry of Health, as well as Research Ethics Committees established in Ha Noi Medical University and Ha Noi College of Public Health. No specific legal document about more general research ethics issues has been developed, and no research ethics committees or similar agencies have been established to deal with such issues. Some regulations related to research ethics are included in PhD guidelines. For instance, a PhD thesis must be creative, not just copied from any previously published work. There is also no national framework for addressing fraudulent activities in research with the exception of the National Professorship Committee, which is the body responsible for addressing ethical accusations, if any. However this committee deals only with accusations related to professorial applicants.

## **Theme 2: leadership of research in institutions**

### **Awareness of international factors and institutional contexts**

Most leaders in research institutes who have trained abroad tend to maintain contact with their international networks. They know about the regulatory, financial and intellectual property (IP) protocols that apply to international research collaboration, particularly where failure to comply could result in institutional risk, financial penalties or sanctions. The leader of one research university interviewed provided evidence of this sensitivity in that his institution does not allow a photocopy shop on campus and it has also made contracts for using licensed software.

Across the nation, however, many leaders in research institutes, especially in the social sciences, do not recognise researchers accessing national and international networks nor do they give them any encouragement to do so. Young researchers have better access to these networks and better awareness of international factors, however their voices are not often heard by leaders of institutions because young academics are usually in low-ranking positions. Some research institute leaders even think that because their institutions are quite large, with hundreds of researchers, there is no real need to connect with others outside.

## **Planning and implementing institutional changes**

Most public higher education and research institutions have a five-year strategic planning process. Research priorities are identified in strategic planning at the national policy and institutional level. However, one interviewee pointed out that Vietnamese higher education institutions have only recently adopted such strategic planning documents and so many people are not fully skilled in this task. In any case, it was suggested that these documents tend to be written to be read, not to be implemented. There is a gap between strategic planning and translating the strategic plans into practice. By and large, research institutions do what they are asked to do. Researchers see research project implementation as a means of generating income rather than a pursuit of scholarship. The normal salary of researchers is very modest.

## **Ethics and research culture**

There are no formal guidelines on research ethics. Research management pays very little attention to ethical issues in research. Some plagiarism scandals have led to an increasing awareness of the importance of research ethics, but more guidance and some specific mechanisms need to be developed at both policy and institutional levels. Institutions do have mechanisms to deal with issues such as disputes and accusations, usually a disciplinary committee or investigation board. Fraudulent activities may be addressed by such bodies because they would be seen as being a form of general misconduct.

Only very recently has there been a tendency to promote publishing in international peer reviewed journals. In some research-oriented universities, research activity is beginning to be used as an indicator for workload and personnel performance assessment.

## **Risk assessment**

Risk assessment, as understood in international research practice, does not exist in Vietnam. One interviewee thought the term "risk assessment" referred only to financial risks. Other kinds of risks are not yet taken into account. Researchers or research managers might consider risks while taking decisions but most of them evaluate situations and weigh risks against opportunities on the basis of instinct, rather than by strictly following a procedure.

## **Communication at institutional level**

Public research institutions focus on connections with the government because they depend on public funding and their leaders are promoted within the framework of a civil service. In education, the connections between research institutes with the community are weak. Private schools might see the benefit of using knowledge to improve their work but they do not think about requesting research institutes to do relevant research. The communications between universities and external stakeholders seem better in the S&T fields. One interviewee from a S&T university reported, for example, that his university had a close relationship with the business sector in terms of technology transfer and the commercialisation of research work. In most cases, relations with alumni are at the personal level and are maintained and managed by centres for student support and business relations.

Research institute leaders connected with the government primarily by means of formal communications and personal contact. For individual researchers, meetings and conferences were the most popular mechanisms for communications with university leaders.

## **Theme 3: management to support leadership of research in institutions**

### **Organisational structure**

There are three categories of support for the leadership of research in public institutions. First, functional departments provide executive and management support – through research offices, postgraduate programme offices, finance and planning offices and international relations offices. Second, bodies such as academic and training councils, and temporarily established bodies such as task forces, provide specific support, for example for writing a proposal. Third, leadership bodies such as the university council and the Communist Party Cell provide direction about priorities and determine appointments to key positions.

Unlike many other countries, Vietnam does not have a well-established system of governing councils in public universities and research institutes. First, only a few public institutions have such a governance body. Second, where they do exist, they are comprised mostly of employees, and only very few members are ever external stakeholders. Third, in many cases, the chair of the governing board also holds the position of rector or director, and may even also be the secretary of the Communist Party Cell. Such an organisational structure is not designed to facilitate vigorous reviews of institutional decisions.

Where governing boards exist, there is generally no induction and training of committee members. Neither are there specific criteria for the performance assessment of research leaders, except for the procedure of self-evaluation applied to Communist Party members. Only a few public research institutions develop job descriptions for all positions, including research management. Therefore it is hard to measure the quality of research management and administration.

### **Research management and administration**

Generally speaking, the management of research institutions provides effective support for research leadership within these institutions, in term of operational routine work. However the relevant responsibilities, accountabilities and formal delegations are not routinely and effectively recorded. Research institutions could adopt more efficient and effective internal research management strategies and administrative best practice if they shared their experiences in annual conferences or seminars. Research institute leaders sometimes learn best practices in management from each other. However this happens mostly at a personal level, rather than being considered a formal process.

## **Financial management**

Though the sources of financial resources have diversified over recent years, most research funding continues to be derived from the state. At the institutional level, international charity foundations provide limited funds for research projects. Research institution leaders and managers do not have much to do but follow rigorous accounting requirements. Recently a few institutions have made delegations to assist researchers to deal with accounting requirements.

## **Theme 4: leadership of researchers in institutions**

### **Research students, postdoctoral researchers and newly independent researchers**

There are no induction programmes for research students, or for newly-appointed members of academic staff. Postgraduate training programmes do include research methodology coursework. Early-career and newly independent researchers have no postdoctoral programmes or career path support. What endeavours there are exist as individually conducted personal efforts without staff development planning at a system level.

### **Established researchers**

There are incentives and rewards for high achievement in research performance, but not in the form of financial benefits. The usual form of reward is to be given individual recognition and to have more opportunity of being promoted to a professorial level.

## **Theme 5: management to support leadership of researchers**

### **Research student management**

The main bodies providing support for research within institutions are functional departments like research offices, postgraduate programmes offices and international relations offices. They undertake a great many of the administrative and support activities required by research students. However most public research institutions are weak in the following areas:

- Functional departments do not contribute to enrolment or admission policy development as such policies are set by MOET.
- Most postgraduate programmes do not include student induction to the institution.
- Although master's degree candidates have a research methods coursework programme which includes academic writing skills, and ethical and intellectual property issues, these topics are addressed superficially.

- There are no training programmes in PhD supervision. One interviewee said that organising this training was difficult because almost all professors think they are the best and have no need to learn how to work more effectively with PhD students.

### **Research staff management**

Universities in Vietnam do not have permanent tenured research staff. Teaching is the major work and primary duty of all faculty members and research is seen a supplementary responsibility. Therefore universities have teacher management procedures but not researcher management ones. As a result, there is neither a specific procedure for appointing and managing research staff members, nor are there any relevant statements of performance expectations, responsibilities and accountabilities for researchers.

## **Theme 6: personal behaviours and qualities of research leaders and managers**

The formal requirements for research leadership positions are not clearly defined. To be promoted to these positions, research leaders/managers go through three steps: a) completion of the Advanced Politics Theory Programme offered by Nguyen Ai Quoc School of the Communist Party; b) completion of the Public Administration Programme offered by the National Institute of Politics and Public Administration; and c) attaining a pass in the Senior Staff Testing programme. The first step requires candidates to be Communist Party members and to have been nominated by their institution's Party Cell.

There are, therefore, many research leaders/managers who have never undertaken any formal research management training. Even if they had, science and technology management training programmes do not include anything on the personal qualities and behaviours that leaders and senior managers of research and innovation need to demonstrate (see Appendix C).

Leaders and senior managers are helped to develop general management skills but not specifically in a research environment. This assistance is implemented via a number of leadership training programmes, however the personal qualities and behaviours needed to achieve distinguished research outcomes do not have a great deal of influence in decisions about promoting someone to higher positions of leadership.

## **Discussion**

Based on these findings, this section addresses matters of significance to Vietnam concerning the knowledge and skills required for effective leadership in research and innovation. In particular it will focus on the gap between what might be regarded as ideal and the realities of research leadership and management practices in Vietnam.

## **Government policy level**

### ***Translating party resolutions and government strategic plans into effective policies***

There are several party resolutions and government strategic planning documents that point out the importance of research and innovation. These statements are expected to provide the direction of R&D policy developments. However, there is obviously a huge gap between the aspirations expressed in these documents and what happens in practice. Translating resolutions and strategic plans into effective and feasible policy requires an awareness of international contexts and a long-term vision. It also requires a policy development process that would enable the participation of all the relevant stakeholders, especially senior researchers in various disciplines. At the national level, priority should be given to the developing R&D policies to support national strategic planning. These policies must be evidence based and feasible. The process should involve all stakeholders and provide a framework of incentives that stimulates and motivates researchers and businesses. As Fatseas (2010) states, there must also be “adequate monitoring and evaluating frameworks in place to ensure that the decision makers can track progress in implementation of their policies”. Such a policy development requires a set of knowledge and skills that need to be developed over time.

### ***Workforce development and research monitoring, assessment and analysis***

Information provided by interviewees, supplemented by other sources of evidence, suggests that research in the social sciences and humanities is much less well developed than research in science and technology. This is evidenced by publication achievements, international collaborations and connections, relations with businesses and other stakeholders, and social impact. This situation suggests the need for a situation analysis to define a national research focus. It also suggests a need for an assessment of research achievements, the research workforce, the effectiveness of public expenditure on research and innovation, and the importance of R&D contributions to economic growth and social development across different disciplinary fields. These assessments are completely absent at a national policy level in Vietnam.

However, while investigations of the current situation, output assessments, need analyses, legislative instruments and policy development can all be progressed with technical support, none of these measures will proceed without the drive and vision of national leaders. It is important that Vietnamese policy makers at the national level recognise the importance of international research developments and the global context surrounding research and innovation.

### ***Research leadership and management training***

There is a pressing need to strengthen research leadership capacity by improving existing training programmes and making them mandatory. Two-year master's degrees in science and technology management have been offered by the National Institute for Science and Technology Policy and Strategies Studies since 1991, and there have been 170 graduates to date (see Appendix C). Although the programme focuses on policy development rather than the full set of knowledge and skills needed for effective leadership and management, it is highly relevant to the role played by research leaders and managers. However, few people in the higher education sector even know about the existence of this programme, primarily because it is not required

for promotion to senior research management positions. The importance of such training seems to be completely underestimated. Many of the findings of this report about weaknesses in Vietnam's research systems and what holds national research activities and achievements back could be solved by improving research leadership.

### ***Ethical issues***

With the exception of the field of medical research, there is no national or institutional framework to deal with research ethical issues. In other fields, there is a lack of both awareness of research ethics principles and procedures for ensuring their acceptance, nor is there any framework or mechanism for addressing fraudulent activities. All of the interviewees considered research ethics to be confined to intellectual property issues. This is one of the key areas that needs to be addressed in training programmes for research leaders and managers.

## **Institutional strategic planning level**

### ***Specific challenges***

Research leadership positions are challenging, but the challenges vary from institution to institution and from country to country, and they are ever-changing. However there are some specific challenges that Vietnamese research leaders and managers face which could largely be addressed through training.

To implement institutional change, it is important to have adequate resources available and to create schemes that provide the right incentives and rewards. The limited institutional autonomy Vietnam's public universities enjoy acts as a serious constraint in this regard. The new *Higher Education Law of 2013* may provide a more autonomous framework for higher education institutions. Financial reforms are also expected in the coming years and institutions will be reclassified into a more stratified framework that will give universities that aspire to be research leaders more funds and more autonomy.

There are also significant challenges in establishing a research culture in a "degree-oriented" society where doctoral degrees are seen as a fashion accessory rather than a qualification for a research career. Over 70% of PhD holders in Vietnam do no research, and among the rest there are few who do their research work at international standards. Many PhD holders work as administrators and government officers in other fields. Talent is not well respected. As in a Chinese formula, "red" (socialist political consciousness) is more important than "expert" (academic and technical excellence). Academic careers do not offer promising financial returns in Vietnam. In a context of widespread IP abuse and limited academic freedom, there is little motivation to do research. These factors are significant obstacles to establishing a research culture.

### ***Things to improve***

There is very little collaboration between research institutions and corporations in Vietnam. Over 70% of research funds are from the state, meaning the business sector is not a significant provider of R&D investment, and there is very little evidence of the commercialisation of research results. To change this situation, research institution leaders need to understand better the kinds of changes taking place in the global knowledge environment and they need to

become more attuned to the research needs of corporations. They must then strengthen institutional research capability accordingly. This is two-way process: close connections with the business sector will bring more resources to the research institutions, as well as provide more motivation for researchers and conditions that are more conducive to the strengthening of research ability.

As mentioned above, the creation of a research culture in Vietnam is a key area in need of improvement. A research culture includes a culture of publication (in international peer-reviewed journals), teamwork and collegiality in research performance, protection of research integrity, the willingness and ability to have academic debate, and a respect for academic freedom. These elements can only be developed over time through the design and consistent exercise of appropriate mechanisms at the strategic level of an institution.

### **Institutional operations level**

Due to limited autonomy, there is not much space for research managers at the operational level to support the institutional leadership in contributing to external policy setting such as enrolment requirements. Functional departments such as research offices, international relations offices, and finance and planning offices mostly deal with routine work and with implementing procedures. These departments bear most of the responsibility for providing research management support and for initiating change. Their members of staff should be well informed in terms of the knowledge and skills needed for effective research leadership and management, so that they can not only do their current jobs better but also, and more importantly, so that they can share in the leadership's vision for addressing problems and creating new policies.

Another area of weakness at all levels is the assessment of research activities and research management performance. Research leaders and managers are evaluated annually by the same process used for all kinds of government officers. The current personnel performance assessment therefore reflects general qualities and outcomes of their work rather than the ones needed as research leaders or managers. Recently, however, in a trend towards more accountability, the use of international peer-reviewed publications and patents have been considered as a criterion for the evaluation of research outputs.

## **Conclusions**

Vietnam is a socialist country that defines itself as having a “socialist-oriented market economy”. This creates a set of conditions for research and innovation that may not be shared by many other countries. This report has sought to outline the overall ethos and recent developments in relation to research leadership and management in Vietnam. It documents significant gaps in the core knowledge and skills needed for effective research management.

Some of the knowledge and skill requirements for research leaders and managers are demonstrated in Vietnam's situation, depending on the development level of the institution. The main gaps identified include:

- *A lack of awareness of international contexts and the global research environment, as well as of Vietnam's relative position globally* – this includes understanding of international and national legislative frameworks, funding agency operations, and intercultural factors.
- *Deficiencies in policy development and analysis skills* – this includes skills in setting goals and strategic planning, creating criteria and measurement for evaluation and assessment outcomes, and making decisions based on evidence and data analysis.
- *Weaknesses in monitoring the implementation of the policies* – this includes skills in attracting the best researchers, and in supporting them to achieve their research goals.
- *A general lack of effective communication with all stakeholders* – this requires the provision of support for managers, research students, researchers, government officers, other institutional senior officers and business leaders to enable them to make a distinctive contribution to the policy making process, and to expand resources and opportunities.

Further study of the complexity of the tasks to be undertaken by Vietnamese research leaders and managers remains to be undertaken. One useful input would be best practices in research leadership from around the world, but there also a need for more analysis of the specific conditions in Vietnam in order to develop a tailor-made training programme that would help reinforce the ability of leaders to turn political aspirations into reality.

In short, there is a need for fundamental reform in Vietnam. It is indeed fortunate that the Communist Party has recognised the need to improve research capacity by building a professional management system. Priority has been given to “intensive and comprehensive reforms on management mechanisms, strategic planning, funding structures, personnel policies, self-financed organisations, etc, those are appropriate to socialist oriented market economy” (*Resolution No. 20-NQ/TW, Nov 2012*). Leadership is of the utmost importance to the development of R&D in Vietnam.

Against a background of limited resources, a not-quite-mature environment for research activities and research management, serious barriers as a consequence of the backwardness of higher education system, and constraints deriving from institutional governance structures intensive training programmes are needed that will provide knowledge and skills needed for effective leadership and management in research and innovation in Vietnam.

By all accounts, Vietnam has the potential to create a large number of talented scientists. A key element underpinning its ultimate success will be the proactive contributions and engagement of high-ranked government officers. It is important for Vietnamese policy makers to recognise that investments in leadership capacity are a prerequisite for national economic prosperity in the long term. There are signs that they are aware of the need for reforms. This study will provide an opportunity for technical support for the on-going reforms in Vietnam and will assist Vietnam in developing its future as a major active player in the world scientific community.

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<sup>1</sup>This report was written with great contributions of Prof. Nguyen Van Tuan (University of New South Wales, Australia), Dr. Dao Van Khanh (Can Tho University/Southern Cross University, Australia); and valuable guidance provided by Prof Martin Hayden, as well as comments given by Prof. Bui Manh Hung (HCMC University of Pedagogy, Hankuk University of Foreign Studies, Korea). The author would like to express her sincere thanks to the above persons for their support. The author would also like to thank the interviewees who provided contributions to this report. They remain anonymous, but their individual contributions are greatly appreciated.

<sup>2</sup> There is also some variability in the quality of the research training acquired by the holders of these awards.

<sup>3</sup> There are almost 412 universities and colleges in Vietnam, of which 16 are "key" universities. These include the 2 national universities (in Hanoi and HCM); 3 regional universities (Da Nang, Hue and Thai Nguyen); and 11 other universities considered important in fields that include pedagogy, medicine, economics, agriculture-forestry-fisheries, technology, military technology (Can Tho University; National Economics University; HCM Economic University; Hanoi Pedagogy University; HCM Pedagogy University; Hanoi Medical University; HCM Medicine and Pharmacy University; Hanoi Agriculture University; Hanoi University of Technology; Vinh University, and the Institute of Military Technology).

<sup>4</sup> Vietnamnet website: <http://vnn.Vietnamnet.vn/khoahoc/tdsk/2007/09/741905/>; Tienphong Online website: [www.tienphong.vn/giao-duc/599383/Giao-duc-dai-hoc-Viet-Nam-chua-the-hoi-nhap-tpp.html](http://www.tienphong.vn/giao-duc/599383/Giao-duc-dai-hoc-Viet-Nam-chua-the-hoi-nhap-tpp.html)

<sup>5</sup>NISTPASS (National Institute for Science and Technology Policy and Strategy Studies) website: [www.nistpass.gov.vn/index.php?option=com\\_content&view=article&id=870:mi-nm-tr-li-ngan-sach-gn-1000-t-ng-vi-sao&catid=15:tin-chin-lc-va-chinh-sach&Itemid=30](http://www.nistpass.gov.vn/index.php?option=com_content&view=article&id=870:mi-nm-tr-li-ngan-sach-gn-1000-t-ng-vi-sao&catid=15:tin-chin-lc-va-chinh-sach&Itemid=30)

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<sup>7</sup>[http://khoahoc.baodatviet.vn/Home/KHCN/phanbien/Dau-tu-cho-khoa-hoc-dang-khong-hop-ly/201210/238852.datviet\\_dated October 15, 2012.](http://khoahoc.baodatviet.vn/Home/KHCN/phanbien/Dau-tu-cho-khoa-hoc-dang-khong-hop-ly/201210/238852.datviet_dated%20October%2015%202012)

<sup>8</sup> Calculated from data in UNESCO (2005).

<sup>9</sup><http://m.tuoiitre.vn/tin-tuc/Giao-duc/Khoa-hoc/168473,Nha-khoa-hoc-cho-tien-tien-cho-nha-khoa-hoc.ttm>

<sup>10</sup> Ibid. <http://m.tuoiitre.vn/news/detail?id=168473>. Sept 23, 2012

<sup>11</sup>Ibid.

<sup>12</sup>[http://tuoiitre.vn/Chinh-tri-xa-hoi/Moi-truong/23\\_9831/Khoa-hoc-Viet-Nam-dang-o-dau.html](http://tuoiitre.vn/Chinh-tri-xa-hoi/Moi-truong/23_9831/Khoa-hoc-Viet-Nam-dang-o-dau.html)

## **Chapter 8**

# **Addressing gaps in knowledge and skills for effective research and innovation management**

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Martin Hayden

## Introduction

This report begins with an overview of the four case study countries in terms of their R&I profiles. It notes the methodology adopted to develop the country reports is noted, and summarises findings from the four country reports. It then concludes with a discussion of the main knowledge and skills gaps identified.

### Overview of the selected countries

The four selected countries, Cambodia, Malaysia, Thailand and Vietnam, are all developing economies located in an economically dynamic region. They form part of the Association of Southeast Asian Nations (ASEAN), which also includes Brunei, Indonesia, Lao PDR, Myanmar, the Philippines, and Singapore. Each is experiencing long-term and reasonably sustained economic growth; each is at a slightly different stage of economic development; and each aspires to develop a stronger capacity in R&I.

Table 1 details their R&I profiles. Economic prosperity is indicated by their gross national incomes (GNI) per capita. In 2011, Malaysia's GNI per capita was USD 8 770, Thailand's was USD 4 440, Vietnam's was USD 1 070 and Cambodia's was only USD 820.<sup>1</sup> These levels fall well short of the OECD average, which in 2010 was USD 36 070. They are also fall well behind Singapore's level, which in 2011 was USD 42 930. Singapore is Southeast Asia's most advanced economy and its indicators are included in Table 1 for comparative purposes.

*Table 1. Selected indicators for Cambodia, Malaysia, Thailand and Vietnam<sup>2</sup>*

Indicators	Countries (year)				
	Cambodia	Malaysia	Singapore	Thailand	Vietnam
<b>GNI per capita</b>	USD 820 (2011)	USD 8 770 (2011)	USD 42 930 (2011)	USD 4 440 (2011)	USD 1 070 (2011)
<b>Researchers per million inhabitants - full-time equivalent</b>	17 (2002)	365 (2006)	6,173 (2009)	316 (2007)	116 (2002)
<b>Researchers employed by business enterprises - % full-time equivalent</b>	15.7% (2002)	36.4% (2006)	53.3% (2009)	23.3% (2007)	10.4% (2002)
<b>Researchers employed in higher education - % full-time equivalent</b>	12.5% (2002)	52.6% (2006)	40.7% (2009)	60.5% (2007)	32.4% (2002)
<b>Researchers employed by government - % full-time equivalent</b>	50.7% (2002)	11.0% (2006)	6% (2009)	14.5% (2007)	56.5% (2002)
<b>GERD as a % of GDP</b>	0.05% (2002)	0.63% <sup>3</sup> (2006)	2.43% (2009)	0.21% (2007)	0.19% (2002)
<b>Population (million)</b>	14.3 (2011)	29 (2011)	5.2 (2011)	69.5 (2011)	87.8 (2011)

Singapore is clearly the leader in many of the indicators shown in Table 1. As well as having the highest level of GNI per capita, it also has the highest level of gross domestic expenditure on research and development (GERD) as a proportion of gross domestic product (GDP). This measure is a standard indicator of an economy's willingness and capacity to invest in research and development. In 2009, Singapore's GERD/GDP ratio was 2.43%. On this indicator, Malaysia came second, with a GERD/GDP ratio of 0.63% in 2006, ahead of Thailand (0.21% in 2007), Vietnam (0.19% in 2002) and then Cambodia (0.05% in 2002). Not surprisingly, Singapore also had the highest number of researchers per million inhabitants, and, interestingly, it also had the highest percentage of researchers employed by business enterprises.

Table 2 presents data extracted from the World Economic Forum (2012) *Global Competitiveness Report* for 2012-13 on world rankings on selected factors underpinning the strength of an economy's R&I capacity. Again, Singapore is included for comparison purposes. A total of 144 countries were surveyed. Singapore was rated as being a world leader across various factors, including the quality of maths and science education, intellectual property protection, "brain drain" (attracting and retaining talent), the quality of the educational system, and venture capital availability. Malaysia also ranked highly on various factors, including venture capital availability, quality of the education system, availability of research and training services, quality of maths and science education, and brain drain. Thailand ranked more highly than Malaysia in terms of tertiary education enrolment, but not on any of the other factors. Vietnam and Cambodia lagged well behind.

**Table 2. Country rankings on innovation factors**

<b>Innovation Factors</b>	<b>Cambodia</b>	<b>Malaysia</b>	<b>Singapore</b>	<b>Thailand</b>	<b>Vietnam</b>
<b>Intellectual property protection</b>	85	31	2	101	123
<b>Secondary education enrolment</b>	118	103	15	92	94
<b>Tertiary education enrolment</b>	118	61	19	54	87
<b>Quality of the educational system</b>	58	14	3	79	72
<b>Quality of maths and science education</b>	90	20	1	61	58
<b>Quality of management schools</b>	96	26	6	62	125
<b>Availability of research and training services</b>	78	17	16	66	126
<b>Brain drain</b>	35	22	2	36	98
<b>Venture capital availability</b>	44	11	4	49	96

Source: World Economic Forum (2012)

Table 3 presents further data extracted from the World Economic Forum's *Global Competitiveness Report* for 2012-13 on specific indicators of innovation. Once again, Singapore ranks highly, but it is of note that Malaysia ranks 4 out of 144 countries on government procurement of advanced technology

products, 16 on company spending on R&D, 17 (ahead of Singapore) on capacity for innovation, 18 on university-industry collaboration in R&D, and 20 on availability of scientists and engineers. These are high rankings for a developing economy. Thailand, Vietnam and Cambodia lag well behind both Singapore and Malaysia on most of the indicators.

**Table 3. Country rankings: indicators of innovation**

<b>Indicators</b>	<b>Cambodia</b>	<b>Malaysia</b>	<b>Singapore</b>	<b>Thailand</b>	<b>Vietnam</b>
<b>Capacity for innovation</b>	65	17	20	79	78
<b>Quality of scientific research institutions</b>	68	28	12	60	87
<b>Company spending on R&amp;D</b>	52	16	8	74	75
<b>University-industry collaboration in R&amp;D</b>	71	18	5	46	97
<b>Government procurement of advanced technology products</b>	24	4	2	98	39
<b>Availability of scientists and engineers</b>	109	20	13	57	70
<b>Patent Cooperation Treaty patent applications</b>	119	34	13	72	97

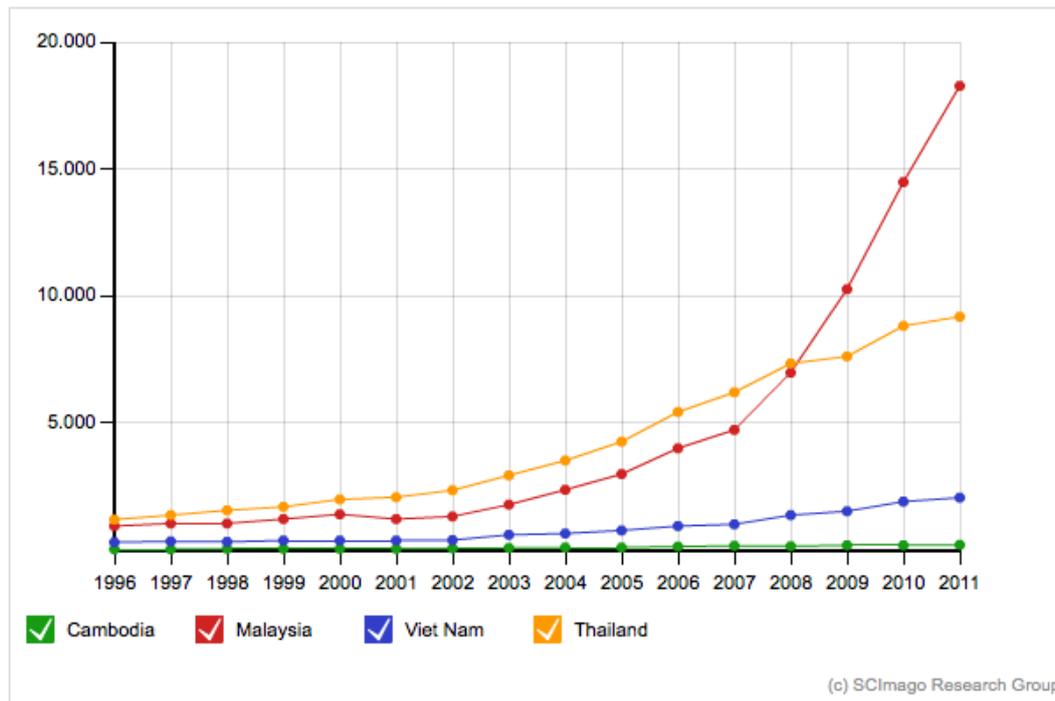
Source: World Economic Forum (2012)

In terms of overall global competitiveness, the World Economic Forum (2012) ranked Singapore 2 out of the 144 countries, Malaysia 25, Thailand 38, Vietnam 75 and Cambodia 85. Malaysia's economy was described as being in transition from being efficiency driven to being innovation driven, that is, its national economic prosperity is relying less on simply improving the efficiency of production and more on being able to utilise new technologies and more sophisticated production processes and business models. In contrast, Thailand's economy is said to remain efficiency driven. The economies of Vietnam and Cambodia are described as being factor driven, that is, they continue to rely significantly on the availability of low-skilled labour and natural resources.

The order of the world rankings for Cambodia, Malaysia, Singapore, Thailand and Vietnam in the *Global Competitiveness Report* for 2012-13 is the same as the order of their rankings on another global index, the World Bank (2012) *Knowledge Economy Index* for 2012. This index is calculated on the basis of an average of country scores on four sub-indexes, referred to as the "four pillars of the knowledge economy": the economic incentive and industrial regime, innovation and technical adoption, education and training, and information and communication technology (ICT) infrastructure. In 2012, Singapore ranked 23 (out of 144 countries), Malaysia ranked 48 (ahead of all remaining ASEAN countries), Thailand ranked 63, Vietnam ranked 104 and Cambodia ranked 132. These rankings are not as high as the World Economic Forum's rankings for global competitiveness, reflecting differences in the purpose and composition of the two sets of indices.

Figure 1, taken from the SCIMago Journal and Country Rank portal (2007), which draws on the Scopus database, shows trends in the growth of citable publications across the four selected countries since 1996. The leading position taken by Malaysia since 2008 is clearly evident.

**Figure 1. Trends in publication of citable documents**



Source: SCImago (2007), SCImago Journal and Country Rank, SJR (SCImago Journal and Country Rank) website, <http://www.scimagojr.com/index.php>.

## Methodology

To explore matters further, and particularly to develop an understanding of the knowledge and skills gaps for effective R&I management in each of the four selected countries, a small group of senior and experienced scholars undertook country studies addressing questions suggested by the typology of knowledge and skills requirements for effective R&I management developed in a previous phase of the project (Pettigrew et al., 2012). Based on this typology, an extended list of questions (Appendix H) was developed to guide interviews with key informants in each of the selected countries.

It was agreed that these informants should include senior managers from at least one large research university, one significant research organisation and one significant research institute. It was also agreed that, if possible, one or more relevant senior ministry officials should be interviewed. Interviewees were to be assured of confidentiality and anonymity in the documentation of their viewpoints. Key interviewees were also invited to attend a workshop to be held in Kuala Lumpur, at which this report would be presented.

The typology proposed six themes for exploration: a) leadership in R&I by government; b) leadership of research in institutions; c) management support for research leadership in public institutions; d) leadership skills of researchers in institutions; e) management support for leadership of researchers; and f) personal behaviours and qualities of research leaders and managers. In light of the fact that the proposed workshop in Kuala Lumpur was to address only the policy and institutional implications of the results, a decision was taken to focus mainly on the first four themes.

The research methodology was qualitative and interpretive. Of interest were the experiences and perceptions of the interviewees regarding knowledge and skills gaps for effective R&I management. Establishing trust was an important consideration, because it was important to ensure that the experiences and perceptions of the interviewees were being recorded and interpreted faithfully, that their claims were plausible in light of other sources, and that their views were consistent over time. The scholars conducting the interviews were familiar with procedures to maximise trustworthiness. Given their own depth of experience with R&I, they were also able to appreciate what was important and informative in what they were being told.

The approach to data collection was “top down”, in that the interviewees were all very senior officials and managers. A top-down approach suited the nature of the project because the typology places a great deal of emphasis on the importance to R&I management of government policies and of leadership within research institutions. For reasons of time and budget, only a small number of interviewees could be approached, and it was not possible to interview researchers from within universities and research institutes.

Four distinct country reports were prepared (presented above). The reports capture the contextual complexity of policies and procedures in each country. They also vary in length and detail, reflecting variations in the availability and quality of relevant data. No attempt was made to dictate how the country reports should be written, except that all of the authors worked from a common sheet of questions derived from the typology.

### ***Findings***

The next section presents a summary of the main findings for each of the first four themes from the typology. It does so by presenting some key points on each theme from each of the four country reports. Tables with accompanying brief explanations are employed to present the key points. They include side-headings and sub-headings based on the typology to assist with the organisation of the summary. Given the richness of detail in the individual country reports, the process of summarising the main findings has been challenging. Many matters of detail have had to be overlooked.

## **Theme 1: Leadership in R&I by government**

Table 4 provides an overview of findings from the country reports that relate to the first theme from the typology, leadership in R&I by government. This concerns the extent to which governments exercise leadership in R&I management.

**Table 4. Findings on leadership in R&I by government**

<b>Elements</b>	<b>Cambodia</b>	<b>Malaysia</b>	<b>Thailand</b>	<b>Vietnam</b>
<b>National policies on R&amp;I</b>	There is a <i>Policy on Research Development in Education Sector</i> and a <i>Master Plan for Research Development in the Education Sector 2011-2015</i> , based on the <i>Education Law of 2007</i> .	There is a <i>National Science, Technology and Innovation Policy (2013-2020)</i> , with associated strategy documents.	There is a <i>National Science, Technology and Innovation Policy and Plan (2012-2021)</i> .	There is a draft <i>Law on Science and Technology of 2012</i> (to replace the existing <i>Law on Science and Technology of 2000</i> ), and there is an <i>S&amp;T Development Strategic Plan 2011-2020</i> .
<b>Governance of R&amp;I</b>	Co-ordination by the Ministry of Education, Youth and Sport. The Supreme National Economic Council, the Royal Academy of Cambodia and the Ministry of Planning also play a role.	Co-ordination by the National Science and Research Council.	Co-ordination by the National Science and Technology Development Agency, under the Ministry of Science and Technology. There are many other co-ordinating agencies.	Co-ordination by the Ministry of Science and Technology, the Ministry of Planning and Investment, and local governments. Various ministries, including the Ministry of Education and Training, are also involved.
<b>Human resource development in R&amp;I</b>	There is an <i>Education Strategic Plan 2009-2013</i> , with many tasks given to the Department of Scientific Research.	There is a strong focus on building national capacity in science and technology areas. There are many initiatives.	Many universities and agencies contribute to human resource development, including the National Science and Technology Development Agency.	Ministries are expected to address human resource development as part of their strategic planning processes.
<b>Funding mechanisms for R&amp;I</b>	Funding comes through the parent ministries of various sectors (agriculture, tourism, health, defence, industry etc.), and the Ministry of Education, Youth and Sport, for public universities/institutes. Research funds also	Various agencies disburse funds for R&I. Research Universities receive additional funds. Incentives are provided to	Funds are received directly from the government. National Research Universities receive additional funds. Incentives exist	Funds are directed through the Ministry of Science and Technology, and the Ministry of Planning and Investment.

	received from a World Bank project.	stimulate private-sector investment.	to encourage private-sector expenditure.	
<b>Forms of communication</b>	Information on R&I funding schemes are made widely available to universities.	Information on R&I funding schemes made widely available. The government routinely involves research leaders in discussions about R&I.	Information on R&I funding schemes made widely available – but from many different sources.	Information on R&I funding made widely available, but arrangements within different ministries and provincial governments vary.
<b>Research ethics</b>	Research ethics policy yet to be developed.	National Ethics Committee, and specialist research ethics committees in the health sciences.	Ethics frameworks are established by funding agencies and the Higher Education Commission.	No national framework, but guidelines exist within the Ministry of Health.

## National policies on R&I

Across all four selected countries, governments have expressed a strong commitment to the importance of R&I. Cambodia's *Education Law of 2007*, for example, requires the state to “promote and support research, development, invention and production, which are scientific and technological for education to meet the needs of the labor markets and globalization to promote human resource capacity and to enhance the development of the country” (Article 28). Malaysia's *National Science, Technology and Innovation Policy 2012-2020* states a commitment to invest in new technologies, to concentrate on the utilisation of research in strategic areas, to develop capabilities and strengthen the nation's capacity for scientific and technological development, to achieve collaboration between research institutions, universities and industries, and to commercialise research outputs. Thailand and Vietnam have similar official expressions of commitment to the importance of R&I.

## Governance of R&I

The four countries differ in terms of the effectiveness of arrangements in place for implementing expressed policies on R&I. In Malaysia, a single body provides co-ordination of the R&I system – the National Science and Research Council, comprised of 20 experts from academia, the private sector and the public research institutes. This council seeks to ensure that national research efforts are aligned with national priorities. In contrast, Thailand has various layers of co-ordinating agencies, resulting in a lack of strong and sustained leadership for R&I according to the country report. In Vietnam, co-ordination of the R&I system is largely shared between two ministries, the Ministry of Science and Technology, which is primarily responsible for the distribution of funds, and the Ministry of Planning and Investment, which is primarily responsible for determining national investment priorities. The

process of allocating research funds is, however, much more complicated in Vietnam – various ministries and other government bodies, together with a large number of local governments, are involved. The government has not been successful in stemming significant and readily identifiable inefficiencies in the allocation of funds to support national R&I priorities – as exemplified by the fact that a sizable proportion of all research funds allocated in one year are refunded in the next because of misallocation and the impact of excessive levels of regulatory control. In Cambodia, the Ministry of Education, Youth and Sport co-ordinates the R&I system, but other agencies including the Supreme National Economic Council, the Royal Academy of Cambodia and the Ministry of Planning all play additional and significant roles. Cambodia’s country report describes the arrangements for the funding of R&I as being “blurred and bureaucratic”.

### **Human resource development in R&I**

Each of the four countries have national policy statements espousing the importance of human resource development in R&I, but the effectiveness of policy implementation varies widely. Malaysia’s approach is the most systematic. It has targets and implementation programmes for improving the quality of science, technology, engineering and mathematics teaching in schools, increasing the proportion of science and technology students enrolling at first-degree levels, expanding the pool of teachers in science and technology areas through the provision of postgraduate awards and scholarships, and supporting brain-gain initiatives. Thailand has similar initiatives, but they may not to be as well co-ordinated – the diversity of co-ordinating agencies contributes to some confusion and fragmentation of effort. Human resource development initiatives for R&I are least well developed in Vietnam and Cambodia. Vietnam’s system of strategic planning, which requires an elaborate cycle of national, institutional and faculty-level five-year plans, should in theory mean that human resource development issues for R&I are routinely addressed. As noted in the relevant country paper, however, these documents are often produced simply because they have to be, and may not necessarily lead to decisive action. In Cambodia, a lack of funds severely restricts human resource development opportunities.

### **Funding mechanisms for R&I**

Though details of the funding mechanisms for R&I support across each of the four countries are perhaps not of critical importance to this report, a notable common theme is the desirability of the private sector playing a more significant role. The greatest need appears to be for the private sector to engage more in the commercialisation of new research products. To encourage the private sector in this regard, tax and other incentives are provided. In Malaysia, for example, the government will allow venture capital companies a five-year tax exemption if they invest at least 30% of their funds in the form of seed capital, start-up and/or early-stage financing. In Thailand, private-sector participation in R&I is encouraged in similar ways. The impact has not been as great as might be expected. One reason here is that the research community itself does not have sufficient understanding of how the commercialisation of new research products works. The stage of development of industrial enterprises and their lack of trust in local innovations may also be responsible. In Vietnam, the state funds more than 70% of all R&I expenditure. The private sector is mainly comprised of small enterprises with limited opportunities to raise venture capital, which severely restricts commercialisation. In Cambodia, private-sector investment in R&I is also reported to be negligible.

## **Forms of communication**

All four countries have the standard forms of communication between governments and R&I providers. There are, however, some qualitative differences. In Malaysia, policy makers seem to be more collaborative in their communication with research leaders than is generally the case in the other three countries. For example, the National Science and Research Council, a top-level advisory body to the government, is comprised entirely of members of the research community. In Thailand, a similar openness in forms of communication is encouraged, but because multiple co-ordinating and funding agencies are involved, achieving effective communication between policy makers and the research community is more complex. In Vietnam, forms of communication by policy makers tend to be top down, reflecting Vietnam's legacy of a Soviet-style "command and control" system of higher education governance. Top-down forms of communication are also reported for Cambodia but the size of its R&I sector is small, and informal avenues of communication between policy makers and the research community are also common.

## **Research ethics**

Malaysia and Thailand are evidently committed to the importance of research ethics , where governments have developed national research ethics frameworks. Vietnam has no national framework, although the Ministry of Health does have a research ethics policy to be followed by researchers in all universities, hospitals and related institutions under its direct control. In Cambodia, a national research ethics framework is under development.

## **Theme 2: leadership of research in institutions**

Table 5 presents an overview of findings on the second theme from the typology, leadership of research in institutions. This theme concerned the extent to which research is recognised as important within institutions such as universities.

**Table 5. Findings on leadership of research in institutions**

<b>Elements</b>	<b>Cambodia</b>	<b>Malaysia</b>	<b>Thailand</b>	<b>Vietnam</b>
<b>Management of R&amp;I</b>	Leading public universities appoint vice-rectors with responsibility for research. There are guiding principles and mechanisms.	The Ministry of Higher Education has designated five research universities that have been given significant responsibilities for research. They typically appoint a Deputy Vice-Chancellor to be responsible for research management.	There are nine designated national research universities that have been given considerable autonomy and additional funds for research. They typically appoint a Vice-President or similar to be responsible for research management.	There are no designated research universities, but there is a hierarchy. Public research institutes are traditionally important as sites for research.
<b>Awareness of R&amp;I settings</b>	There is no structured avenue for advanced training. Outstanding faculty members have their own networks with other research organisations/funding agencies.	Leaders in research universities and in specialised research institutes have a sound awareness of R&I settings.	Leadership in national research universities and in specialised research institutes have a sound awareness of R&I settings.	Research leaders are informed about R&I policies, but information flow is top down. Researchers trained abroad are better able to maintain international networks.
<b>Institutional governance of R&amp;I</b>	Universities have been advised by the ministry to establish research offices, but the system is not working well.	Research universities make internal appointments to support their research activities. Research advisory committees are common at public research institutions.	National research universities make internal appointments to support research activity. Faculties appoint sub-deans.	There tends to be a centralised research leadership model within faculties and research institutes.
<b>Strategic planning for R&amp;I</b>	No strategic plan or annual operational plan for R&I – discussion about the need is on-going but	Strategic plans are common.	Strategic plans are common. There is widespread involvement in	Five-year strategic plans are common across most institutions.

	with no action.		their development.	
<b>Establishing research culture and ethos.</b>	The importance of a research culture is officially recognised but institutions do not have a strong research culture.	Research universities and government research institutes have policies to promote and support a research culture and ethos.	National research universities and research institutes actively promote the development of a research culture and ethos.	The need to promote and facilitate an institutional research culture is recent. In some universities, publications are becoming performance indicators.

## Management of R&I

There are differences between the four countries in terms of the distinctiveness and strength of the research mandate given by governments to different institutions. Malaysia and Thailand have adopted strategies of designating particular public universities as research intensive. Malaysia has five designated research universities, and Thailand has nine. These universities have also been given access to significantly larger amounts of public funding to support their research. The designated Malaysian universities have also been given more institutional and financial autonomy than other universities in Malaysia. In Thailand, there are 16 “autonomous” higher education institutions, but some of the designated national research universities are not recognised as autonomous. With more freedom, and particularly as a consequence of having additional funds, research-intensive universities in Malaysia and Thailand have been able to develop internal management structures to drive and support a research agenda. The designated research universities in Malaysia, for example, typically appoint a deputy vice-chancellor with research management responsibilities. A research management office supports this position, and there is also a network of research sub-deans across schools and faculties. In Thailand, the national research universities have a vice-president for research affairs. In Vietnam, there are no designated research-intensive universities, though the government has signalled its intention to move in that direction and trials are under way within the two national universities and with several small “new-model” universities established through international collaborations. In Cambodia, there are no designated research-intensive universities.

## Leadership awareness of R&I settings

There is no proper basis for comparing the four countries in terms of the extent to which leaders within research institutions have a sound awareness of R&I settings – concerning global research trends, policy settings and funding sources. There are, however, differences between the four countries in the ways in which policy makers and institutional leaders engage with one another in developing an understanding of these settings. From the country reports for Malaysia and Thailand, it is evident that policy makers and institutional leaders engage collaboratively with the task of assessing trends, reviewing policies and determining funding allocations. There is an emphasis on the use of committees through which multiple stakeholders can contribute to the discussion of R&I settings. A

similar level of collaboration is not evident from the country report on Vietnam where policy is determined more in a top-down fashion, and institutional leaders rely more on their own informal networks to become aware of R&I settings. In Vietnam and Cambodia, there is little emphasis on the importance of training programmes for research leaders. One consequence is that, as noted in the country report for Cambodia, “policy decisions are more often based on assumptions, values and personal experiences, than on systematically collected data.” Vietnam does have some policy researchers to provide advice to the state, but the extent to which their voices are heard is uncertain.

### **Institutional governance of R&I**

With greater institutional autonomy and with better research funding, research-intensive universities in Malaysia and Thailand are able to establish institutional governance and management systems that enable them to engage meaningfully in long-term planning, make staffing appointments that support a research culture, reward research achievements, and implement policies and processes in support of a research culture and ethos. In Vietnam and Cambodia, progress in this direction is taking place much more slowly, if at all.

### **Strategic planning for R&I**

Strategic planning for R&I is reported to take place in Malaysia, Thailand and Vietnam. As noted earlier, in Malaysia and Thailand there is more of a collaborative approach to planning, whereas in Vietnam the planning culture is more top down. Of note is Malaysia’s strategic plan to assist the Science University of Malaysia (USM) to secure “world-class” status. In Vietnam, similar aspirations have been expressed for the two “new-model” universities being supported by with funds from consortiums in Germany and France, respectively, but, to date, these universities appear to be falling well short of official expectations.

### **Establishing a research culture and ethos**

There are differences between the four countries in terms of their commitment to and ability to support the development of a research culture and ethos in public universities. Again, the situation in Malaysia and Thailand contrasts with that in Vietnam and Cambodia. The country reports for Malaysia and Thailand indicate that a research culture and ethos is established in the research-intensive universities. The challenge now is to boost this culture in all public universities. The country reports for Vietnam and Cambodia present a different picture – neither country has a well-developed research culture and ethos in their public universities. A significant obstacle to the development of a research culture is the relatively low level of salaries paid to university lecturers. To supplement their income, academic staff members from public universities often take second jobs teaching at private universities, or teaching in in-service and other non-regular programmes, or undertaking paid after-hours tutoring for students. There is little or no time for research, which is much less financially rewarding.

## Theme 3: Management support for leadership of research in public institutions

Table 6 presents an overview of findings relating to the third theme from the typology, management support for leadership of research in public institutions. This theme concerned the extent to which research leadership is well supported within public research institutions.

*Table 6. Findings on management support for leadership of research in public institutions*

Elements	Cambodia	Malaysia	Thailand	Vietnam
<b>Organisational structure</b>	Research offices within public universities act as a focal point for co-ordinating research activities and liaising with the ministry.	Most public universities have a Division of Research and Innovation to support the leadership of research.	Autonomous national research universities and public research institutes establish their own supporting infrastructures for R&I.	Functional departments (e.g. research offices), consulting bodies (e.g. Academic and Training Councils), and leadership bodies (e.g. rector's boards) provide support at an institutional level.
<b>Research management and administration</b>	Specialised departments or graduate programmes under the management of the university seek external funds or get involved in research funded by external agencies. There are no research funds at university level.	There are appropriate and extensive management structures to support the research leadership. A deputy vice-chancellor is normally appointed to be responsible for research, and this position is well supported in schools.	Bodies such as the Office of Research Affairs at Chulalongkorn University provide the main institutional support. A vice-president for research is often appointed, together with deputy deans for research.	A senior academic staff member may be assigned responsibility for research leadership by being appointed as a vice-rector in charge of research affairs – but this culture is new in many universities and research management may not be the appointee's only responsibility.
<b>Commercialisation of R&amp;I</b>	There is little or no focus on commercialising research outputs.	At all levels, the pressure to commercialise research products	Structures and processes exist to support research commercialisation	There is increasing pressure on universities and

	Institutional capacities for research and the commercialisation of research products are too weak.	is intensifying. Structures and processes are being developed to support commercialisation, but it is one of the weaker aspects of the system.	by national research universities, but significant progress remains to be seen.	public research institutes to commercialise their research products – but this culture is new and there is limited capacity.
<b>Management of research personnel</b>	Incentives to undertake research are minimal or non-existent. Leadership tends to focus on teaching facilities and infrastructure, rather than research	Research universities rely on committees for decision-making, and on faculties for implementing policies and plans. Universities now have no problem in attracting high-calibre PhD graduates.	Research commitment and achievements now feature prominently in human resource planning and management.	Decisions are more likely to be taken by a research leader, and the Academic and Training Council of the University, who will normally take account of the views of a research team. Universities do not generally have staff members with dedicated research roles.
<b>Management of research students</b>	Research Offices within universities provide support and guidance for research students. Their impact is limited.	Research universities have established various forms of support for research students.	National research universities usually have offices responsible for the provision of centralised support for research students. For individual support, the students tend to rely on their supervisors.	Functional departments (e.g. research offices, postgraduate programme offices and international relations offices) provide general support, but there are gaps. A regulation that requires academic staff to devote a proportion of their annual workload to research, but it is not consistently enforced.

## **Organisational structure**

Public universities across all four countries have organisational structures to support the leadership of research. Typically, these involve the appointment of a member of the institution's executive team to provide leadership of the research agenda. This position is supported structurally with other appointments across faculties and schools, and administratively with functional departments. In Malaysia and Thailand, for example, universities typically appoint a deputy vice-chancellor for research or a vice-president for research affairs to develop the research priorities for the institution and to ensure the delivery of appropriate support for academic staff members and students undertaking research. This position is supported by the appointment of research sub-deans (or similar) across schools or faculties, and by the establishment of a research management office that helps to formulate policies and create processes for the management and advancement of research. Universities that are more research-intensive may also have an innovation and commercialisation office. In Thailand, for example, a University Institute for Intellectual Property Management operates under a foundation agreement. Arrangements of this nature also exist in universities in Vietnam and Cambodia, but it is clear that the capacity of universities in Vietnam and especially in Cambodia to support these structures is significantly constrained by limited funds.

## **Research management and administration**

Universities in Malaysia and Thailand, especially the research-intensive universities, are much better resourced for establishing research management and administration systems than are universities in Vietnam or Cambodia.

## **Commercialisation of R&I**

Governments are increasingly pressurising public universities and research institutes in Malaysia, Thailand and Vietnam to commercialise research products. Many universities are establishing offices for the commercialisation of research products, and the commercialisation of research products and processes has become a mainstream activity for larger public research institutes, especially in Malaysia and Thailand. The country reports for Malaysia and Thailand suggest, however, that the process of commercialisation of research products is not yet as well supported as it might be. In universities, in particular, academic staff members need to be given more skills so that they are more aware of possibilities for commercialisation and are better able to master the relevant procedures. The Malaysia country report also notes the need for more skills and knowledge in the area of international collaborations and the sourcing of international venture capital.

## **Management of research personnel**

Structures and processes for the management of research personnel are becoming well established in the research-intensive universities in Malaysia and Thailand. Models being developed in these universities are having an impact on other universities in those countries. A distinctive characteristic of these models is the emphasis placed on research publications and success in obtaining research grants as foundations for career progression. In some universities in Vietnam, a research culture is becoming established, and management processes are placing more emphasis on research

productivity. In Cambodia, the research culture in universities is not yet strong enough for these developments.

### Management of research students

The mechanisms for supporting research students are broadly similar across all four countries, but Vietnam and Cambodia are more restricted by limited research budgets. Across all four countries, universities have offices to support research students that provide administrative, mentoring and training support to various degrees. The Malaysia country report documents a highly sophisticated level of support provided for research students at USM – which is, of course, being strongly supported by the government to become a “world class” university. The Vietnam country report profiles the more limited range of support provided by public universities for research students in that country.

## Theme 4: leadership skills of researchers in institutions

Table 7 presents an overview of the findings for the fourth theme of the typology, leadership skills of researchers in institutions.

*Table 7. Findings on leadership skills of researchers in institutions*

Elements	Cambodia	Malaysia	Thailand	Vietnam
<b>Research students, and postdoctoral and newly independent researchers</b>	There are relatively few full-time doctoral students, no postdoctoral appointments, and no full-time research staff in Cambodia’s public universities.	Responsibility for developing researchers rests mainly at the school level within RUs, though with central support in the form of general training programmes. Larger public research institutes are more likely to conduct extended induction programmes for new research staff members.	Research students are generally inducted to research in their faculties or in their research institutes. Centralised training programmes on specific aspects of research are routinely provided. At Chulalongkorn University, a central Graduate College	There are no induction programmes, but there are research methodology coursework and postgraduate training programmes. There are no post-doctoral programmes.

			oversees quality control.	
<b>Development of research leadership</b>	As there is no link between research achievements and promotions, there is no incentive to pursue research leadership. Some well-established researchers do, however, engage with national committees, councils and research-focused government instruments.	In research universities, committees assist with the development and implementation of strategies to increase research productivity. Development of research leadership skills occurs informally in research universities. The Malaysia Higher Education Leadership Academy conducts programmes on R&I for university leaders.	In national research universities, research productivity is becoming an increasingly important consideration in decisions over promotions. Government agencies conduct training programmes for research leaders. Universities themselves organise their own training programmes.	There are no significant financial rewards or incentives for established researchers. They are usually given public honours. They may also have more opportunity to be promoted to professorial level. Formal requirements for research leadership are not clearly defined. Promotion to these positions requires political acceptability as well as administrative training.

### **Research students, postdoctoral and newly independent researchers**

The extent of the induction provided to research students, and to postdoctoral and newly independent researchers, varies greatly across the four countries. In Cambodia, it is reported to be negligible because there are relatively few full-time doctoral students and few, if any, full-time research staff in public universities. In Vietnam, there are training programmes provided by the larger universities, but gaps exist, particularly in relation to writing skills, ethical issues and intellectual property issues. In Thailand and Malaysia, a culture is developing whereby younger researchers are mentored by more experienced researchers, and experienced researchers are expected to demonstrate research leadership. Research leadership skills are also being developed, mainly by sending younger researchers to conferences and by arranging for their participation in specialised training programmes such as the training programmes conducted in Malaysia by the Higher Education

Leadership Academy (AKEPT). Public research institutes may also provide extended induction training programmes for new employees, and they may invest significantly in developing the skills of more senior researchers in commercialising research outputs.

## **Development of research leadership**

Differences between the four countries are again evident in relation to the development of research leadership. The pathways to research leadership in Malaysia and Thailand are similar to those in most developed countries – the accumulation of research experience, publishing success and success in obtaining research funds. In addition, attending high-level training programmes may be important as a basis for ensuring a better understanding of research policy settings and research trends. The pathway to senior research leadership in Vietnam is different. As documented in the Vietnam country report, the requirements for institutional leadership are the same across all areas of university life: nomination by the institutional Communist Party Committee to attend an advanced political theory programme conducted by the Party, followed by successful completion of a public administration programme conducted by a National Institute of Politics and Public Administration, followed by success in obtaining a passing grade in a Senior Staff Testing Program. Vietnam’s Confucian legacy is evident in its attachment to the importance of an examination to attain high office, but so too is the extent of political control exercised by the Party. As noted in the country report, there may, therefore, be research managers in Vietnam who have never undertaken any formal research management training, and who may not have even been screened for personal qualities and behaviours that research managers usually require to be effective.

## **Gaps in knowledge and skills**

Each of the country reports identified gaps in knowledge and skills for effective R&I management for research institutions, and for funding agencies and policy makers and makes recommendations for improvement. Table 8 summarises these at a policy level. Table 9 summarises them at an institutional level.

The order of importance of these gaps indicated or implied in the individual country reports is retained in these tables – the most important gaps are identified first. For clarity, however, the wording to express the gaps has been standardised.

A feature of the country reports, reflected in both tables, is the extent to which emphasis is placed on recommendations for action, rather than on gaps in information and skills. Taking one example, the country report for Malaysia states that “the success of R&I in Malaysia could be further improved if there were less wastage of resources and a change in the work ethics of the researchers”. This statement sounds like a call to action for institutional managers to address issues of wastage and a lack of sufficient commitment to research success. However, it can also be interpreted as indicating an underlying gap: the need for more knowledge about the extent to which resources for research might be combined more efficiently and better skills in staff performance management. In interpreting the information presented in Tables 8 and 9, attention is given only to what the recommendations imply in

terms of a need for more knowledge and better skills, at a policy level or within institutions. This paper does not address the “call to action” aspect of them.

**Table 8. Gaps in knowledge and skills at a policy level**

<b>Cambodia</b>	<b>Malaysia</b>	<b>Thailand</b>	<b>Vietnam</b>
Increase the level of commitment of national leaders to the importance of R&I.	Improve the capacity of universities to support research and to provide research opportunities for trained researchers.	Improve national leadership capacity for the development of strategic and evidence-based R&I policies.	Ensure a better understanding by institutional leaders about research trends, policy settings and funding settings.
Ensure a better understanding by institutional leaders about research trends, policy settings and funding settings.	Develop the capacity of universities and research institutes to commercialise research products.	Reform the national research system with a view to removing imbalances, fragmentation and redundancies in the way the system is managed and administered.	Improve performance in translating policy aspirations into practice.
Improve national leadership capacity for the development of strategic and evidence-based R&I policies.	Shift the focus of research funding to ensure more funds are being spent on basic research.	Provide better co-ordination between the national agencies providing support for R&I.	Improve national leadership capacity for the development of strategic and evidence-based R&I policies.
Improve the capacity of universities to support research and to provide research opportunities for trained researchers.	Make the availability of public funds for research more competitive, and attach more importance to medium-sized research projects.	Improve the effectiveness of national funding, budgeting and accountability mechanisms as these relate to R&I.	Reform the national research system with a view to removing imbalances, fragmentation and redundancies in the way the system is managed and administered.
Improve performance in translating policy aspirations into practice.	Require increased participation by international experts on review panels for funding applications, especially in emerging fields of research.	Ensure a better understanding by institutional leaders about research trends, policy settings and funding settings.	Provide far more training opportunities for research leaders.
Develop adequately funded research universities that are autonomous in their governance and management.	Ensure a better understanding by institutional leaders about research	Improve the capacity of universities to support research	Establish a national framework for research ethics.
			Give research universities more institutional

	trends, policy settings and funding settings.	and to provide research opportunities for trained researchers.  Develop the capacity of universities and research institutes to commercialise research products.	autonomy.  Improve the capacity of universities to support research and to provide research opportunities for trained researchers.  Develop the capacity of universities and research institutes to commercialise research products.
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Some important themes emerge from Table 8. First, there is a persistent concern about the need at a policy level to “improve the capacity of universities to support research and to provide research opportunities for trained researchers”. This need is identified across all four country reports, and it links with other identified needs, including the need to “increase the level of commitment of national leaders to the importance of R&I”, “improve the capacity of universities to support research and to provide research opportunities for trained researchers”, and “improve performance in translating policy aspirations into practice”. Interpreting what these needs mean in terms of more knowledge and better skills for policy makers, the implication is that policy makers need to become better informed about the national importance of making a stronger commitment to R&I by investing more heavily in capacity building and the expansion of opportunities for research in universities. They also need to be encouraged to develop skills in translating expressions of support for R&I (as found in official documents across all four countries) into focused plans of action.

Second, there is a persistent concern about the need at a policy level to “ensure a better understanding by institutional leaders about global research trends, policy settings and funding arrangements”. This need is also identified across all country reports, and is given most emphasis in the reports for Vietnam and Cambodia. It links with another need identified in the reports for Thailand, Vietnam and Cambodia, that is, to “improve national leadership capacity for the development of strategic and evidence-based R&I policies”. These imply a gap in the knowledge of policy makers about trends, settings and institutional arrangements that relate to the national advancement of R&I. They also imply a need to improve skills in developing R&I policies that are based on evidence and informed by strategic considerations – as opposed to being based on “assumptions, values and personal experiences”, as was reported to be the case in Cambodia.

Third, there is a concern expressed in the reports from Malaysia, Thailand and Vietnam about the need to “develop the capacity of universities and research institutes to commercialise research products”. In other words, policy makers need to develop an appreciation of the training needs of researchers in universities and research institutes concerning the processes of commercialisation. By implication,

they also need to become better informed about the effectiveness of different policy levers that might improve the willingness of the private sector to invest in the commercialisation of research products.

The other areas of need the reports identify are more specific to the individual countries concerned. The country reports for Cambodia refers to a need to “develop adequately funded research universities that are autonomous in their governance and management”, for example, while the Vietnam report identifies a need to “give research universities more institutional autonomy”. The implication here is that policy makers should develop a better appreciation of how important institutional autonomy is to universities that are expected to make a significant contribution to R&I. The country reports for Thailand and Vietnam both refer to a need to “reform the national research system with a view to removing imbalances, fragmentation and redundancies in the way the system is managed and administered”, and the report for Thailand also indicates a need to “provide better co-ordination between the national agencies providing support for R&I” and to “improve the effectiveness of national funding, budgeting and accountability mechanisms as these relate to R&I”. The research systems in these two countries are markedly different in terms of how they function and in their developmental stage. Policy makers in both countries, however, need to develop a deeper appreciation of the adverse impact that leaving their national research systems in their current state of organisation and co-ordination would have on their national commitment to R&I.

The country report for Malaysia identifies additional needs that may well relate to Malaysia’s more advanced research status. They include needs to: “shift the focus of research funding to ensure more funds are being spent on basic research”, “make the availability of public funds for research more competitive, and attach more importance to medium-sized research projects” and “require increased participation by international experts on review panels for funding applications, especially in emerging fields of research”. Policy makers need opportunities to appreciate the depth of international experience underpinning these identified needs. They may also need to be provided with knowledge about relevant policy levers.

The country report for Vietnam also identifies needs that relate particularly to its national setting. It is proposed that policy makers should “provide far more training opportunities for research leaders”, and that they should “establish a national framework for research ethics”. The gap in knowledge underlying these suggestions relates to information about the kind of training opportunities that would be appropriate for research leaders and about examples of other national research ethics frameworks.

Table 9 covers gaps at the institutional level. The country reports for Malaysia, Thailand and Vietnam identify the need for institutions to “provide more training for research managers and administrators in vetting research proposals, managing finance, staff and assets, and monitoring and evaluating research projects”. In this case the clear implication is that research managers and administrators are at present insufficiently skilled and insufficiently knowledgeable for the effective performance of these tasks. The Cambodia and Thailand country reports indicate a need to “develop and implement routinely mechanisms to support university-industry linkages”. Here, the implied suggestion is that in these two countries knowledge and skills about university-industry linkages are deficient. The Cambodia and Vietnam country reports indicate a need to “develop a career structure in universities for researchers”. This need may, however, reflect a resource deficiency as well as a need for

institutional leaders to become more familiar with the benefits of creating a career structure for researchers.

**Table 9. Gaps in knowledge and skills at an institutional level**

<b>Cambodia</b>	<b>Malaysia</b>	<b>Thailand</b>	<b>Vietnam</b>
Increase the extent of institutional co-operation in support of research.	Provide more training for research managers and administrators in vetting research proposals, managing finance, staff and assets, and monitoring and evaluating research projects.	Provide more training for research managers and administrators in vetting research proposals, managing finance, staff and assets, and monitoring and evaluating research projects.	Provide opportunities for trained researchers to proceed with research that is at an international standard.
Develop and implement routinely mechanisms to support university-industry linkages.	Reduce the extent of wastage and improve the work ethic of researchers.	Develop and implement routinely mechanisms to support university-industry linkages.	Develop a career structure in universities for researchers.
Develop a career structure in universities for researchers.	Assist researchers to expand their international networks and improve their writing skills in English.		Provide more training for research managers and administrators in vetting research proposals, managing finance, staff and assets, and monitoring and evaluating research projects.
	Increase the number of trained researchers.		Appraise researchers and appoint research managers solely on the basis of their research achievements and merits.

The country reports for Cambodia, Malaysia and Vietnam identify specific areas of concern. The country report for Cambodia indicates an institutional need to “increase the extent of institutional co-operation in support of research” but it is difficult in this instance to identify what the underlying gap may be in knowledge and skills. The country report for Malaysia indicates an institutional need to “reduce the extent of wastage and improve the work ethic of researchers”, “assist researchers to expand their international networks and improve their writing skills in English” and “increase the number of trained researchers”. These point to gaps in knowledge about the extent of resource wastage at an institutional level, skills in the performance management of academic staff members at an institutional level, skills in developing international networks at an institutional level and in using

English for academic purposes, and gaps in knowledge about future institutional need for trained researchers. The country report for Vietnam indicates an institutional need to “provide opportunities for trained researchers to proceed with research that is at an international standard” and to “appraise researchers and appoint research managers solely on the basis of their research achievements and merits”. These needs imply that academic institutional managers do not appreciate enough the value of capitalising on the skills of trained researchers, and that they need to develop a better understanding of international practices in the appraisal of researchers and the appointment of research managers.

## Concluding comments

This paper has sought to develop a summary of the knowledge and skills gaps for R&I management for universities engaged with R&I, and for funding agencies and policy makers. The summary is based on four country reports for Cambodia, Malaysia, Thailand and Vietnam. The scope of the task has been ambitious, but there are some straightforward conclusions to be drawn.

Before addressing these conclusions, some cautionary general points need to be made. First, while the countries on which this report are based appear generally to be committed to developing their R&I capacity, it is not clear to what extent they have explicitly investigated the foundations for such a commitment. If they have not, then there is a significant gap in their policy-related information. Given Singapore’s status as a model of economic development for the region, developing countries in the region may have a tendency to follow its example and invest heavily in R&I without examining carefully the social rates of return from such investments. However, where these have been investigated, and are found to be attractive, then the lack of political commitment referred to in some of the country reports, and the instances of misallocation of resources referred to directly or indirectly in all of them, become inexcusable.

Second, globalisation, increasing international mobility and rapid technological change, while creating significant social benefits on a worldwide scale, also present significant challenges for developing economies. For example, the costs of commercialising research products can be prohibitive in situations where an expensive bureaucracy is required to protect patents and to fend off counter-claims of ownership by well-funded global rivals. “Brain drain” can quickly whittle away many of the immediate benefits of years of public investment in building a reserve of highly trained researchers. Rapid technological change means that even keeping up with contemporary research in laboratory-based and technological fields requires ongoing and ever-increasing expenditure on new items of equipment. These costs are difficult for developing economies to sustain.

Third, developing economies often have legacies of political and social instability. The countries selected for examination in this report are cases in point. These legacies may mean that there are “sensitive topics on which research is not generally encouraged” (an extract from the Cambodian country report). The identification of knowledge and skill gaps for R&I management by universities, funding agencies and policy makers in developing countries cannot be completely divorced from the political and social reality of the developing countries concerned.

### **The strongest conclusions from the country studies are, then:**

- Policy makers in general need to become better informed about the national importance of making a stronger commitment to R&I by investing more heavily in capacity building and the expansion of opportunities for research in universities.
- Policy makers and institutional leaders need to become much better informed about global research trends, policy settings and funding arrangements affecting R&I management.
- Policy makers need to be assisted to develop skills in developing R&I policies that are based on evidence and informed by strategic considerations.
- Policy makers need to develop an appreciation of the training needs of researchers in universities and research institutes concerning the processes of commercialisation.
- Policy makers need to develop a better appreciation of how important institutional autonomy is to universities if universities are to be expected to make a significant contribution to R&I.
- Research managers and administrators within universities and research institutes need more support with the development of knowledge and skills related to their responsibilities.

There are some final comments to be made, more in the form of suggestions about what might come next. First, it is curious that the topic of intellectual property did not feature more strongly across the country reports. These issues are known from many other sources to be challenging for developing economies. Perhaps intellectual property as an area of concern in R&I management in the four countries requires more detailed attention at some point in the future. Second, the brief for this report was to focus on the deficits – its quest was to find “gaps”. In fact, however, each of the countries reviewed has recorded many achievements in R&I management. At some point in the future they should be recorded, although more time would be needed to do so. Third, there has not been sufficient time to assess properly the potential for collaboration across the four countries in terms of initiative to improve R&I management.

*At the International Workshop on the Effectiveness of Research and Innovation Management at Policy and Institutional Levels, held in Kuala Lumpur as a part of this project, it was suggested that establishing certified executive training courses could be one way forward for providing a structured forum for policy learning and exchange of research and innovation management. These courses would target professionals in charge of research funding at the policy level and research leaders and managers at institutional levels. The courses would be comprised of a mix of theory and practice through lectures and exercises designed to put the course participants’ experiences, challenges and interests at the centre of the learning experience. So as to enhance accessibility and flexibility, a mixed mode of online and face-to-face delivery approached should be explored. In this fashion countries would develop their own expertise and it would give the research leaders and managers access to a regional network of professionals in similar positions. This potential warrants attention, particularly within an ASEAN framework of co-operation*

## References

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<sup>1</sup> From the World Bank's databank for GNI per capita, adjusted for purchasing power parity (PPP) for 2011, the figures are: Malaysia USD 15 650, Thailand USD 8 360, Vietnam USD 3 250, Cambodia USD 2 230. In comparison, the figure for Singapore was USD 59 380.

<sup>2</sup> UNESCO Institute of Statistics and World Bank databank.

<sup>3</sup> In the country paper on Malaysia, the figure for 2008 for Malaysia is reported as being 0.82%.

# Appendix A

## Programme: Workshop on Effectiveness of Research and Innovation Management at Policy and Institutional Levels

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**Workshop on  
Effectiveness of Research and Innovation Management at Policy and  
Institutional Levels**

**27 February – 1 March 2013**

**Intercontinental Hotel, Kuala Lumpur**

<b>Day 1 – Wednesday, 27 February 2013</b>	
5:00 p.m.	<b>Arrival of participants &amp; check-in at Intercontinental Hotel, Kuala Lumpur</b>
7:30 p.m. – 9:30 p.m.	<p><b>Welcome reception &amp; dinner</b></p> <p><b>Welcoming remarks by</b></p> <p>Assoc. Prof. Dr. Mohd Fadzil bin Mohd Idris (Deputy Director of AKEPT)</p> <p>Åsa Olsson (OECD)</p> <p>Professor Leo Goedegebuure (L.H. Martin Institute)</p>
<b>Day 2 – Thursday, 28 February 2013</b>	
8:00 a.m. – 8:30 a.m.	<b>Registration</b>
8:30 a.m. – 9:00 a.m.	<p><b>Seminar welcomes by</b></p> <p>Åsa Olsson (OECD, IHERD)</p> <p>Professor Leo Goedegebuure (L.H. Martin Institute),</p> <p>Professor V. Lynn Meek (L.H. Martin Institute)</p> <p>(Programme overview and procedural information)</p>
9:00 a.m. – 9:25 a.m.	<p><b>Welcoming speech by</b></p> <p><b>Datuk Ab. Rahim Md. Noor</b> <b>The Hon. Secretary-General of the Ministry of Higher Education Malaysia</b></p>
9:30 a.m. – 11:00 a.m.	<p><b>Session 1: Typology of knowledge and skills requirements for research leadership</b></p> <p><b>Chairperson:</b> Dr. Molly Lee</p> <p><b>Presenter/author:</b> Professor Alan Pettigrew</p> <p><b>Discussion:</b> All participants</p>
11:00 a.m. – 11:30 a.m.	Coffee Break
11:30 a.m. – 12:15 p.m.	<p><b>Session 2: Overview of key providers of capacity building programmes</b></p> <p><b>Chairperson:</b> Professor Alan Pettigrew</p> <p><b>Presenter/author:</b></p>

	Fabiana Barros de Barros  <b>Discussion:</b> All participants
12:15 p.m. – 2:00 p.m.	<b>Lunch</b>

2:00 p.m. – 2:30 p.m.	<b>Session 3: Introduction to case studies</b>  <b>Chairperson:</b> Professor V. Lynn Meek  <b>Presenter/author:</b> Professor Martin Hayden
2:30 p.m. – 3:30 p.m.	<b>Session 4: Presentation of country case studies of research management needs and capacity at sector and institutional levels</b>  <b>Chairperson:</b> Professor Martin Hayden  <b>Presenter/author:</b> Dr. Molly Lee (and team)  Dy Sideth (and team) Pham Thi Ly (and team) Professor Charas Suwanwela (and team)  <b>Discussion:</b> All participants
3:30 p.m. – 3:45 p.m.	Afternoon tea
3:45 p.m. – 4:45 p.m.	<b>Session 4: Continued</b>  <b>Chairperson:</b> Professor Martin Hayden  <b>Presenter/author:</b> Dr. Molly Lee (and team)  Dy Sideth (and team)

	<p>Pham Thi Ly (and team) Professor Charas Suwanwela (and team)</p> <p><b>Discussion:</b> All participants</p>
4:45 p.m. – 5:00 p.m.	<p><b>Day one overview and outline of day two</b></p> <p><b>Chairperson and facilitator:</b> Dr. Mary-Louise Kearney Adjourn Dinner: Saloma Bistro Restaurant</p>
<b>Day 3 – Friday, 1 March 2013</b>	
9:00 a.m. – 10:00 a.m.	<p><b>Session 5: Recap of country case studies and outline of key issues</b></p> <p><b>Chairperson:</b> Professor V. Lynn Meek</p> <p><b>Presenter/author:</b> Professor Martin Hayden</p>
10:00 a.m. – 11:00 a.m.	<p><b>Session 6: Country expert breakout group discussion of strategies to enhance effectiveness of research and innovation management at policy level</b></p> <ul style="list-style-type: none"> <li>● Thailand / Malaysia / Vietnam / Cambodia</li> </ul>
11:00 a.m. – 11:30 a.m.	Coffee break
11:30 a.m. – 1:00 p.m.	<p><b>Session 7: Country expert breakout group discussion of strategies to enhance effectiveness of research and innovation management at institutional level</b></p> <ul style="list-style-type: none"> <li>● Thailand / Malaysia / Vietnam / Cambodia</li> </ul>
1:00 p.m. – 2:30 p.m.	Lunch
2:30 p.m. – 4:30 p.m.	<p><b>Session 8: Report and recommendations of the breakout groups</b></p> <p><b>Chairperson:</b> Professor Martin Hayden</p> <ul style="list-style-type: none"> <li>● Thailand / Malaysia / Vietnam / Cambodia</li> </ul>

4:30 p.m. – 5:00 p.m.	Afternoon tea
5:00 p.m. – 6:00 p.m.	<p><b>Session 9: Workshop overview and recommendations for future action</b></p> <p><b>Chairperson and facilitator:</b> Dr. Mary-Louise Kearney</p> <p>Closing remarks: Åsa Olsson</p>
8:00 p.m. – 10:30 p.m.	<b>Networking dinner</b>

<b>Day 4 – Saturday, 2 March 2013</b>	
9:00 a.m. – 1:00 p.m.	<p><b>Project team members only</b></p> <p><b>Outline and prioritise main follow-up actions and policy options arising from the workshop</b></p>
1:00 p.m.	Lunch / end of programme

# Appendix B

## List of participants: Workshop on Effectiveness of Research and Innovation Management at Policy and Institutional Levels

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Name	Institution/Organisation
<b>Malaysian participants</b>	
Saari Mustapha	University Kebangsaan Malaysia (UKM)
Abdul Jalil bin Nordin	University Putra Malaysia (UPM)
Awangku Abdul Rahman Hj. Awangku Yussuf	Pengarah PHIP, USIM
Christopher Hill	University UNIM
Azizan bin Hj. Abu Samah	Director, NARC, Department of Geography, University of Malaya
Magewary Karpudewan	School of educational studies, University Sains Malaysia (USM)
Mohamad Nidzam Rahmat	Research Management Institute, UiTM
Mohd Fadzil Mohd Idris	Deputy Director, Centre for leadership research and innovation
Mohd Ghazali Abas	Director, Human Capital Development Section Economic Planning Unit (EPU)
Mohd Jailani Mohd Nor	Deputy Vice Chancellor, Research and Innovation, University Teknikal Melaka
Molly Lee	University Sains Malaysia (USM)

Morshidi Sirat	Deputy Director-General, Department of Higher Education (Public Sector), Ministry of Higher Education
Norasikin Ahmad Ludin	SERI, UKM
Normy Nurfiza Abd. Razak	University Tenaga Nasional (UNITEN)
Norzaini Azman	Faculty of Education, University Putra Malaysia
Syahrulnizam Kamaruzzaman	Faculty Alam Bina, UM
Wan Chang Da	Research fellow, National Higher Education Research Institute (IPPTN)
Zainal Abidin Sanusi	Deputy Director, Center for Leadership Training, AKEPT
<b>International participants</b>	
Alan Pettigrew	Professorial Fellow, L.H. Martin Institute for Tertiary Education Leadership and Management, Melbourne Graduate School of Education, University of Melbourne
Anshumali Padayachee	Chef Executive Officer, SANPAD
Åsa Olsson	Project manager IHERD, OECD
Buncha Pulpoka	Assistant to the President for Research, Chulalongkorn university , Bangkok
Charas Suwanwela	School of medicine of the Chulalongkorn University, Bangkok, Thailand.
Dao Van Khanh	Post Doctoral Research Fellow, Southern Cross University
Elodie Pierre	OECD, Directorate of Science Technology and Industry
Fabiana Barros de Barros	PhD candidate, L.H Martin Institute for Tertiary

	Education Leadership and Management Melbourne Graduate School of Education, University of Melbourne
H.E Mak Ngoy	Director-General of Higher Education, Ministry of Education Youth and Sport, Cambodia
Hoang Dung	Director of the Science and Technology Department at VNU-CHM
Huong Nguyen	PhD Candidate, L.H Martin Institute for Tertiary Education Leadership and Management Melbourne Graduate School of Education, University of Melbourne
Khov Makara	Director of Post-Graduate Programmes, Institute of Technology of Cambodia
Leo Goedegebuure	Director, L.H Martin Institute for Tertiary Education Leadership and Management Melbourne Graduate School of Education, University of Melbourne
Ly Pham	Dean, Research Programme International Education Institute, Vietnam, National University HCMC,
Martin Hayden	Head, School of Education, Southern Cross University, Australia.
Mary-Louise Kearney	Fellow, Department of Education, University of Oxford
Nguyen Loc	Vice-Director, Vietnam Institute of Education Research (VNIER)
Nguyen Quang Tuan	Vietnam
Nico Cloete	Director of Center for Higher Education Transformation, South Africa
Oum Ravy	Vice-Rector, University of Technology, Vietnam

	National University
Piyawat Boon-Long	President, Knowledge Network Institute of Thailand
Sideth Sam Dy	Consultant, Cambodia
Sundran Govender	Chief Financial Officer, SANPAD
Tran Thi Thu Huong,	Ministry of Science and Technology, Vietnam
V. Lynn Meek	Professorial Fellow, L.H Martin Institute for Tertiary Education Leadership and Management

# Appendix C

## Actors building skills and knowledge in research management

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### Introduction

This overview summarises the sort of programmes that are available for knowledge and skills development in leadership and management of research and innovation. These serve as a basis for compiling a typology for research and innovation management at policy and institutional levels.

It offers a first step towards visualising what is currently being done, especially in countries considered to be advanced in terms of R&D management. It also demonstrates how existing demand has shaped the rise and profile of providers as well as the content and delivery modes of such capacity-building initiatives.

#### Purpose of the overview

The purpose of this overview is to present the key providers of capacity-building programmes in research, innovation and higher education policy management. It is not intended to be exhaustive but rather to:

- provide examples and good practices found in different contexts
- serve as an inspiration for future initiatives
- provide input for future policy making
- highlight the growing demand for such initiatives in a diversity of contexts and disciplinary areas.

It is important to emphasise that the terms “training” and “capacity building” have been used in a broad sense encompassing different levels and skills-building approaches ranging from professional development and executive training to academic certificates and programmes (such as master's by research).

The content is organised into five thematic areas:

**Professional organisations:** the most active associations representing research and development managers with capacity building as one of their core missions.

**Development and executive training:** training programmes aimed at building capacity in R&D leadership and management.

**Research centres:** selected organisations that offer research management programmes not as a core function but as a response to a growing demand from their staff (academic or administrative).

**Academic and certificate programmes:** examples of academic programmes, master's or PhDs with a focus on higher education and research management.

**Leadership training for specific funding programmes:** examples of donors and funding programmes that provided support to projects aimed at building capacity in higher education and in R&D management and leadership.

Each example includes further details such as type, target audience, geographical scope, programme content and website for extra information.

## Professional organisations

- **Profile:** professional organisations that provide training opportunities for research and innovation managers and administrators.
- **Target audience:** research managers and scientists interested in acquire or reinforce management/fundraising skills.
- **Key training topics covered:**
  - acquisition of R&D funds
  - project management
  - European funding programmes
  - proposal writing
  - science lobbying
  - international scientific co-operation
  - contractual issues, communication issues
  - facilitation of technology transfer
  - commercialisation of research results
  - intellectual property rights in research
  - quality assurance

## Development & executive training programmes

- **Profile:** the objective of these programmes is to strengthen the management of research at an institutional level. They are often short term and many of these programmes are directed towards development imperatives for example agriculture.
- **Target audience:** the target audience varies but the most common are research staff executives, senior scientists with increasing managerial duties, early-career researchers and students.

➤ **Topics covered:**

- establishment of new research management offices within universities
- leadership and management skills
- research and technology management
- information and knowledge management
- administration and finance management
- academic entrepreneurship
- providing skills to students supporting partnerships between academy and the business sector.

## Academic and certificate programmes

➤ **Key programme types:**

- two-year full-time master's programmes
- Postgraduate certificates with a professional orientation, including face-to-face, distance education which may be partly online

➤ **Examples of type of programmes:**

- Master of Higher Education
- Tertiary Education Leadership and Management
- Master of Research Administration
- Master of Science in Management with specialisation in Research Administration
- Certificate in Clinical Research Management
- Introduction to Research Administration and Management (formerly called Foundations in Research Administration and Management)

## Leadership training for specific funding programmes

- **Actors:** these courses are led by organisations that have a direct relation to specific research funding programme and thus led by funding organisations. These could be national research councils, research foundations or bilateral and international funding organisations such as USAID and Sida.
- **Common programmes:** examples include the EU Framework Programmes and International Development Co-operation Programmes.

**Table 1. Professional organisations**

<b>Organisation and geographical reach</b>	<b>Type</b>	<b>Overview</b>
VITAE <a href="http://www.vitae.ac.uk">www.vitae.ac.uk</a> United Kingdom	Executive training for research managers & research scientists	Vitae is the UK organisation championing the personal, professional and career development of doctoral researchers and research staff in higher education institutions and research institutes.
NCURA - National Council of University Research Administrators <a href="http://www.ncura.edu">http://www.ncura.edu</a> United States	Executive training for research managers	NCURA is an organisation representing the professional interests and development of research administrators in the US offering annual meetings, thematic workshops and online courses.
EARMA - European Association of Research Managers and Administrators <a href="http://www.earma.org">www.earma.org</a> European Union	Executive training for research managers	EARMA represents the community of Research Managers and Administrators within Europe. They organise several fora for debate and training such as annual conferences and workshops most of them focusing on the European Research Area and funding instruments.
SRA - Society of Research Administrators International <a href="http://www.srainternational.org">www.srainternational.org</a> International	Executive training for research managers	SRA offers educational and professional development opportunities to its members including certificate programs and preparation to certification.
SARIMA - Southern African Research & Innovation Management Association <a href="http://www.sarima.co.za">www.sarima.co.za</a> South Africa	Executive training for research managers	SARIMA is an association for administrators and managers of research and innovation enterprises. Its objectives are to promote best practice in management and administration of research and innovation mainly through its annual conference.
ARMS - Australasian Research Management Society <a href="http://researchmanagement.org.au">http://researchmanagement.org.au</a> Australia	Executive training for research managers	ARMS is the professional society for research managers and administrators
AAIR - Australasian Association for Institutional Research <a href="http://aaair.org.au">http://aaair.org.au</a> Australia	Executive training for research managers & research scientists	AAIR is the professional association for institutional research practitioners in higher education and other institutions in Australasia. "Institutional research" is viewed as a range of activities involving the collection, analysis and interpretation of information descriptive of an institution and its activities, including its students and staff, programs, management and operations. The findings of such "institutional research" assist institutional leaders (in both academic and administrative domains) by informing their planning and decision making.
ACU - Association of Commonwealth Universities <a href="http://www.acu.ac.uk">www.acu.ac.uk</a> International	Executive training	With over 500 members and about 100 years of existence, ACU is the oldest international inter-university network in the world. It provides mainly networking opportunities through several events, information and mobility for its members.

INORMS - International Network of Research Management Societies <a href="http://www.inorms.org">www.inorms.org</a> International	Executive training for research managers	INORMS is an international network of research management societies and associations. INORMS Congresses are held biennially, usually linked to one of the member societies' annual meetings. The first such congress took place in Brisbane in 2006, the second in Liverpool in 2008, and the third in Cape Town in 2010.
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Organisation and scope	Type	Overview
WARIMA - West African Research and Innovation Management Association <a href="http://www.warima.org/en/">www.warima.org/en/</a> Africa	Executive training for research managers	WARIMA is the professional body for research management in the West Africa sub-region with the core objective of advancing research and innovation through advocacy of national and institutional policies by ensuring professional development and capacity building of individual members.
UCEA - the Universities and Colleges Employers Association <a href="http://www.ucea.ac.uk">www.ucea.ac.uk</a> United Kingdom	Executive training for research managers	UCEA also provides research and information, seminars, training and networking events but also lobbying with statutory and other bodies, and negotiation with trade unions.
ARMA - Association of Research Managers & Administrators <a href="http://www.arma.ac.uk">www.arma.ac.uk</a> United Kingdom	Executive training for research managers	ARMA is the professional association for research managers and administrators in the UK with around 1 800 individual members from universities, funding bodies and independent research institutions. Its objective is to facilitate excellence in research by identifying and establishing best practice in research management and administration.
DARMA - Danish Association of Research Managers & Administrators <a href="http://www.darma.dk">www.darma.dk</a> Denmark	Executive training for research managers	DARMA aims to contribute to the promotion of research conditions through the professionalisation of research administration and management in Denmark.
SARMA - Swiss Association of Research Managers and Administrators <a href="http://sarma.ch">http://sarma.ch</a> Switzerland	Executive training for research managers	SARMA is a non-profit national network of research management professionals which aims to promote networking, training and the sharing of good practice amongst its members.
TII - Technology Innovation International <a href="http://www.tii.org">www.tii.org</a> European Union	Executive training for research managers	TII is an independent association of technology transfer and innovation support professionals providing specialist training.
IGLO - Informal Group of RTD Liaison Offices <a href="http://www.iglortd.org">www.iglortd.org</a> European Union	Executive training for research managers	IGLO is an informal association of Brussels-based non-profit R&D Liaison Offices. The aim of IGLO is to facilitate and enhance the interaction, information exchange and co-operation between members of IGLO, their national research systems and the European institutions on issues related to EU RTD, in particular, the Framework Programme.
AUA - Association of University Administrators <a href="http://www.aua.ac.uk">www.aua.ac.uk</a> United Kingdom	Executive training for research managers	AUA promotes the professional recognition and development of all who work in professional services roles in higher education, and aims to be an authoritative advocate and champion for the sector in the UK.

Note: Programmes cover: acquisition of R&D funds, project management, European funding programmes, proposal writing, lobbying, international scientific co-operation, contractual issues, facilitation of technology transfer, communication issues, commercialisation of research results, and intellectual property rights in research"

**Table 2. Development and executive training programmes**

Programme and organisation	Main target audience and scope	Programme details
<p><b>Carnegie Programme to Strengthen Research Management in African Universities</b></p> <p>Carnegie Corporation and the Association of Commonwealth Universities (ACU)</p> <p><a href="http://www.acu.ac.uk/member_services/professional_networks/research_management/research_management_programme_carnegie">www.acu.ac.uk/member_services/professional_networks/research_management/research_management_programme_carnegie</a></p>	<p>Research managers &amp; research scientists</p> <p>Africa</p>	<p>The ACU was awarded a grant to run a three year project to support the strengthening of research management in a small cohort of African universities. This project aims to assist institutions to convert their awareness of research management issues into robust, sustainable structures by: ensuring that such structures have the opportunity to gain support and recognition throughout the institution; developing appropriate professional standards within the newly established structures and; ensuring that the new structures are able to draw on, and form part of, appropriate communities of practice.</p> <p>The participant universities are University of Winneba GHANA; University of Jos, NIGERIA; Obafemi Awolowo University, NIGERIA; Makerere University, UGANDA and University of Dar es Salaam, TANZANIA</p>
<p><b>Regional Course on Research Management for Executives (RRMEX)</b></p> <p>SEARCA (Southeast Asian Regional Center for Graduate Study and Research in Agriculture)</p> <p>SEAMEO (Southeast Asian Ministers of Education Organization)</p> <p><a href="http://beta.searca.org/searca/index.php/knowledge-management/learning-events/crosscutting-themes--staple-offerings/609-regional-course-on-research-management-for-executives-rrmex">http://beta.searca.org/searca/index.php/knowledge-management/learning-events/crosscutting-themes--staple-offerings/609-regional-course-on-research-management-for-executives-rrmex</a></p>	<p>Research Managers &amp; Research Scientists</p> <p>Southeast Asia</p>	<p>This programme has a strong regional drive as it aims to build regional competence in research management. It was created as a response to the strong demand from researchers in the region with increasing managerial duties and unmet training needs. Eligible participants: qualified nationals of selected SEAMEO member countries (i.e., Cambodia, Indonesia, Lao PDR, Myanmar, Philippines, Thailand, Timor Leste, and Vietnam) senior research executives or managers, head of unit/institution spending half of their time in research management. Duration: 3 days Cost: US\$415 (including materials, accommodation, meals, health insurance and airport transfer). Module 1: The Research Management System – the unique features, components, and interactions affecting team productivity and culture of excellence in knowledge-creating systems</p> <p>Module 2: Strategic Research Management – relevant concepts and analytical tools with their application to actual problems experienced in various contexts by research organizations</p> <p>Module 3: Managerial Leadership – issues and concerns faced by research executives with regard to leadership and management of research in the context of modern-day organizations and on the necessary skills, decision-aid tools, and useful tips on managing relations and dynamics of knowledge-creating teams</p> <p>Module 4: Resource Generation and Management – strategic ways by which research executives generate and allocate research grants and revenues, and establish resource complementation through institutional linkages/partnerships</p>
<p><b>Medici - The Enterprise Training Programme</b></p> <p>University of Birmingham - Centre for</p>	<p>Research Managers &amp; Research</p>	<p>The Medici Enterprise Training Programme trains internal and external entrepreneurial academic and research staff in the skills they will need to realise the commercial potential of their research.</p>

Professional Development <a href="http://www.birmingham.ac.uk/partners/business-services/professional-development/The-medicine-programme.aspx">www.birmingham.ac.uk/partners/business-services/professional-development/The-medicine-programme.aspx</a>	Scientists  United Kingdom	Through a combination of seminars and interactive group work sessions the programme identifies, and develops, the vital business skills that delegates will need in order to successfully commercialise their research. The programme also explores the various routes that delegates could follow to take their ideas and inventions forward commercially. In addition the course provides delegates with the opportunity to network and develop relationships with personnel from other universities.
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<b>Programme and organisation</b>	<b>Main target audience and scope</b>	<b>Programme details</b>
<p><b>Coach Lab</b></p> <p>The Innovation Hub</p> <p><a href="http://theinnovationhub.com/index.php?option=com_content&amp;view=category&amp;layout=blog&amp;id=47&amp;Itemid=190">http://theinnovationhub.com/index.php?option=com_content&amp;view=category&amp;layout=blog&amp;id=47&amp;Itemid=190</a></p>	<p>Technology students</p> <p>South Africa</p>	<p>CoachLab™ is a partnership between The Innovation Hub, local industry, training providers and universities and is aimed at top students - specifically those from disadvantaged backgrounds - studying in technology-related disciplines. Participants take part in action-learning projects that stimulate innovative thinking and develop leadership potential. This helps the students bridge the gap between the academic and business world.</p>
<p><b>Research Management Training</b></p> <p>Steinbeis Team Northeast</p> <p><a href="http://www.bio-ethics.eu/images/steinbeistraining.pdf">www.bio-ethics.eu/images/steinbeistraining.pdf</a></p> <p><a href="http://www.steinbeis-nordost.de/index_e.html">www.steinbeis-nordost.de/index_e.html</a></p>	<p>Research scientists</p> <p>Europe</p>	<p>Young scientists at the start of their careers as independent researchers are faced with a multitude of new challenges for which they are generally not well-prepared. This includes the management of scientific projects, the acquisition of research grants, commercialisation of research results, the professional presentation of scientific results and team leading qualifications. These skills are typically not taught in science curricula and few young researchers acquire qualifications in these fields during their early training. As researchers progress from PhD students to post docs and group leaders, this lack of training frequently leads to frustration and reduced efficiency. The presented research management training programme closes this gap.</p>

Programme and organisation	Main target audience and scope	Programme details
<p><b>The Researcher development framework</b></p> <p>Vitae</p> <p><a href="http://www.vitae.ac.uk/researchers/234471/Framework-content.html">www.vitae.ac.uk/researchers/234471/Framework-content.html</a></p>	<p>Research managers &amp; research scientists</p> <p>United Kingdom</p>	<p>The Researcher development framework is structured in four domains encompassing the knowledge, intellectual abilities, techniques and professional standards to do research, as well as the personal qualities, knowledge and skills to work with others and ensure the wider impact of research.</p> <p>The Researcher Development Statement (RDS) is derived from the Researcher Development Framework (RDF), and is the evolution of the Research Councils' Joint Skills Statement (JSS), replacing the JSS as the key reference statement for policy makers and research organisations that provide personal, professional and career development for postgraduate researchers and research staff employed in higher education.</p> <p>Within each of the domains are three sub-domains and associated descriptors, which describe different aspects of being a researcher.</p> <p>Domain A: Knowledge and intellectual abilities. The knowledge, intellectual abilities and techniques to do research.</p> <p>Domain B: Personal effectiveness. The personal qualities and approach to be an effective researcher.</p> <p>Domain C: Research governance and organisation. The knowledge of the standards, requirements and professionalism to do research.</p> <p>Domain D: Engagement, influence and impact. The knowledge and skills to work with others and ensure the wider impact of research.</p>
<p><b>Leadership in Action</b></p> <p>Vitae</p> <p><a href="http://www.vitae.ac.uk/researchers/104253/Leadership-in-Action.html">www.vitae.ac.uk/researchers/104253/Leadership-in-Action.html</a></p>	<p>Research managers &amp; research scientists</p> <p>United Kingdom</p>	<p>This three day residential course has been Vitae's most popular event ever since its launch in 2009. It allows researchers (postgraduate students and research staff) to explore and develop their leadership skills. Participants have the opportunity to look at relevant theory, practice their unique leadership styles and receive feedback.</p> <p>develop your leadership skills • explore the concept of leadership • build confidence in your own leadership style • learn more about your strengths and weaknesses • understand your personal values and how you make decisions • recognise your achievements and how to use these to create future success • explore more choices in how to lead • understand the impact you have on those who you are leading • develop and maintain a sense of direction • influence people towards a common goal/purpose • identify how these skills can benefit you in your current role.</p> <p>The course has so far been attended (yearly) by up to 60 researchers from across the country, from different disciplines and career stages. It is led by a team of experienced facilitators who work with you throughout the 3 days to support your learning. They are from a variety of backgrounds with experience in leadership, academia and other sectors.</p>

<b>Programme and organisation</b>	<b>Main target audience and scope</b>	<b>Programme details</b>
<p><b>Professional Skills for Research Leaders</b></p> <p>Epigeum  <a href="http://www.epigeum.com/component/programmes/?view=programme&amp;programme=45">www.epigeum.com/component/programmes/?view=programme&amp;programme=45</a></p>	<p>Research scientists</p> <p>Australia</p>	<p>Epigeum's new collaboration is for early to mid-career researchers to progress from where they are now, to where they want to be professionally.</p> <p>The collaboration will produce five online courses (supported by an introduction) which together will enable researchers to learn about key career drivers, assess their professional skills, access 24/7 online training in key areas such as managing staff, grant writing, collaboration and research communication.</p> <p>Online course containing 5 modules: introduction (30 minutes), managing your research career (1 hour), the grant process (2 hours), research collaboration (1 hour), managing a research team (2 hours), communicating your research (1 hour).</p>

**Table 3. Academic and certificate programmes**

<b>Program</b>	<b>Level</b>	<b>Modality</b>	<b>Organisations</b>	<b>Funding</b>	<b>Websites</b>
<b>European Master's in Higher Education (HEEM)</b> Europe	Master's	Traditional , full-time, two years	University of Oslo University of Aveiro University of Tampere	European Union	<a href="http://www.uio.no/english/studies/programmes/heem-master/">www.uio.no/english/studies/programmes/heem-master/</a>
<b>Postgraduate Certificate in Professional Practice</b> United Kingdom	Postgraduate certificate		AUA - Association of University Administrators		<a href="http://www.aua.ac.uk/pgcert-0-.html">www.aua.ac.uk/pgcert-0-.html</a>
<b>Master of Research Administration (MRA)</b> United States	Master's	Distance learning	University of Central Florida	NCURA	<a href="http://www.ce.ucf.edu/research">www.ce.ucf.edu/research</a> - see <a href="http://www.ncura.edu/content/news/rmr/docs/v18n1_Smith_Torres.pdf">www.ncura.edu/content/news/rmr/docs/v18n1_Smith_Torres.pdf</a> for more background
<b>Higher Educational Management and Policy</b> United States	Master's		University of New England  Centre for Higher Education Management and Policy (CHEMP)		<a href="http://www.une.edu.au/study/higher-educational-management-policy/">www.une.edu.au/study/higher-educational-management-policy/</a>
<b>Graduate Certificate in Research Administration</b> United States	Postgraduate certificate	Traditional and online	Emmanuel College		<a href="http://www.emmanuel.edu/GPP_Programs/Research_Administration/Degrees_and_Certificates/Research_Admin_Certificate.html">www.emmanuel.edu/GPP_Programs/Research_Administration/Degrees and_Certificates/Research_Admin_Certificate.html</a>
<b>M.S. in Management with Research Administration</b> United States	Master's	Traditional and online	Emmanuel College		<a href="http://www.emmanuel.edu/GPP_Programs/Grad_Management/Degrees_and_Certificates/MS_in_Management_and_Research_Admin.html">www.emmanuel.edu/GPP_Programs/Grad_Management/Degrees_and Certificates/MS_in_Management_and_Research_Admin.html</a>
<b>The Higher Education Program (HEP)</b> United States	Master's	Traditional, one-year programme	Harvard University		<a href="http://www.gse.harvard.edu/academics/masters/highered/">www.gse.harvard.edu/academics/masters/highered/</a>

**Table 4. Leadership training for specific funding programmes**

Funding Source	Example	Scope	Website	Overview
EU FP7	<b>BioProtech Project</b>	European Union and Tunisia	<a href="http://bioprotech.org">http://bioprotech.org</a>	<p>In order to become a more knowledge-based economy and in accordance with scientific and technological agreements with the European Union, Tunisia launched the policies and measures to set up and improve the efficiency of research centres such as the Centre of Biotechnology of Sfax (CBS). As a key element of the Tunisian Biotechnology Plan the CBS focuses on applied research particularly in terms of use, development, transfer and application of bioprocesses.</p> <p>BioProtech aims to support the CBS in the improvement of its capacities in bioprocesses development such as fermentation and microarrays technologies as well as all related fields such as technology transfer mechanisms, know-how about the EU research framework program and biosafety competencies to be better integrated in the European Research Area.</p> <p>BioProtech project is an ERA-WIDE action supported and funded under 7th Framework programme (FP7) by the European Commission</p>

Note: Organisations that provide fellowships, travelling scholarships and the like for leadership experience and training. ACIAR is one example - they have a special fellowship for leadership training.

# Appendix D

## Research management at the Ministry of Higher Education, Malaysia

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### Introduction

The Ministry of Higher Education (MoHE) is one of the key line ministries with the responsibility of managing research and innovation in Malaysia. The other key ministry is the Ministry of Science, Technology and Innovation (MOSTI). MoHE is in charge of basic research whereas MOSTI is in charge of applied research.

As stated in the *National Higher Education Strategic Plan for 2007-2020* (NHESP), one of the main thrusts of MoHE is to enhance research and innovation by producing a critical mass of researchers, developing knowledge corpus and supplying sufficient R&D resources (MoHE, 2007). To achieve this aim, MoHE has established research universities (RUs), allocated research funds under various grant schemes, established Higher Institution Centres of Excellence (HICoEs), and promoted the commercialisation of R&D products.

### Funding mechanisms

MoHE allocated research funds to universities on a block grant basis under various research grant schemes, namely,

- The *Fundamental Research Grant Scheme (FRGS)* funds basic research, i.e. answering the questions of why and how it covers pure and applied sciences, technology and engineering, clinical and health sciences, social sciences, arts and applied arts, natural sciences and national heritage, defence and security, and information and communication technology.
- The *Exploratory Research Grant Scheme (ERGS)* funds exploratory or experimental research where the findings are expected to be extended through applied research, i.e. answering the questions of what and where. The research areas are the same as those listed under FRGS.
- The *Long Term Research Grant Scheme (LRGS)* funds fundamental research that will take between five and ten years to execute. Its fields of research are global warming, tropical medicine, health care, energy safety and water, food security, advance manufacturing with added value, and information and communication technology.

- The *Prototype Research Grant Scheme (PRGS)* produces research products that will be ready to be commercialised.

The amount of funds allocated to fundamental research under these schemes has been on the rise: MYR 100 million in the 8<sup>th</sup> Malaysian Plan (2001-05), MYR 285 million in the 9<sup>th</sup> Malaysian Plan (2006-10) and MYR 741 million for the first two years of the 10<sup>th</sup> Malaysia Plan (2011-15). All these grant schemes are directed at the research universities (RUs).

In addition to these grant schemes, MoHE provides Research Allocation Grant Schemes (RAGS) to all the other public universities. To encourage collaboration between research universities and non-research universities, MoHE initiated another grant scheme in 2011, known as RACE, which aims at building capacity in research and innovation among the non-research universities.

### Research universities

Since 2006, MoHE has established five research universities<sup>1</sup> (RUs) to undertake the bulk of fundamental research in the country. The target is to establish 6 RUs by the year 2020. Each of these RUs has a budget allocation of MYR 400 million<sup>2</sup> per year as block grant from MoHE for research and innovation. MoHE carries out a research assessment on each of the RUs annually based on an instrument known as Malaysia Research Assessment Instrument (MyRA) with eight assessment criteria (Table 1).

**Table 1. MyRA research assessment criteria of RU Performance**

No.	Criteria	Weightage (%)
1	Quality and Quantity of Researchers	25
2	Quality and Quantity of Research	30
3	Quantity of Postgraduates	10
4	Quality of Postgraduates	5
5	Innovation	10
6	Professional Services and Gifts	7
7	Networking and Linkages	8
8	Physical Resources and System	5
<b>Total</b>		<b>100</b>

Each of these RUs have established research centres of excellence, known as Higher Institution Centres of Excellence (HICoEs) in certain specialist areas are established. In 2010, MOHE had recognised six of these HICoEs.<sup>3</sup> They carry out research on renewable energy, cancer bio-markers, diagnostics platforms, animal vaccines and therapeutics, behavioural research in drug addiction, and Islamic Finance Criminology. The HICoEs represent vehicles for researchers and postgraduate students to undertake multi-disciplinary research that are internationally recognised, meet global standards and in areas of national importance.

MoHE has been focusing its attention on the commercialisation of R&D by targeting its efforts to commercialise at least 10% of all R&D products by 2020. To achieve this target, MoHE organises the International Exposition of Research and Invention of Institutions of Higher Learning (PECIPTA) once every two years to display products, inventions and innovations produced by researchers from universities.

## **Research management**

MoHE seeks research funds from the Ministry of Finance and the Prime Minister's Department and disperses these funds to higher education institutions. Most of these funds are allocated to the RUs as block grants but there are also some competitive grant schemes which involve inter-institutional research clusters working on national priorities. MoHE encourages collaborative inter-university research and the sharing of expensive research facilities and equipment with the aim of each university developing its own specific research niche areas.

Applications for the competitive grant schemes are vetted by review panels comprising of experts from various universities. The vetting of many of the grant applications and the monitoring and evaluation of research projects are being devolved from the ministry to the various universities.

Besides dispersing funds and monitoring research among the public universities, MoHE also carries out evidence-based policy research pertaining to various aspects of higher education which cover topics such as access and equity, lifelong learning, teaching and learning, delivery systems, academic needs and others. MoHE works with other line ministries to research on how to raise the country's competitive index in various sectors so as to promote national growth, socio-economic development as well as Gross National Happiness (GNH).

## **Capacity building**

As most of the staff in MoHE are generalists and administrators, MoHE has to rely on the expertise of researchers and academics from the universities to help in managing research and innovation in general and in establishing research foresight and vetting of research proposals in particular. Much of the high-level policy making is based on decisions and inputs from technical committees and advisors. Inter-ministry co-ordination, especially between MoHE and MoSTI over the commercialisation of research, is carried out through a joint working board and joint technical committee.

In 2008, MoHE established an academy for training leadership in the universities known as AKEPT (Malaysia Higher Education Leadership Academy). AKEPT provides training in university governance and management, teaching and learning, and research and innovation. The training for research and innovation includes courses on:

- finance and budget management
- human resource management
- creating research opportunities and networking

- seeking opportunities for international collaboration

Besides short courses, AKEPT also organises conferences, seminars and workshops on topics such as publications, research leadership, commercialisation of research, entrepreneurship and personal growth. A training programme to certify academics as having the knowledge, skills and ethics to vet applications for the various research grant schemes is also in the pipeline.

One of AKEPT's missions is to develop a talent pool for succession plan to replace university leaders. To achieve this mission, AKEPT has established a number of platforms such as AKEPT Young Researcher Circle (AYRC), AKEPT Young Global Leaders Caucus (AYGLC), AKEPT Young Global Educator Caucus (AYGEC), AKEPT Young Entrepreneurs Network (AYER).

### **Challenges faced**

MoHE faces a number of challenges in managing research and innovation at the national level. These include a lack of expenditure and funding for R&D and the limited number of prolific researchers. Another challenge is the commercialisation of research because Malaysian companies, especially the small and medium-sized enterprises (SMEs), are not ready to commercialise research products from universities. As for the multinational companies, much of their R&D work is carried out within the companies and more often than not outside Malaysia. There is a lack of research culture among the academics in many of the new public universities. Furthermore, the staff working in the various Research Creativity Management Offices (RCMOs) lack the capacity to review research projects and to manage and evaluate projects properly. Most of the research administrators and managers do not have specialised training and have to learn on the job. Many of the universities and researchers are competitive and tend to work in silos. International research collaboration is generally weak and participation in international projects are based on invitation to individual researchers rather than on competitive bidding.

## References

MOHE (Ministry of Higher Education) (2007), *National Higher Education Strategic Plan, 2007-2020*, Ministry of Higher Education, Putrajaya.

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<sup>1</sup> The 5 research universities are Universiti Malaya (UM), Universiti Sains Malaysia (USM), Universiti Kebangsaan Malaysia (UKM), Universiti Teknologi Malaysia (UTM), and Universiti Putra Malaysia (UPM).

<sup>2</sup> Budget allocation for each research university has risen from MYR 200 million in 2007 to MYR 400 million in 2011.

<sup>3</sup> The 6 HICoEs are UM Centre of Research for Power, Electronics, Drives, Automation and Control, UKM Molecular Biology Institute, USM Institute for Research in Molecular Medicine, UPM Institute of Bioscience, USM Centre for Drug Research, and UiTM Accounting Research Institute.

# **Appendix E**

## **Research and innovation management at Universiti Sains Malaysia**

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### **Introduction**

Universiti Sains Malaysia (USM) is a public university founded in 1969 in the state of Penang. USM is the second public university in the country and consists of a main campus on the island of Penang, and two branch campuses – a health campus in Kubang Kerian and an engineering campus in Nibong Tebal. The university was given a mandate to promote and develop higher education, and to provide for research, advancement and dissemination of knowledge in the fields of natural sciences, applied sciences, medical and health sciences, pharmaceutical sciences, building sciences and technology, social sciences, humanities, and education. Since its inception, USM has adopted a school system instead of the traditional faculty system, which provides an interdisciplinary approach to produce and train multi-skilled graduates (USM, 2011). To date, USM has a total of approximately 28 000 students (MOHE, 2012) who are enrolled in undergraduate and postgraduate programmes across 26 schools and 24 research institutes, centres and units (Appendix F).

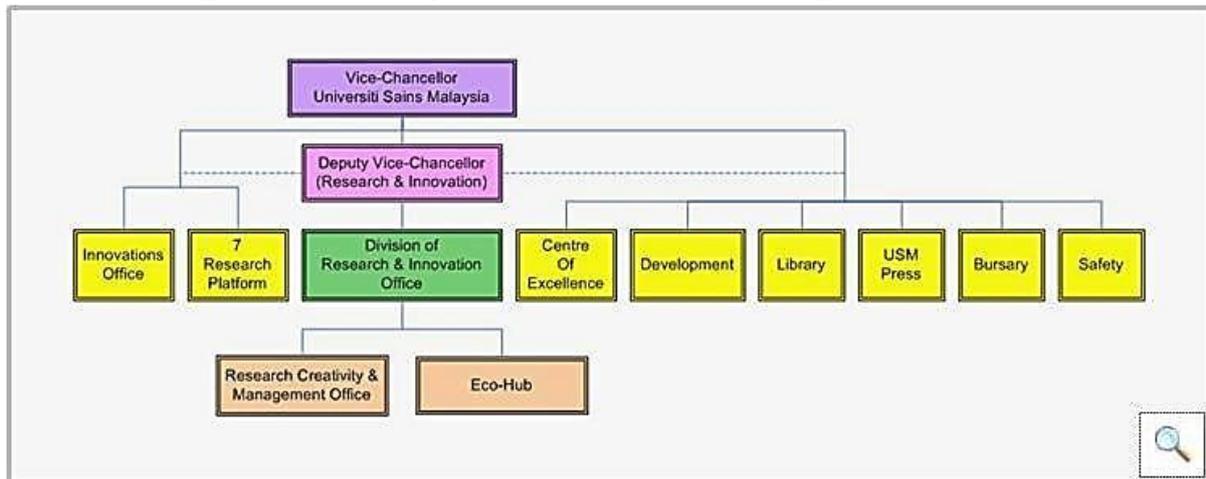
USM is one of five research universities in Malaysia recognised by the Ministry of Higher Education (MOHE). On top of that, in 2008, USM was selected by MOHE to be the only Accelerated Programme for Excellence (APEX) university in the country. The APEX programme is one of the Critical Agenda Projects (CAPs) outlined within the National Higher Education Strategic Plan (NHESP). The university was selected on after a rigorous evaluation of the universities in the country and whether they were capable of attaining world class status (MOHE, 2007a; USM, 2011). Another CAP within the NHESP seeks to recognise research centres of excellence that have gained international recognition under the Higher Institution Centre of Excellence (HICoE) programme. Two of the first six HICoEs in the country are based in USM, namely the Institute for Research in Molecular Medicine (INFORMM) and Centre for Drug Research (CDR) (MOHE, 2007b, 2011).

### **Research and innovation management structure of USM**

Research and innovation is a major part of the university and USM has established the Division of Research and Innovation that comes directly under the purview of the Vice Chancellor. The division is led by the Deputy Vice Chancellor for Research and Innovation, and consists of the

Research Creativity and Management Office (RCMO) and the Eco-Hub.<sup>1</sup>The division is also linked indirectly to the Innovation and Commercialisation Office, various centres of excellence, seven research platforms and other entities within the university such as the USM Press, library and bursary (Figure 1).

**Figure 1. Division of Research and Innovation organisation chart**



Source: Division of Research and Innovation (n.d.), Division of Research and Innovation website, USM, [www.research.usm.my/default.asp?tag=11](http://www.research.usm.my/default.asp?tag=11), accessed 18 December 2012.

RCMO acts as a one-stop centre in the university, which:

- formulates policies and creates processes for the management of research and innovation throughout the university
- promotes a research culture in the campus
- generates research opportunities
- deploys and manages research projects.

The office is tasked to create a research environment in the university by paying attention to the whole process of research, development and innovation through to entrepreneurship, and to put in place a research system. This system has to meet the needs of a wide range of academics and researchers by providing a variety of incentives to those who publish in high impact journals through different types of grants, recognition and monetary rewards. At the same time, the office has to streamline the processes of reporting, monitoring and evaluating research projects and put in place an information system for monitoring and evaluation. It also plays a part in connecting researchers in USM with external parties such as research funders, the industry and various governmental ministries, and encouraging collaborative research among research teams and with different institutions. The increasingly active role of the RCMO has seen tremendous progress in developing the research culture in USM from merely 20% of researchers and academics holding research grants to the current 85%.

The Deputy Vice Chancellor of Research and Innovation, who is a prominent researcher of international standing, also leads the RCMO as its director in order to reduce bureaucracy. The director is assisted by a senior administrator alongside six administrators who oversee the

various units within the office, including the Policy, Strategy and Monitoring Unit; the Grant Management and Research Development Unit; and the Fund Management Unit. These administrators are recruited from the central pool of university administrators, and could in theory be posted to other administrative positions within the university. This means that the administrators who are directly involved in managing and monitoring of research and innovation in RCMO may not have the experience to do so, and are required to learn on the job without much formal training provided on the various aspects of research and innovation management.

The Innovation and Commercialisation Office is closely linked to the Division of Research and Innovation. The primary function of the office is to evaluate the viability and potential of research for patenting or commercialisation. The office also handles the logistical arrangements for researchers to promote their research at international and national exhibitions. Where these exhibitions suggest that research products might have commercialisation potential, the office provides seed funding to assist researchers in translating them into industry. The office is headed by a director, who is a professor, assisted by a senior administrator, a patent evaluation officer, a commercialisation/intellectual property (IP) officer, three research officers and a designer. Apart from the administrator, who is recruited from the central pool of university administrators, the other staff of this office are recruited on the basis of their areas of expertise. While the patent evaluation officer and researcher officers have qualifications in the field of engineering, science and technology, the commercialisation/IP officer is a lawyer by profession. Although their educational background is related to the tasks and responsibilities they undertake in this office, these officers also have a lot to learn on the job. For instance they need skills related to IP tools, IP management, negotiating and connecting academics and researchers with patent lawyers. Staff also have to learn to balance the selection of research products based on the commercial value evaluated and assessed by a committee, with the financial constraints faced by the university.

In the early 1990s, the Malaysian government began to corporatise public universities. While the corporatised public universities were expected to raise a proportion of their operating costs in anticipation of the reduction of support from the government, they were not allowed to raise tuition fees at the undergraduate level and any increase in fees has to be approved by the ministry (Lee, 2004b). In the case of USM, a holding company by the name of USAINS was established in 1998 to function as the corporate arm of the university and to generate revenue for the university. One of its major functions is to undertake an active role in commercialising products that emerged from the work of researchers in USM. The patents and IPs developed by USM are licensed to USAINS, and USAINS then licenses them to industry.

USAINS Industry Council (USIC), which consists of academics and representatives from industry, has two important roles. First, it advises USAINS on industry norms, and second, it provides leads on possible contracts and collaborations. The main marketing strategy of USAINS is to register with various ministries and to write proposals to bid for projects. The nature of its work requires staff to develop skills in business management, the law, finance and marketing, as well as subject matter knowledge of various disciplines, and skills in writing project proposals,

assembling expert teams, costing and managing of projects, and developing the network to bid for international projects.

Apart from the centralised offices involved in managing research and innovation activities, the Division of Research and Innovation also has seven research platforms. Each platform is led by a research dean and assisted by administrators. The primary role of the platforms is to coordinate research activities within its area of specialisation. The seven research platforms are:

- Biomedical and Health Sciences Research Platform
- Clinical Sciences Research Platform
- Engineering and Technology Research Platform
- Fundamental Sciences Research Platform
- Information and Communication Technology Research Platform
- Life Sciences Research Platform
- Social Transformation Research Platform

As the role of the research platforms is primarily the administrative functions of monitoring and managing research projects, there are plans in the near future to streamline the seven platforms into five Centres for Research Initiative (CRIs). Besides consolidating overlapping areas of specialisation, the new setup will shift the administrative responsibilities to the RCMO, which then allow the researchers in these CRIs to focus on developing the research agenda and its related policies, as well as enhancing national and international collaborations and linkages.

In short, research and innovation at the centralised university level predominantly involves administrating, managing and monitoring these activities. The actual research and innovation activities in USM take place at the research institutes/centres/units and the schools, and at these levels, there is a different form of research and innovation management.

## **Research and innovation management at research institutes, centres and units**

USM has 24 research institutes, centres and units (Appendix F) that focus on a wide range of areas. Each of these entities was established to cater for a particular need in its area of specialisation, and is managed and administered in its own way. In order to provide a better understanding of these research entities within USM, three will be discussed as case studies to provide a more in-depth understanding of the management of research and innovation at this particular level in USM.

### **Centre of Drug Research**

In 1973, the Government of Malaysia appointed USM to undertake research on drugs, mainly on the issue of drug abuse, a matter of critical concern to the country at that time. This led to the founding of the Centre for Drug Research (CDR) in 1978 at the University Senate. In 1979, the

World Health Organisation (WHO) recognised CDR as a collaborating partner in this particular area. In 1983, the WHO began collaborating with CDR to undertake research in clinical pharmacology and the CDR has been formally recognised by WHO as an analytical laboratory in this region. The collaboration with WHO has diversified the research focus of CDR, and to date, CDR undertakes research in socio-medical, clinical pharmacological and health areas with a focus on drug dependence and tropical health, particularly indigenous diseases (USM, 2011). In 2010, CDR was recognised by the Ministry of Higher Education as one of the first six Higher Institution Centres of Excellence (HICoEs) in the country, specialising in behavioural research in addiction (MOHE, 2011). This recognition comes with an annual grant of MYR 3 million for the purpose of research, infrastructure, training and networking.

Over more than three decades, the research focus of CDR has evolved into drug discovery and development, biomedical analysis, epidemiology and behavioural science, as well as more recently, blood-brain barrier research. As it has evolved, the relevant knowledge and skills its researchers need have also changed. One of the major avenues to address this is for CDR to recruit and train new researchers by funding potential researchers to pursue doctorates in areas where future needs are projected. For example, with its current specialisation on addiction under the HICoE programme, CDR has begun to venture into neuro-related blood-brain barrier research to understand the mechanism of addiction in the human body. To do so, it sent two young researchers through the university to pursue a doctorate in the United Kingdom at a world-renowned institution in this particular area of research. In addition, CDR collaborates with researchers in various disciplines within USM and throughout the country to undertake multi-disciplinary research on issues of drug abuse, drug dependence, tropical diseases and biomedical analysis to develop bioequivalence for generic drugs, as well as to organise educational programmes on the prevention of drug abuse and training programmes for officers of the National Anti-Drug Agency on risks and challenges of drug users, drug education and ethical frameworks.

Besides undertaking research, CDR also provides postgraduate training as well as placements for undergraduates. Each year about 40 to 50 undergraduates from various public universities in Malaysia will do an industry attachment with CDR. In terms of its postgraduate training, CDR has 19 PhD and 28 master's students, who are all supported by the various research grants and university fellowships.

### **Institute for Research in Molecular Medicine**

In 2001, the then Vice Chancellor of USM in his maiden speech to the campus community proposed that the USM should become a world class institution. An Advisory Committee on World Class Programmes were formed, and one of its major tasks was to assess the impact and sustainability of research activities and to identify potential areas to be nurtured (Lee, 2004a). The assessment of 16 research programmes in USM clearly indicated that medical biotechnology was the only area of research in the university at that point which could be recognised immediately as "world class". This strong specialisation in medical biotechnology therefore led to the founding of the Institute for Research in Molecular Medicine (INFORMM) in 2003 in the Health Campus in Kubang Kerian. INFORMM became the first multidisciplinary

research institute in USM to be formed "bottom-up" and currently operates at both the main campus and the Health Campus (INFORMM, 2012). Within a short period of time, INFORMM has progressed remarkably and claimed a number of "firsts" in the country. It was the first research institute in Malaysia to develop and commercialise a research product and the first university research institute in Malaysia to win the Islamic Development Bank award for science and technology (USM, 2011). In 2008, INFORMM was also recognised as a HICoE by the Ministry of Higher Education, specialising in diagnostics platforms (MOHE, 2011).

INFORMM brands itself as a fundamental and translation research institute in priority areas in molecular medicine. The centre focuses on rapid diagnostics for typhoid, paratyphoid, cholera, filariasis, tuberculosis, pharmacogenomics and novel therapeutics towards the development of personalised medicine (USM, 2011). Its longer-term aim is to translate research into products and services, concentrating on neglected diseases for the bottom billions. Apart from the HICoE grant, INFORMM is richly funded by grants from MOSTI, MOHE, the Malaysian Technology Development Corporation (MTDC), the BioTech Corporation, and international bodies such as the Islamic Development Bank, WHO and European Union Commission. To date, INFORMM has successfully translated three of its research outcomes into products for commercialisation and these products have been internationally recognised by the WHO. They are the typhoid diagnostic test, the Brugia diagnostic test for filarial disease, and the Personalised Medicine for Methadone.

As INFORMM has grown it has trained an echelon of young researchers internally and externally. These researchers were either sent abroad or funded internally to pursue doctorates. As INFORMM is a research institute established under the University Senate, it can also award postgraduate degrees. Currently, there are approximately 100 research students pursuing a master's or PhD. About 10% to 15% of these students are international students. Within a relatively short period of time, the leadership of INFORMM has developed a systematic approach to managing research and innovation. The centre has been awarded the ISO 9100 standard for the standard operating procedure for work instruction. Internally, INFORMM has established a committee to oversee the application of grants, and to monitor the status of applications and projects. This setup has three benefits. First, it ensures that applications for grants submitted by INFORMM are of high quality. Second, by specifying the internal reviewers, this arrangement has also become a mentoring process for established and experienced researchers to guide younger ones in preparing and applying for research grants. Third, the systematic approach and the ISO system also ensure research projects are progressing and research funds are spent accountably.

### **National Higher Education Research Institute**

The National Higher Education Research Institute (IPPTN) was formally established in 1997 by the National Council on Higher Education in the Ministry of Education, before the creation of the Ministry of Higher Education. Since its establishment, IPPTN has been hosted by USM and is accountable to the Ministry of Higher Education and the Vice Chancellor of USM (USM, 2011). Over more than a decade, IPPTN has developed various areas of expertise in higher education research, namely, curriculum development and preparation of an entry-level workforce,

governance of universities. changing conditions for academic work and career. growth and development of transnational higher education services, higher education and regional engagement, higher education systems, and comparative international education. More importantly, one of its priorities is to explore emerging possibilities that will result in a new higher education landscape in Malaysia. IPPTN has also participated actively at the international level with research institutes from Australia, Germany, Japan, the United States and ASEAN nations, and in recent years, has started engagement activities with Cambodia, Lao PDR, Myanmar and Vietnam to enhance bilateral collaboration between Malaysia and these developing countries in the region.

However, IPPTN differs significantly from INFORMM and CDR in its structure and the way it is run. Apart from the Director and Deputy Director who are based in IPPTN, its other researchers are academics from universities around the country who participate in its research projects and activities on a voluntary basis. These researchers are supported by research officers and support staff based in IPPTN. The way in which IPPTN operates has advantages as well as disadvantages. On the one hand, bringing researchers together from various universities and disciplines, such as management, law, languages, economics, humanities, and education, has allowed the research undertaken by IPPTN to take a cross-disciplinary approach that led to policy recommendations. On the other hand, the voluntary participation of researchers outside of their own area of specialisation, department and university has made it much more challenging for administrators to measure key performance indicators (KPIs) such as numbers of publications and research grants. With the institutionalisation of such measures in the management of research and innovation in the public universities, there have been increasing difficulties for researchers playing a greater role in research activities and projects of IPPTN.

Furthermore, as IPPTN was not established under the University Senate, in theory, IPPTN is not able to recruit permanent researchers and offer postgraduate degrees, and these constraints have hindered its development and have implications for the management of research in this research institute.

### **Research and innovation management at schools**

Schools in USM are not only involved in teaching undergraduates and postgraduates, but are also actively involved in research and innovation activities. Four schools – School of Biological Sciences, School of Chemical Sciences, School of Educational Studies and School of Materials and Mineral Resource Engineering – were sampled as case studies to help understand the management of research and innovation activities within the entities at this level, along with the Institute of Postgraduate Studies to help understand the development and training offered to future researchers through postgraduate degrees.

Across the four schools, research and innovation is a major part of their key performance indicators (KPIs). Academics and schools are assessed in terms of the number of publications, and the number of research grants and their total amount. A large majority of research grants at the school level are from MOHE and a significant proportion are from MOSTI. Research and innovation at the schools are led by the Dean and assisted by the Deputy Dean of Research and

Innovation. The schools conduct research in similar ways to INFORMM and CDR; only the schools' undergraduate programmes distinguish them from the research institutes. Despite an increased emphasis on research and innovation, the schools are obliged to continue managing undergraduate programmes, as well as the master's programmes by coursework. In other words, the academics in schools also have teaching responsibilities on top of their research and innovation activities.

Although the structure of the schools is similar, the ways in which they manage research and innovation and the extent to which they manage them differ considerably. One influence may be the leadership of the deans, deputy deans and administrators. While there are schools that tend to be more *laissez-faire*, there are also schools that tend to be more authoritarian in the way research and innovation is managed. The *laissez-faire* management style encourages the academics and researchers to participate in research and innovation activities. For example, young researchers are encouraged to seek advice and guidance from more experienced researchers, and experienced researchers are expected to understand their responsibilities to conduct research and publish. Conversely, the authoritarian style tends to focus on the number of publications, and the number of grants and their total amounts, and to use these statistics as yardstick to measure the KPIs of academics and researchers. In addition, these indicators are also used to compare across academics and researchers within a school and to put some form of peer pressure on them to be involved in research. Driven by an increasing culture of auditing and KPIs in USM, particularly once it gained the status of a research university, the authoritarian style is increasingly being adopted at the school level to encourage academics and researchers to apply for grants, conduct research and publish.

Schools have also introduced a number of different strategies to encourage academics and researchers to apply for grants, conduct research and publish. For example, one of the schools organised an internal committee to help academics and researchers with grant applications. In the sciences, where research is laboratory based, academics are discouraged from taking on postgraduate students if they do not have a research grant that can support their students' research. Schools also assume the role of "matchmaking", bringing together experienced and young researchers in some form of mentoring scheme so that the experienced researchers can guide the younger ones to develop know-how about grant applications and managing a research project. Schools also organise writing workshops, getting researchers who have published in journals with a high impact factor to share and teach the skill of writing in the schools. Through these different strategies, schools have played a role in developing the knowledge and skills for researchers and academics to participate more actively in research and innovation activities and to create a research ethos within the schools.

The Institute of Postgraduate Studies (IPS) is also a school but it has a different responsibility in relation to the management of research and innovation. Unlike the other schools, the IPS has an active role to play in the human resource development of researchers. It is tasked to not only administer the postgraduate students, but more importantly to oversee the training of skills of future researchers in the form of postgraduate students. Thus, the IPS has provided a number of

formal training courses to equip postgraduate students with the relevant knowledge and skills for research.

The Postgraduate Academic Support Services (PASS) is the main training programme organised by IPS. This programme includes providing a statistician and an editor at the school on a full-time basis to support postgraduate students across USM with the statistical and editorial work related to their research. Furthermore, PASS also includes the Personal and Professional Development (PPD) programme that focus on personal skills, such as presentation and communication skills, as well as professional skills, such as writing research proposal and curriculum development. All postgraduate students in USM are encouraged to participate in the PASS programme in addition to the transfer of knowledge and skills they get through supervision with supervisors at the school level.

## **Conclusion**

Research and innovation has become an important part, if not the most important part, of USM. As to maintain the status of a Research University, USM from the top managerial level of the institution down to the research institutes, centres and units, and schools, have introduced various structures, mechanisms and strategies to promote and manage research and innovation activities. The structures, mechanisms and strategies across different levels have in one way or another shape the culture and ethos of research and innovation in the university.

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<sup>1</sup> The Eco-Hub was established with the objective of preserving the ecosystem, heritage and landscape of the university and developing the main campus into an eco-park/botanical garden in line with the concept of "Campus in the Garden".

# Appendix F

## List of schools and research institutes, centres and units at University Sains Malaysia

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### Schools

Graduate School of Business  
Institute of Postgraduate Studies  
School of Aerospace  
School of Arts  
School of Biological Sciences  
School of Chemical Engineering  
School of Chemical Sciences  
School of Civil Engineering  
School of Communication  
School of Computer Sciences  
School of Dental Sciences  
School of Distance Education  
School of Educational Studies  
School of Electrical and Electronic Engineering  
School of Health Sciences  
School of Housing, Building and Planning  
School of Humanities  
School of Industrial Technology  
School of Languages, Literacies and Translation  
School of Management  
School of Materials and Mineral Resources  
School of Mathematical Sciences  
School of Mechanical Engineering  
School of Medical Sciences  
School of Pharmaceutical Sciences  
School of Physics  
School of Social Sciences

## Research Institutes, centres and units

Advanced Medical and Dental Institute (AMDI)  
Animal Research and Support Centre (ARSC)  
Astronomy and Atmospheric Science Research Unit  
Basic Education Research Unit (BERU)  
Centre for Advanced Analytical Toxicology Services  
Centre for Drug Research  
Centre for Education, Training and Research in Renewable Energy and Energy Efficiency  
(CETREE)  
Centre for Global Archaeological Research  
Centre for Global Sustainability Studies (CGSS)  
Centre for Islamic Development Management Studies (ISDEV)  
Centre for Marine and Coastal Studies (CEMACS)  
Centre for Policy Research and International Studies (CenPRIS)  
Collaborative Micro-Electronic Design Excellence Centre (CEDEC)  
Engineering Innovation and Technology Development Unit (EITD)  
Human Genome Centre  
Institute for Research in Molecular Medicine (INFORMM)  
Malaysian Institute of Pharmaceuticals and Nutraceuticals (IPHARM)  
National Advanced IPv6 (NAv6)  
National Higher Education Research Institute (IPPTN)  
National Poison Centre  
Research and Education for Peace Unit (REPUSM)  
River Engineering and Urban Drainage Research Centre (REDAC)  
Vector Control Research Unit  
Women's Development Research Centre (KANITA)

# Appendix G

## Research management at the Malaysian Agricultural Research and Development Institute (MARDI)

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### Introduction

The Malaysian Agricultural Research and Development Institute (MARDI) is the premier public food and agricultural research and development organization in Malaysia. MARDI is one of nine agencies that operate under the Department of Agriculture, Ministry of Agriculture and Agro-based Industry. It was established in 1969, through the MARDI Act (Act 11) and began its operations from March 1971. The period from the time MARDI started to operate until now can be divided into three phases:

- Development phase (1969-83): start of operation and strengthening of organisational structure.
- Intermediate phase (1990-99): amendment of MARDI Act; establishment of MARDITech Corp. Sdn.Bhd to focus on commercialisation activities.
- Transformation phase (2000-): award and upgrade recertification; further amendment of MARDI Act to embark on commercialisation and research and development output; strengthening of technology-transfer system (entrepreneur development); and knowledge management.

For almost 40 years, MARDI has fruitfully generated many new crop varieties, clones and animal breeds, and continuously improved its management practices. Its function is based around the four main areas: research implementation, development and technology transfer, technology commercialisation, and competency development. MARDI operates along these four areas to create, innovate, transfer and apply knowledge, competencies and services to transform the national food, agriculture and bio-based industries towards increased commercialisation and competitiveness.

MARDI is mandated to fulfil the following functions:

- To conduct research in the fields of science, technical, economics, and social sciences with regards to the production, use and processing of all crops (except rubber, oil palm and cocoa);, livestock and food.
- To serve as a centre for collecting and disseminating information and to provide advisory services pertaining to scientific, technical and economic matters related to food, agriculture and agro-based industry. These functions are carried out through various means including publishing reports, periodicals and related papers and organising exhibitions, conferences, seminars and lectures.
- To serve as a centre that provides expert services in food, agriculture and agro-based industry. These include consultancy services, laboratory analysis, quality assurance and contract research and development (R&D).
- To provide various forms of training to cater for the development of the food, agriculture and agro-based industry.
- To provide grant-in-aid for pure and applied scientific, technical and economic research and development related to food, agriculture and agro-based industry.
- To liaise local and foreign public and private organisations engaged in scientific, technical, economic and social research related to food, agriculture and agro-based industry.
- To conduct commercial research and production.
- To develop, promote and exploit research findings.
- To provide extension services to the agriculture, food and agro-based industries.

## Research at MARDI

At MARDI, research is conducted in the following areas: crops, livestock, food technology, mechanisation and automation, strategic resources, biotechnology, economy and technology management. Research is conducted at various research stations located throughout the country. In total there are 32 research stations, 8 major stations and 24 support stations which together encompass an area of 7 065 hectare. This includes two stations located outside the country, in Malawi and Mali in Africa. Each station focuses on a specific research area. For example, the research station at Seberang Perai mainly conducts research into paddy. Research at MARDI is grounded on the philosophy of "from bench to market" and "from farm to table". From bench to the market focuses on technology transfer, whereby technology is used to improve yields and this technology is then licensed to individuals, companies or partners on agreement basis. From farm to table is focused on using new technology to produce new breeds or varieties as well as packaging, storing and marketing of products.

## Funding of the research

MARDI has three sources of funding. Its main funding, making up 80% of the total funds received, is obtained from the government (MOSTI) through science funds and technology

funds. The private sector and international organisations contribute the remaining 20% of the funding. Revenue generated from commercialisation of the institute's products, technology and services is used for internal funding.

The government funds are open funds. Researchers need to submit proposals which fit in with the strategic planning of the government to bid for these funds.

Internal short-term funding from the revenue generated by commercialisation is disbursed through internal bidding. Mainly, these funds are provided to newly recruited officers at the beginning of their research careers.

The leader of the project manages the funds obtained by each project. The leader is responsible in getting approval from the finance department for the use of the money for particular purposes, such as buying laboratory equipment. One of the main responsibilities of the project leader is to ensure that purchasing is done according to the procedures set by the government. Because MARDI has a good track record in commercialising its research outcomes (15% in 2012) MARDI will receive additional funding of MYR 85 million for research from the Economic Planning Unit for the year 2013, and MYR 60 million in 2014.

## Priority/thrust areas

Priority areas are based on government policies. The trend of research will be in line with these policies when the policy changes the priority areas will change accordingly. Consequently, these changes have an effect on the availability of relevant experts. The availability of experts in the particular areas is maintained by having cross-functional teams. Teams are formed based on disciplines such as technical commercialisation and post-harvest technologies. Team composition will shift internally with the change of policy.

### **MARDITECH Corporation Sdn. Bhd. (MCSB)**

MARDITECH is the business arm of MARDI. One of its major functions is to commercialise new technologies developed at MARDI and to target clients for the expertise available. The company aims to accelerate the uptake of research results as mandated by the government. Its strategy is to facilitate technological innovations and to impart professional management experience (tacit knowledge) in order to develop successful agro-based businesses. MARDITECH serves this purpose by generating the vital link between the reservoir of scientific minds from MARDI and the industry.

### **Policies affecting MARDI**

National policies have a direct impact on the research conducted at MARDI. For example, the policy on food security aims to ensure the availability of food despite forecast

shortages due to population increases, climate change and globalisation. In line with this policy, MARDI has conducted research to develop technology that could transform agriculture to be more competitive and modern. These advanced farming techniques could ensure a consistent food supply. Malaysia also has a policy on climate change. In the context of this policy, MARDI is carrying out research projects on mitigation and adaptation. In addition MARDI also carries out research on adding values to agriculture products. For example, it is researching ways to increase the availability and variety of processed food to reduce the country's dependence on fresh food. In this context, MARDI share technology and entrepreneurship with small and medium-sized enterprises (SMEs) to help them improve their production and penetrate the global market. Currently, under its value adding policy, MARDI is providing assistance and guidance to 200 SMEs. MARDI has other institutional policies, for example human resource development in which the institution is moving towards having 60% of their holding PhD or master's degrees. Other institutional policies include an ICT policy, a land use policy to optimise the usage of the land and research, and a development policy mainly to determine the priority areas based on the government policies, and to ensure all staff hold at least one research project. Its intellectual property policy seeks to set internal guideline for the proper management of intellectual property rights (IPR) at MARDI. The objective of this policy is to ensure that all MARDI's intellectual property activities are conducted according to the core mandate and business strategy in order to produce optimum results for MARDI and its employees. For the purpose of this policy, IP is taken to include information, ideas, inventions, innovations, art work, designs, literary text and other matters that are capable of legal protection or the subject of legal rights.

### **Licensing procedure at MARDI**

MARDI utilises two licensing approaches, one for licensing "public good" technology and the other for "private good" technology. Public good technology covers varieties of paddy, orchids and fruit breeds. MARDI does not impose any charges for licensing public good technology. On the other hand, products such as virgin coconut oil, and omega eggs are considered private good technologies and licensed to partners or collaborators that already have a proven track record with MARDI. These collaborators are required to pay for obtaining and using this license on agreement basis. In future, MARDI is preparing licensing its hybrid products as well.

### **Staffing at MARDI**

Currently, there are 3 019 people working at MARDI in three sections: research, technology transfer, and commercialisation and operations. These sections are each led by a deputy director general who directly reports to the director general of MARDI. MARDI has 14 senior managers, 547 research scientists (78 PhDs, 243 MScs and 226 BScs), 46 professionals (accountants, lawyers, engineers, programmers, librarians etc.) and 2 412 support staff (including technicians).

Vacancies are advertised through major newspapers and the applicants need to apply online. One of the major requirements is a CGPA of more than 3.00. Applications are screened on line, and then shortlisted individuals called for interview. One of the main challenges faced by MARDI is that its staff appear to be very specialised in one particular niche area. As a consequence, they lack the knowledge of other aspects including general knowledge about agriculture in Malaysia. They are also lacking in communication skills, especially in English, and the ability to express their views and ideas.

MARDI hires about 80-100 people MARDI each year. These newcomers are given mentoring and training for six months when they start their career in MARDI in order to orient them to its work. During the training they will learn about MARDI, and the status of agriculture in the country. They are also given hands-on workshop-type training in writing proposals, presenting their ideas and communication skills. For the mentoring, senior staff assist the new staff members to run small-scale experiments and give them group assignment which allow them work as a team.

After three years, new staff members are allowed to further their studies at master's and PhD levels, either locally or abroad. provides Financial assistance is provided, based on the availability of the funding. The government provides MYR 1.5 to 1.7 million a year for this purpose. The area of study is very much dependent on the country's current needs. Due to attractive salaries and working conditions the turnover rate of the workforce at MARDI is reported to be very low.

### **Publication**

Research outcomes at MARDI are disseminated through journal publication. Staff are encouraged to publish their work in peer-reviewed, high-impact journals. Staff who do publish are awarded with merit points and publications are considered as one of the criteria for promotion.

### **Outreach programmes**

MARDI conducts various outreach programmes. One of these is known as "AzamTani" and its aim is to reduce poverty. Individuals are identified and educated on the use of appropriate technology to improve farming yields. They are also provided with resources and skills based on their needs. Currently, 1 700 people have participated in this programme. The success rate is reported to reach nearly 70%.

### **Networking**

MARDI has established a good network with the local universities, particularly with Universiti Putra Malaysia (UPM), which is adjacent to it. In addition, MARDI has signed memoranda of understanding (MoUs) with local and international universities to receive students from these universities for industrial training at MARDI.

MARDI achieves International recognition through collaborative work with research organisations and universities from Australia, Canada, China, Japan, Taiwan and the United States as well as from ASEAN and EU countries. It also conducts collaborative research with international research institutes such as the International Network for the Improvement of Bananas and Plantains (INIBAP); ACIAR; IRRI; IPGRI; CABI; Agriculture Biotechnology Center, Hungary; the Asian Vegetable Research and Development Center (AVRDC); EU/ALTERRA Greenworld Research; the International Atomic Energy Agency (IAEA); and the Food and Agriculture Organization (FAO) of the United Nations. It has offered technical consultations on agricultural development to Bosnia, Cambodia, the Ivory Coast, Kyrgyzstan, Qatar and Syria. MARDITech has also extended its activities internationally.

## Challenges

One of the challenges faced by MARDI is to replace existing experts who retire. The retirement of these experts tends to create a vacuum in a particular area which the newcomers, who are generally lacking in experience, cannot fill. The other challenge is in the context of transferring of technologies. New technologies developed and tried out at MARDI improve yield dramatically. However, when the same technologies are used in mass production, yields frequently fail to reach the expected level. The problem is the implementation level, whereby the people using the technology lack the skills and knowledge to use it properly. MARDI has engaged in various efforts to transform agriculture into a competitive sector which is as lucrative as other sectors. This is another challenge MARDI is dealing with currently.

# Appendix H

## Testing the typology: questions to address

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### Background matters

The preamble to the typology introduces the economic and social value of research and innovation, and it documents various facets of the environment for research and innovation. The evidence base is OECD-oriented. As we begin our document, some questions needing attention concerning Cambodia, Malaysia, Thailand and Vietnam will include:

- What proportion of their GDPs is invested in R&D?
- What proportion of R&D is undertaken by businesses, governments, universities and publicly funded research institutes?
- What proportion of R&D expenditure is devoted to basic research, and which kinds of institutions undertake this research?
- What levels of collaboration exist between the different institutional sectors (university sector, college sector, public research institutes sector, private corporations sector) undertaking R&D? Are there barriers to collaboration?
- Do policy makers see R&D expenditure as being very important to national economic growth, improved productivity and socio-economic development?
- How relevant to the four countries is Houghton's (OECD, 2005) characterisation of changes in the nature of research activity and other changes described in the document?
- How effectively are researchers in the four countries able to tap into the global knowledge economy using the Internet?
- What evidence is there in the four countries that the management of R & D is becoming more professionalised and more specialised?
- Where are researchers in the four countries most likely to have obtained their research training? If they become research managers, what training are they likely to have received, and where did they obtain it?

The preamble also suggests the relevance of the following questions concerning the four case study countries:

- what exactly are the government policies on R&D? How inclusive of the national research community are these policies (to what extent are they involved in developing these policies? How well are they kept informed about these policies? To what extent do the policies address a wide range of issues affecting the

research community as a whole?), and how much of a sense of ownership of them exists across the research community?

- Is reputation (international or otherwise) a potent force influencing the attractiveness of research for individuals and institutions?
- How feasible is it in the case study countries to differentiate three levels of the national research system, i.e. a) the government policy and regulatory level; b) the strategic level in research organisations; and c) the operational level?
- In the case study countries, what is the extent of variation in research activity according to: a) levels of institutional autonomy; b) differences in levels of funding available; c) differences in the extent of international co-operation and collaboration; d) differences in the level of institutional research productivity; e) geographic differences; f) differences in the valuing of "mode 1" (disciplinary) and "mode 2" (transdisciplinary and applied) forms of research?

## Themes

Theme 1 refers to a need for governments to recognise the importance of providing leadership in R & D. Relevant questions suggested for exploration in the four case study countries are:

- Have there been any official statements of national priorities for research, innovation, infrastructure and capacity building?
- By means of which mechanisms are governments seeking to direct funds to support R&D?
- What forms of support exist to enable researchers and research managers to obtain benefit from participation in international research collaborations?
- Is there a stable and well-regarded national framework for addressing ethical issues in research?
- Is there a national framework for addressing fraudulent activities in research?
- Is there a national framework for ensuring compliance with official funding rules and regulations?
- How effective are different forms of communication between governments and the research community, and how easily can the research community obtain necessary information from the state?
- What steps are taken within government to ensure that decision makers and those that develop policy are familiar with the practice and conduct of research in different disciplines and institutions? Are people experienced or active in research included in these national processes? What level of international engagement in research practice is expected in these nationally important positions?
- What steps are taken to assess the potential impact of funding decisions and tax frameworks on national R&D and international collaboration?
- Does the government consider the interplay between public, corporate, philanthropic and international funding on R&D?

- To what extent does the government:
  - Monitor research outcomes and productivity?
  - Analyse the scope of research activity to identify strengths and gaps?
  - Analyse and monitor research workforce needs and development?
  - Monitor international developments in R&D policy and practice?

Theme 2 refers to a need for leadership development in institutions. Relevant questions are:

- In what ways, and to what extent, are leaders in research institutions recognized and given encouragement to access national and international networks likely to result in research collaboration?
- To what extent are research managers being made aware of regulatory, financial and IP protocols that apply to international research collaboration, particularly where failure to comply could result in institutional risk, financial penalties or sanctions?
- To what extent are research managers being made aware of the importance of remaining connected through personal communications with research networks, and of the importance of accessing sources of up-to-the-minute information on recent developments concerning research and innovations?
- To what extent are there effective institutional governance arrangements in place to lend support to the effective functioning of a research capability?
- To what extent are there effective strategic planning processes in place in research institutions, including higher education institutions with a research capability?
- To what extent are there effective and comprehensive internal planning processes for research within institutions with a research focus or a research capability?
- To what extent do institutional leaders give expression to a belief in the value and importance of a research capability, and how do they typically do this?
- Is there evidence of effective risk-assessment processes, and how well applied are these across research institutions?
- How effectively do research institutions communicate with stakeholders (students, staff, alumni, government, the community) and with potential benefactors and commercial partners?

Theme 3 refers to a need for management to support research leadership in public institutions. Relevant questions are:

- Does the management of institutions with a research mission generally provide effective support for research leadership within these institutions?
- Are relevant responsibilities, accountabilities and formal delegations routinely and effectively recorded?
- To what extent are efficient and effective internal research management and administration practices being adopted across research institutions?

Theme 4 refers to a need for the development of leadership of researchers within institutions. Relevant questions are:

- To what extent are there formal and informal processes that have a deliberate focus on the development of the leadership and management abilities of researchers in institutions?
- To what extent are induction programs being provided for research students?
- To what extent is there career-development planning for postdoctoral and newly independent researchers?
- To what extent are there explicit recognition and reward processes for senior researchers, to maintain their motivation and commitment?

Theme 5 refers to the provision by management of support to the leadership of researchers. A relevant question is:

- To what extent is there formal provision of support for researchers and research students?

Theme 6 refers to the need for leaders and senior managers of research and innovation to demonstrate certain personal qualities and behaviours. A relevant question is:

- To what extent are research leaders and senior research managers being assisted to develop personal qualities and behaviours that are conducive to distinctive research outcomes?