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December 2020

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Making Indonesia's Research and Development Better:
Stakeholder Ideas and International Best Practices

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ABBREVIATIONS AND DEFINITIONS

ANU	Australian National University
APBN	*Anggaran Pendapatan dan Belanja Negara* (State Revenue and Expenditure Budget) (Indonesia)
APBD	*Anggaran Pendapatan dan Belanja Daerah* (Regional budgets)(Indonesia)
ARC	Australian Research Council
ARN	*Agenda Riset Nasional* (National Research Agenda)(Indonesia)
ARDA	Agricultural Research Development Agency (Thailand)
A*STAR	Agency for Science, Technology and Research (Singapore)
ASEAN	The Association of Southeast Asian Nations
Balitbang	*Badan Penelitian dan Pengembangan* (Indonesian Ministries' research and development bodies)
BAPPENAS	*Badan Perencanaan Pembangunan Nasional* (National Development Planning Board) (Indonesia)
Binaan	A 'targeted' institution in the lowest cluster of universities in Indonesia that are under the guidance of the Education and Culture Ministry
BKN	*Badan Kepegawaian Negara* (National Civil Service Agency)(Indonesia)
BLU	Non-functional' public service agency (Indonesia)
BPPT	*Badan Pengkajian dan Penerapan Teknologi* (Agency for the Assessment and Application of Technology Indonesia
BPS	*Badan Pusat Statistik* (Central Bureau of Statistics)(Indonesia)
BRIN	*Badan Riset dan Inovasi Nasional* (National Research and Innovation Agency) (Indonesia)
CAT	Computer-assisted test
CIPG	Centre for Innovation Policy and Governance (Indonesia)

CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
CSIS	Centre for Strategic and International Studies
DRN	*Dewan Riset Nasional* (National Research Board)(Indonesia)
DRPM	*Direktorat Riset dan Pengabdian Masyarakat* (Directorate of Research and Community Service) (Indonesia)
EDB	Economic Development Board (Singapore)
FGD	Focus Group Discussion
Fokus kajian	Research Focus
FTE	Full-Time Equivalent
GBHN	*Garis-garis Besar Haluan Negara* (State Policy Guidelines)(Indonesia)
GDP	Gross Domestic Product
HASS	Humanities, Arts and Social Sciences
HCDP	Human Capital Development Plan
HDR	Higher Degree Research
Hilirisasi	'Downstream' process (of research application and possible commercialization) (Indonesia)
HR	Human Resources
HSRI	Health Systems Research Institute (Thailand)
ICT	Information and communications technology
Indonesia Maju 2045	'Developed Indonesia 2045'
IRL	Innovation Readiness Level
JAD	*Jurnal Akuntansi & Keuangan Dewantara* (Dewantara Journal of Accounting of Finance)
Jakstranas Iptek	Ministry of Research and Technology strategic policies on national development concerning science and technology 2000-2004 (Indonesia)
Kemenristekdikti	Ministry of Research, Technology and Higher Education (Indonesia)
Kemendikbud Dikti	The Directorate General for Higher Education of the Education and Culture Ministry (Indonesia)

KEN	*Kebijakan Energi Nasional* (National Energy Policy) (Indonesia)
KPI	Key Performance Indicators
KSI	Knowledge Sector Initiative (Indonesia)
KUM	(acquiring) credits to support academic promotion within universities (Indonesia)
LIPI	*Lembaga Ilmu Pengetahuan Indonesia* (Indonesian Institute of Sciences)
Litbangjirap	Core activities of research, development, studies, and application by Indonesian Ministry research and development bodies (Balitbang) (Indonesia)
LPDP	*Lembaga Pengelola Dana Pendidikan* (Management Agency for Education Fund) (Indonesia)
LPK	Lembaga Pemerintah Kementerian (Ministerial government agencies) (Indonesia)
LPNK	Lembaga Pemerintah Non-Kementerian (Non-Ministry Government Institutions) (Indonesia)
LPPM	*Lembaga Penelitian dan Pengabdian kepada Masyarakat* (Indonesia university research and community institutes that develop and manage the capacity of researchers)
MoF	Ministry of Finance (Indonesia)
MTI	Ministry of Trade and Industry (Singapore)
NRCT	National Research Council of Thailand
NRF	National Research Foundation (Singapore)
NSTD	National Science and Technology Development Agency (Thailand)
NWA	Netherlands Research Agenda
NWO	Netherlands National Research Agency
OECD	Organisation for Economic Co-operation and Development
OHEC	Office of the Higher Education Commission (Thailand)
Perpres	*Peraturan Presiden* (Presidential Decree) (Indonesia)
PNBP	*Penerimaan Negara Bukan Pajak* (non-tax state revenue)
PNS	*Pegawai Negeri Sipil* (Civil Servants)(Indonesia)
Prakarsa	*Perkumpulan Prakarsa* (Welfare Initiative for Better Societies (NGO) (Indonesia)
Propenas	The National Development Program (Indonesia)(Formally *Repelita* (Indonesia)

PP	Peraturan Pemerintahan (Government Regulation) (Indonesia)
PRI	Policy Research Institute (Indonesia)
PRN	Prioritas Riset Nasional (National Research Priorities) (Indonesia)
PT	*Universitas Perguruan Tinggi* (Indonesian universities)
PTN	*Perguruan Tinggi Negeri* (state university) (Indonesia)
PTN BH	*Perguruan Tinggi Negeri Badan Hukum* (state university with legal entity status) (Indonesia)
PTN BLU	*Perguruan Tinggi Negeri Badan Layanan Umum* (state universities with public service body status)
PTN *Satker*	*Perguruan Tinggi Negeri Satuan Kerja* (state universities with working unit status)
Rakornas	National Coordinating Meeting (Indonesia)
R&D	Research and Experimental Development
Renstra	Strategic Plans (Indonesia)
Repelita	Indonesia's five-year development plan during 1966-1988 (renamed the National Development Program (Propenas) (Indonesia)
RIEC	Research, Innovation and Enterprise Council (Singapore)
RIEKN	*Rencana Induk Pengembangan Ekonomi Kreatif Nasional* (Indonesia's National Creative Economy Master Plan)
RIPIN	*Rencana Induk Pembangunan Industri Nasional* (National Industry Development Master Plan 2035) (Indonesia)
RIRN	*Rencana Induk Riset Negara* (National Research Master Plan) (Indonesia)
RISTEK	*Kementerian Riset dan Teknologi/Badan Riset dan Inovasi Nasional* (Ministry of Research and Technology) (Indonesia)
ROI	Return on investment
RPJPN	*Rencana Pembangunan Jangka Panjang Nasional* (National Long-Term Development Plan 2020-2025) (Indonesia)
RPJMN	*Rencana Pembangunan Jangka Menengah Nasional* 2020-2025 (National Medium-Term Development Plan 2020-2025) (Indonesia)
RPP	*Rancangan Peraturan Pemerintah* (draft government regulations) (Indonesia)
RRI	Research and Researchers for Industry Program (Thailand)

RUU	*Rancangan Undang-undang* (Legislative Bill) (Indonesia)
SDG	Sustainable Development Goals
Satker	Abbreviation for *Satuan Kerja* (Working Units)(Indonesia)
Simlitabmas	Information System for Research Management and Community Service scheme (Indonesia)
Sisnas Iptek	National System of Science and Technology (Indonesia)
SMERU	SMERU Research Institute (Social Monitoring and Early Response Unit) (Indonesia)
SME	Small and Medium sized Enterprises
SPRING	Standards, Productivity and Innovation Board (Singapore)
SPSS	IBM SPSS statistics analysis software
SRI	Strategic Research Issues
STEMM	Science, Technology, Engineering, Mathematics and Medicine
STI	National Science, Technology and Innovation Policy Office (Thailand)
TRF	Thailand Research Fund (Thailand)
Tri Dharma Perguruan Tinggi	'Three pillars (obligations)' of university academic staff: teaching, research and community service (Indonesia)
TRL	Technology Readiness Level
TRON	Thailand National Research Network
UI	Universitas Indonesia (University of Indonesia)
UKRI	United Kingdom Research and Innovation
UU	*Undang-undang* (Law/Legislation)

EXECUTIVE SUMMARY

In 2020, Indonesia entered a new national development era. During 2014-2019, the country's national development had been focused more on infrastructure, but for his second term, President Joko Widodo turned his focus to developing Indonesia's human capital and mastery of science and technology.

As a key step in building this national research and development capacity, the government issued Law No. 11/2019 on the National System of Science and Technology (the Sisnas Iptek Law). A National Research and Innovation Agency (BRIN) followed in 2019, although its final institutional form is still under development.[1]

The Sisnas Iptek Law signals Indonesia's desire to become a 'knowledge economy' and the overarching policy goal is to become one of the world's leading economies by 2045. It is an ambitious goal, made moreso by Indonesia's unique set of circumstances. Many policy makers want to accelerate the pace of change, in order to join the ranks of mature knowledge economies. The question is which steps – and which investments – will help reach that goal faster?

Contribution of this Report

Research and development, as key assets within a knowledge economy, require investment. In every improving 'knowledge economy', the government is the 'first investor'. Return on investment matters, and so we need to strengthen the parts of the knowledge economy that are most likely to produce measurable improvement in the quality, as well as the quantity, of research and development.

This report identifies 9 key pathways in which Indonesia can make its national research and development performance better. It draws on international best practices in research and development; the experience of Indonesia's peer economies in ASEAN; and the insights of more than 40 stakeholders who are research actors and institutional leaders in Indonesia. We ask: 'What key changes to policy and practice are most likely to make a difference for the quality and utility of the research produced in Indonesia?'

Recommendations

The improvements in policy and practice that are most likely to bring Indonesia's research and development performance closer to its national aspirations are described in full in Section 6 of this report. They include:

1. Apply a precise definition of research and development

- Adopt the OECD definition as the national, uniform, meaning of research and experimental development (R&D) in Indonesia
- Apply the OECD definition as a condition of government funding for all research (basic, applied and experimental) -- at the institutional or the project level
- Ensure that government funding and support schemes include Open Science

[1] Based on Presidential Regulation No. 74/2019

2. Establish a national research mission

- Reformulate the national research priorities as a national research mission, made up of no more than 10 discrete research missions, at least one of which prioritizes applying knowledge from the social sciences and humanities to pressing social issues
- Establish a follow-on institution to replace the National Research Council (DRN) as a national advisory body that can help shape the new national research missions
- Link the new national research mission meaningfully to competitive funding opportunities.
- In practical terms, this means that 'mission-led' research funding by government would be at least 40% (and up to 60%) of the government funding available for research

3. Build Comprehensive Research governance

- Strengthen BRIN's capacity by establishing discipline-specific research advisory panels to advise BRIN on funding needs in specific research fields.
- Undertake a study of how peer review in competitive funding of research projects has been implemented in 2-3 comparison systems (e.g. Thailand, Australia, Singapore)
- Build out or strengthen the system components (reviewer pool, database, discipline classifications, procedures, integrity checks) that are currently missing, to create an 'enhanced peer review' framework. Apply this framework to all categories of government-funded research, at the project level.
- Invest in a national program of research management professionalization that builds on good practice in Indonesia and the experience of comparison systems such as Thailand, Australia, and Singapore
- Develop a national code of research ethics that builds on international models
- In the longer term, establish an independent national research agency or one or more research councils

4. Competitive funding for efficiency and excellence

- Establish a national principle of merit-based, competition for all government funding (from any source) at the project level
- Open government funding schemes to all government, university and civil society research organizations whose work meets the OECD definition of research and development
- Make institutional funding for government research institutions competitive
- Link research performance to the operational budgets of government research institutions
- Review and strengthen performance measures of research for the university sector, particularly for those with independents status and link these to universities' operational budgets

5. Research funding for infrastructure

- Allow inclusion of small equipment in research budgets at project level
- Introduce a competitive scheme for institutional bids for large-scale research infrastructure (prioritizing multiple institutions that form consortia)
- Increase the national budget allocation for large-scale research infrastructure to support international collaborations

6. Attracting non-government and private sector contributions

- Support and monitor the effect of Indonesia's new super-tax deduction policy
- Boost the 'absorptive capacity' of Indonesian industry by accelerating the production of PhD-qualified researchers, particularly in STEM disciplines
- Create a new research grant scheme that invites industry contributions (in cash or in kind) and rewards these with co-investment by government (usually a multiple of the industry funding)
- Support BRIN to evolve into an independent research council which has the professional capability to attract and manage non-government research funding (domestic and international)

7. Professionalize management of research funds

- Develop and pilot a scheme to professionalize management of research within government research institutions and universities
- Allocate some of the national research funding available for this purpose
- Require universities and government research institutions to demonstrate that some of their institutional funding is being invested in effective research management
- Develop a reward (dividend) scheme for institutions that are successful in attracting competitive research funds and require this to be re-invested in research management

- Reduce the compliance burden on individual researchers and research teams

8. Accelerate Growth of Researcher Numbers and Quality

- Announce a national goal to move to PhD as the baseline qualification for entry-level researchers.
- Revise national targets for human capital development to accelerate PhD production in fields in the (new) national research mission that lack sufficient researchers (as for South Korea, Thailand) including STEM and social sciences and humanities disciplines
- Create a new category of portable funded fellowships for post-doctoral researchers
- Review the implementation of the tri dharma framework for structuring academic work within universities
- In the medium term, require 50% new university appointments to hold PhDs or professional equivalent.
- Include PhD training within research funding schemes
- Consider a funding scheme for creating/strengthening domestic centres and networks for national PhD training (as in the UK)
- Develop an agreed set of research training modules for national implementation that target early career researchers (PhD students and post-doctoral researches) (potentially with international support)
- Develop a national research ethics code that underscores academic freedom and responsibilities and develops processes for peer-review of research design
- In the longer term, require all new university appointments to hold PhD qualifications
- Revise workload expectations and career pathways to permit postdoctoral researchers to have more dedicated research time earlier in their careers
- Ensure that competitive research funding schemes at the institutional level include specific allocations for early-career researches (PhD students and post-doctoral researchers)

9. Grow Research network

- Make government research funding conditional on a clear plan for disseminating research results, including holding academic conferences
- Ensure competitive grants allow budget items support for the creation of national academic networks and associations and conferences and for international conference attendance
- Use evidence of membership of international research networks and associations as a criterion for grant application evaluation

INTRODUCTION

0.1 Indonesia's new investment in research

In 2020, Indonesia entered a new national development era. During 2014-2019, the country's national development had been focused more on infrastructure, but for his second term, President Joko Widodo administration turned its focus on developing Indonesia's human capital and mastery of science and technology. The 2020-2024 National Medium-Term Development Plan (RPJMN) sets out four pillars of national development:

1. Human development and mastery of science and technology;
2. Sustainable economic development;
3. Development based on principles of justice and fairness; and
4. National security and excellent state administration.

First, the development of human resources will be our main priority; building a workforce that is hard-working, dynamic, skilled, with a mastery of science and technology, [as well as] inviting global talents to work together with us.[2]

Presiden Joko Widodo (2019)

These four pillars are intended to be the foundations for achieving the vision of Indonesia becoming one of the world's biggest and economic powers by 2045 (*Indonesia Maju 2045*).[3]

This shift in national development focus is not accidental. In 2030 -2040, Indonesia is predicted to receive a 'demographic bonus', when the number of people within the productive age bracket 15-64 years is higher than the number of those under 15 or older than 64. This productive age group is predicted to reach 64 % of the projected population of 297 million (Bappenas, 2017). For Indonesia to reap the maximum benefit from this, however, the increase in human capital must be matched by increases in its quality and innovation capacity.

As a key step in building Indonesia's national research and development capacity, the government issued Law No. 11/2019 on the National System of Science and Technology (the *Sisnas Iptek* Law). This 2019 Law amended Law No. 18/2002 to address deficiencies that prevented the 2002 law from being an optimum framework for contributions from science and technology towards national development.[4] By issuing Law No. 11/2019, the Government of Indonesia was signalling more attention to, and commitment for, the growth of the research and innovation during the next phase of Indonesia's development.

[2] President Joko Widodo, Inauguration Speech, 20 October 2019: https://www.setneg.go.id/baca/index/pidato_awal_periode_kedua_presiden_jokowi_kerja_keras_dan_dobrak_rutinitas

[3] Bappenas. 2019. "Indonesia 2045: Berdaulat, Maju, Adil, dan Makmur". Kementerian PPN / Bappenas. Dokumen ini dapat dilihat di: https://www.bappenas.go.id/files/Visi%20Indonesia%202045/Ringkasan%20Eksekutif%20Visi%20Indonesia%202045_Final.pdf

0.2 Research as an asset: Sisnas Iptek

The quality of a country's research and development is a national asset. *The Sisnas Iptek* Law treats science and technology as assets that are the foundation of investment for national development (Articles 5 and 6). The new Law establishes the National Research and Innovation Agency (BRIN) (Article 48), and sets up a national Endowment Fund for Research, Development, Studies, and Application (Article 62).

The *Sisnas Iptek* Law also contains several new provisions, including those on a Master Plan for Advancement of Science and Technology (Article 8); on Inventions and Innovations (Articles 34-38); and on Ethics. As part of creating a national research repository, it mandates submission of research (*wajib serah*) and compulsory retention (*wajib simpan*) of research outputs. It requires registration of research and development institutions (Article 82); and provides tax incentives for entities that allocate part of their revenues for research and development activities (Article 89).[5]

The National Research and Innovation Agency (BRIN) was officially established in 2019 based on Presidential Regulation No. 74/2019. Although that Presidential Regulation specified the position, duties, authority, organizational structure, and working procedures of BRIN, the final institutional form of the agency itself has yet to be fully established. Moreover, the draft of the subordinate legislation that will provide more specific rules on implementing the provisions of Law No. 11/2019 (*Sisnas Iptek*) — (the RPP)— are still under discussion.

Without those implementing regulations, the management system and distribution mechanism for the Research Endowment Fund, among other elements, will not be able to commence.

0.3 The knowledge economy and knowledge ecosystem

The *Sisnas Iptek* Law signals Indonesia's desire to become a 'knowledge economy' – a concept of economic development in which innovation and access to information drive productivity growth (e.g. EBRD, 2019).[6] This requires an educated and skilled population; technology infrastructure; a regime that encourages technology and entrepreneurship and a tightly knit network of public and private research organisations, including academia, the private sector and civil society. Economies can be clustered by reference to how their competitiveness indicator places them closer to, or further from the 'mature' post-industrial economies where skills and knowledge are the key source of personal capital, and where these drive innovation and economic growth.

Research and development as key assets within a knowledge economy require investment. In every improving 'knowledge economy', the government is the 'first investor' (Mazzucato, 2018; Miedzinski, Mazzucato and Ekins, 2019). Even in mature knowledge economies (e.g. the United States, Sweden, Japan, the United Kingdom, Germany, France, Canada)(EBRD, 2019) where industry and non-government funding is significant, government has been the primary investor in research and development for most of the latter half of the 20th century (e.g. Flagg and Harris, 2020:4).

Beyond funding, research and development requires other kinds of 'inputs'– problems that require answers, supportive institutional settings, networks, equipment and talent. Communicating research and development 'outputs' (such as scholarship and teaching, publications, public knowledge) and translating these into applied forms for innovation and commercial use (e.g. patents and knowhow) also requires institutional support.

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[4] In Academic Paper of Law No. 11/2019, these were identified as:
- not creating any regulatory mechanism for coordination among [science, research and technology] institutions and sectors at levels of agenda setting, program/ budget planning, and implementation;
- not regulating, in a clear and straightforward manner, aspects of guidance that the government should provide to institutions, human resources departments and networks concerned with the research, development, study and application of, Science and Technology (*Litbangjirap Iptek*);
- not aligning with developments of other legislation, especially those concerning the state's financial system and national planning system; and
- not regulating other specific and strategic matters pertaining to current developments in the context of science and technology system.

[5] Administrative and criminal sanctions for violation are also included (Articles 91-96).

[6] Ojanperä dkk. (2019) menyatakan bahwa kita juga harus mengevaluasi 'negara dengan ekonomi berbasis pengetahuan digital' dan sumber daya digital yang (tidak) tersedia – serta bagaimana hal ini dapat kian memperlebar kesenjangan di dalam masyarakat dan antar negara.

In this report, we use 'knowledge ecosystem' (Hertz et al, 2020:2) as a contemporary way of thinking about the ways in which knowledge (including research) is created and distributed and adopted, with a particular emphasis on the human and technological agents that create, store, access, communicate and apply knowledge (knowledge producers, enablers, users and intermediaries).

This approach is widely understood in Indonesia, both through the work of the Knowledge Sector Initiative (KSI) and its partners and through the research practices of key knowledge actors, such as LIPI.[7]

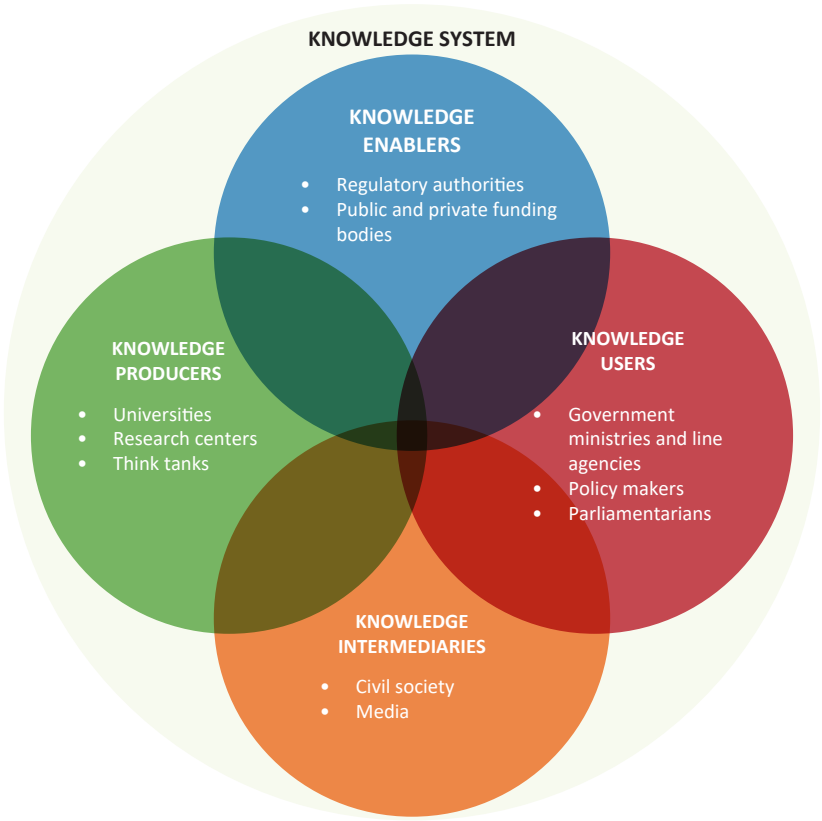
0.4 Study aims and key question

This report aims to identify ways in which Indonesia can improve its national research and development performance as it builds and implements this new regulatory framework. The overarching question for the study that informs this report is: 'What key changes to policy and practice might make a difference for the quality and utility of the research being produced in Indonesia?'

We answer that question in relation to five domains in which research and development in Indonesia – and globally - is shaped by national policymaking, institutional norms, and the practices of system actors responding to those policies:

- The quality of research and development policy — how research and development as a national asset contributes to national development;
- Indonesia's research and development ecosystem: how research actors and structures interact and what stakeholders say about the reforms needed to improve those interactions;
- The role of research funding and its impact on research capacity;
- Research human capital – the creation, quality, motivations and behaviours of researchers; and
- Research collaboration: how domestic and international research networks, links between research institutions and industry, and research accountability to the public matter for research outcomes.

FIGURE 0.1 **THE KNOWLEDGE ECOSYSTEM**[a]



[a] Hertz et al (2020) p.2

[7] LIPI adopts a 'Pentahelix approach' (see: http://osmosnetwork.com/stakeholder-management/) in its social science research, to involve multiple knowledge actors as investigators and solve complex social issues through research Pentahelix approach: https://www.ksi-indonesia.org/en/insights/detail/1191-economic-growth-needs-research-support

These are domains which:

- contain the institutions in which knowledge producers, enablers, users and intermediaries create and shape research and development;
- are the focus of policy interventions, benchmarking and measurement internationally;
- track the key elements of Indonesia's *Sisnas Iptek* Law No. 11/2019;
- emerged as concerns during group discussion with Indonesian policy makers as part of this study; and
- are domains in which Indonesia can assess its own policy choices and progress.

The question we are asking is not new for Indonesia. Many of the observation and recommendations that we make in this report have been made before, by other domestic and international observers. What this report shows is the remarkable **level of consensus** among key stakeholders about **what has to change in the structure and performance of Indonesia's research and development.**

0.5 Scope of this study

This report focusses on the 'upstream' production of Indonesia's research, with an emphasis on the policies and practices that support and govern its production and quality. The uptake of research by the Government of Indonesia for policy purposes has been the subject of prior studies (e.g. Hertz et al, 2020; KSI, 2020; Rakhmani et al, 2020; Pellini et al, 2018, Prasetamartari et al, 2018), and so this is not covered in this report. The 'downstream' uptake of research by industry and its commercialization are also important, and we report participant views about this, but drawing on experience from Indonesia's peer economies, this study focusses on 'core before commercialization' (Schiller and Liefner, 2007:554).

0.6 Recommendations

Recommendations in this report are set out in Section 6 and flow from the data gathered for the study that informs this report. The study methodology and participants are set out in Appendix A and Appendix B. Recommendations address regulations and practices that support or hinder the ways in which research is produced, financed and evaluated by research actors in Indonesia.

We often think of 'regulation' as being the laws and implementing regulations that flow from these, but institutional and individual norms and practices are equally important in shaping the course of events (see Drahos, 2017), and so we report on these as well.

Recommendations are made for the short term, the medium term and the long term. We think of these as 5-year time horizons because internationally that is a cycle that is accepted as having sufficient stability for institutions but allowing for continual improvement.

0.7 What do we mean by 'research and development'?

Effective research is research that is truly research – work that advances the state of knowledge. In this report we use the OECD definition of 'research and experimental development' (R&D)[8] in all disciplines:

> *creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge (OECD, 2015).*

In Australia, for example, to qualify as an R&D activity for funding or tax benefit purposes, the activity can take one of three forms basic research, applied research, or experimental development.[9] However to qualify as research, the work must be:

- aimed at new findings (novel);
- based on original, not obvious, concepts and hypotheses (creative);
- uncertain about the final outcomes (uncertain);
- planned and budgeted (systematic); AND
- lead to results that could be possibly reproduced (transferable and/or reproducible).[10]

[8] The OECD definitions are contained in the 'Frascati Manual': http://www.oecd.org/sti/inno/Frascati-Manual.htm The fields of science and technology used to classify R&D according to the Revised Fields of Science and Technology Classification are: 1. Natural sciences; 2. Engineering and technology; 3. Medical and health sciences; 4. Agricultural sciences; 5. Social sciences; 6. Humanities and the arts. (OECD, 2015)

[9] 1) Basic research - Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view. (2) Applied research - Applied research is also original investigation undertaken in order to acquire new knowledge; it is, however, directed primarily towards a specific practical aim or objective. (3) Experimental development - Experimental development is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

[10] (https://www.education.gov.au/higher-education-research-data-collection

FIGURE 0.2 **RESEARCH PRODUCTION VS RESEARCH COMMUNICATION**

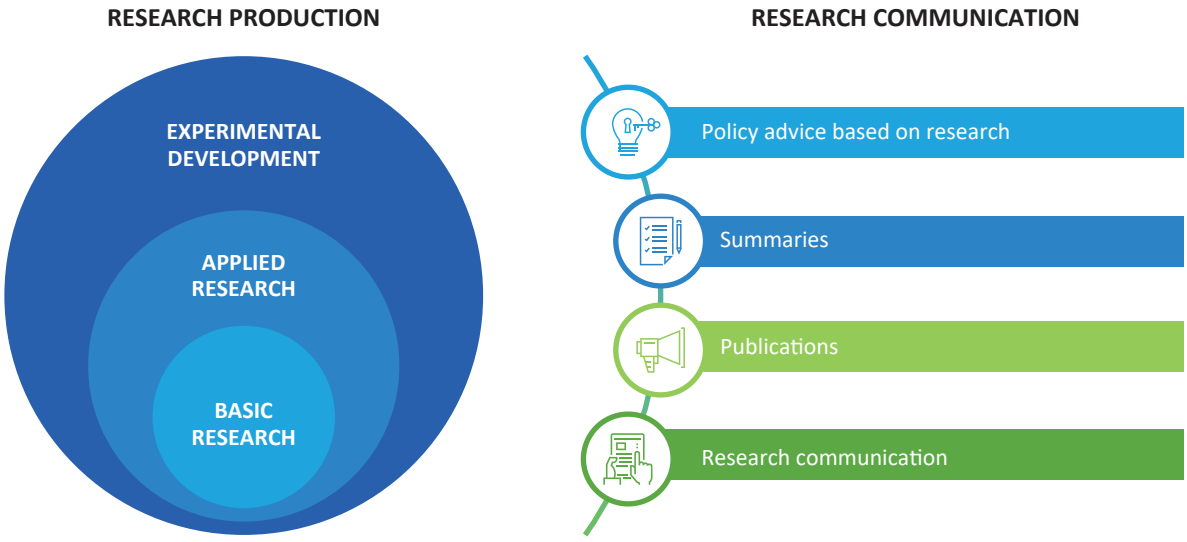


Figure 0.2 shows the difference between work that is research – that is, generating new knowledge, being novel, systematic, and reproducible – and work that consolidates or summarizes existing research, or uses research as the basis of policy advice or decision-making, or communicates research through publication or other means. These modes of using and communicating research are important, but they are not research.

Effective research is also research that is fit-for-purpose, meaning that it meets the needs of the funding source (usually government, but in the US, Japan and Europe, also the philanthropic and private sectors) and the society that those funders represent.

Generally funded research takes two forms:

1. curiosity-driven 'discovery' research by researchers, from the bottom-up; and
2. 'mission-oriented' research that aligns to the funder's priority themes (or national research priorities) and that is top-down, in the sense that research teams respond to calls for proposals or invitations to submit projects.[11]

0.8 Open Science

The OECD definition of research includes 'open science' – or what in the humanities and social sciences is often called 'open research'. Open science is a movement and a set of practices that are increasingly highlighted in both mature and developing knowledge economies. A core idea of open science is that research and discovery can be performed not only by professional researchers, but also by non-professionals, including members of the community. The quality – and review -- of the research should be rigorous, regardless of the actor performing it, but the research may be developed in a collaborative way, through networks. What open science does require is that publications, data, physical samples, and software are made publically accessible. It also demands that research results are transparent and accessible, so it encourages practices such as publishing open research, open access for publications and open-notebook science – all designed to make it easier to replicate, publish and communicate scientific knowledge.

There are many practical implications of open science – it requires governments and research institutions to store primary data from research and make this available after the original research has been completed; it encourages researchers and their institutions to make published results freely available (and not the exclusive property of commercial publishers); and it recognizes that 'researchers' can be found in the community and not exclusively in government research institutions, universities or business.

[11] Research does not have to be independently generated; it can be commissioned (as this report has been). We discuss some of the challenges of commissioned research in Appendix A: Methodology.

0.9 Importance of social science and humanities research

Mature knowledge economies treat all disciplines as valuable, because the most pressing societal, economic and environmental challenges of our time require interdisciplinary research. This depends on having advanced capability in the social sciences and humanities (which are clearly included in the OECD classification of research) as well as the science, technology, engineering, mathematics (and medicine) (STEM)(M) disciplines.

In Asia, the importance of social science and humanities research – and adequate funding for it -- is acknowledged as in mature knowledge economies like Japan, Korea and is increasingly important in Indonesia's ASEAN peer economies such as Vietnam and Thailand.

0.10 Return on investment (ROI) for research and development

Governments in knowledge economies continue to invest in research and development (even during economic downturns) because the asset delivers direct and indirect returns. We can think of return on investment for research and development being direct and indirect – with indirect returns sometimes continuing over decades (Figure 0.3).

But we can say that direct returns on research and development expenditure include economic impact, such as:

- new products, businesses and services;
- increased business growth and job creation; and
- links between the research and the development, business and investment communities.

In Australia, for example, the return on investment (ROI) for medical research is currently calculated as 400% or a 4:1 ratio --meaning that for every dollar of medical research funding provided, the research generates four dollars of economic value.[12] That calculation includes the research impact on the downstream medical technology and pharmaceutical sector, which employs more than 110,000 people. That ROI is an increase on previous estimates of AUD 3.2 return on AUD 1 of research (health and medical research) and compares very favourably to older estimates for Europe (250% return on investment (science research) and a 2.21:1 in the United States for science and technology research.[13]

The ROI can also be indirect; these are the returns that become visible over time.[14] They include social and cultural impact (e.g. improved wellbeing, health outcomes, improved policy making and public services, improved security, resilience, and cost avoidance) (UKRI, 2018:44). They also include the intrinsic value of research as a means of increasing human knowledge and understanding, nationally as well as internationally.

The long-run economic return on research and development investment can be significant. For example, the United Kingdom measures this in part by the degree

FIGURE 0.3 **TYPES OF RETURN ON INVESTMENT (ROI) FOR RESEARCH AND DEVELOPMENT**

[12] https://aamri.org.au/news-events/new-findings-show-medical-research-is-top-return-for-investment-in-australia/16th October, 2018.

[13] https://scienceandtechnologyaustralia.org.au/medical-research-investment-returns-big-dividend/

[14] https://www.arc.gov.au/policies-strategies/strategy/research-impact-principles-framework
https://webarchive.nla.gov.au/awa/20111215220334/http://pandora.nla.gov.au/pan/131022/20111216-0901/ReviewAdvicePaper.pdf

to which it contributes to national identity and prestige: the UK has 1% world's population, accounts for 2.7% of global spending on research and development; but produces 15.2% of the world's highly cited papers (UKRI, 2018:20). That demonstrated research capability in turn boosts the reputation of its higher education sector and makes possible the export of its education and research capabilities. The same is true for mature knowledge economies such as the U.S., Japan and Australia, where higher education and research are important service exports. Those long-run returns are difficult to measure and quantify in advance, which is why proxy measures - such as research paper citations – are often used by governments to explain their research and development investments.

Generating these kinds of returns on investment is only possible if the baseline level of investment by government is sufficient (as the major component of the gross national expenditure on research and development or GERD) and – importantly – if that investment is well-managed through research governance, which we discuss in Section 2.

0.11 Current indicators for Indonesia

Perceptions of the quality of national research and development is increasingly being driven by private measurement and ranking schemes. Performance against the indices in each of these schemes is its own form of global competition. It influences global researcher mobility, student mobility and international partner perceptions of national research institutions, and this in turn affects the quality of 'inputs' available to national research and development systems.

Research and development metrics and the methodologies to produce these are criticized.[15] Subjective elements in those methodologies (e.g. peer perceptions) and objective measures (e.g. number of highly cited papers produced by a researcher) can disadvantage researchers located in developing knowledge economies. Factors such as the budget of the research institution and its staff's ability to produce research outputs in English can significantly influence aggregated results.

By quality of research institution

Even understanding those limitations, Indonesia's research institutions (university, government and non-government) are not ranked – and their outputs are not counted[16] – in way that is proportionate to the country's size, population, regional political importance and economic potential.

By university reputation

In mature knowledge economies, universities are the institutions where fundamental knowledge and research skills are produced. In world rankings, which include perceptions of university quality, Indonesia does not rank highly. In the most recent Times Higher Education World University Rankings (2021), for example, *Universitas Indonesia* (UI) was the only Indonesian university in the 801-1000th band of world institutional rankings (162 in the Asia University rankings).[17] In the same round *Universitas Gadjah Mada* (UGM) sat in the 1001+ band, and in the 301-350 bank for Asia University Rankings.

Peer universities like Chulalongkorn (Thailand) sit well above these two Indonesian leaders, in the 601-800 band, and Viet Nam National University sits with UI in the 801-1000 band, but if we look at universities from the mature knowledge economies in Asia, the gulf is enormous: Tsinghua University, China (20); Peking University (23); National University of Singapore (25), Tokyo University (36) and Hong Kong University (35). If we add Australia, there are 6 universities in the top 100, with Melbourne (31), Sydney (51) and ANU (59) leading that group.

By human capital

A proxy measure for national research capability in the form of human capital is the number of researchers per million population.[18] In this measure, in 2018 Indonesia's

[15] Tyranny of metrics, Muller, Jerry Z. Princeton University Press, Princeton, NJ, 2018.

[16] For a sample of natural science outputs by Indonesian institution, for example, see: https://www.natureindex.com/annual-tables/2020/institution/all/all/countries-Indonesia

[17] https://www.timeshighereducation.com/world-university-rankings/university-indonesia

[18] The number of researchers engaged in Research &Development (R&D), expressed as per million. Researchers are professionals who conduct research and improve or develop concepts, theories, models techniques instrumentation, software of operational methods. R&D covers basic research, applied research, and experimental development. Data are for full-time equivalent (FTE); the FTE of R&D personnel is defined as the ratio of working hours actually spent on R&D during a specific reference period (usually a calendar year) divided by the total number of hours conventionally worked in the same period by an individual or by a group. The data are obtained through statistical surveys which are regularly conducted at national level covering R&D performing entities in the private and public sectors. (UNESCO Institute for Statistics).

capability was 100-350 times less than some of its regional neighbours – and peer ASEAN economies: (Indonesia 215)(Australia 4500+)(Korea 7,500+)(Thailand 1350).[19]

What is more significant is that both Thailand and South Korea have prioritized the production of researchers (Masters research and PhD level graduates) as part of their national research plans and in both cases have linked this explicitly to producing better qualified researchers for, and with, industry. The Thailand Research Fund (TRF), for example, established a Research and Researchers for Industry Program (RRI) from 2012 that aims for a supply of 11,400 master's degree graduates and 10,500 PhD degree graduates for industry within 15 years (TRF, 2013:29).

The Table 0.1 below shows how the number of researchers in Thailand and Indonesia might look like in 15 years' time, if both countries maintain their current policies with regard to human capital improvement.

TABLE 0.1 **THAILAND/INDONESIA RESEARCHER POPULATION, PROJECTED TO 2035[a]**

YEAR	TOTAL R&D PERSONNEL		NUMBER OF R&D PERSONNEL PER MILLION INHABITANTS	
	THAILAND	INDONESIA	THAILAND	INDONESIA
2001	32,011	51,544		266
2005	36,967		565	
2011	53,122		787	
2016	112,386	59,658	1,629	228
2017	138,644	64,635	2,003	244
2020	189,940	79,638	2,731	328
2025	282,966	104,613	4,053	458
2030	375,993	129,588	5,375	587
2035	469,019	154,563	6,696	716

[a] The linear trend data was calculated through a given set of y-values (total R&D personnel) and a given set of x-values (the year of the data) then extending the linear trendline to calculate additional y-values for a further supplied set of new x-values (future estimated personnel). TREND(known y's, [known x's], [const])

TABLE 0.2 **ASEAN MEMBER COUNTRIES BY POPULATION, GDP AND GDP PER CAPITA[a]**

COUNTRY	POPULATION (000) 2019	GDP (IN MILLION USD) 2019	GDP PER CAPITA (USD) 2019
Brunei Darussalam	442.4	13,483	29,343.3
Cambodia	15,981.8	27,102	1,663.8
Indonesia	**265,015.3**	**1,121,298**	**4,182.8**
Lao PDR	6,887.1	18,844	2,645.4
Malaysia	32,385.0	364,403	11,184.4
Myanmar	53,625.0	66,500	1,229.2
Philippines	106,598.6	377,116	3,483.0
Singapura	5,638.7	372,063	65,232.9
Thailand	67,831.6	543,958	8,000.6
Vietnam	94,666.0	261,587	2,711.2

[a] ASEAN Macroeconomic Database (compiled/computed from data submission, and/or websites of ASEAN Member States' national statistics offices and relevant government agencies). Last accessed 30 September 2020 https://www.aseanstats.org/ebooks/

[19] https://data.worldbank.org/indicator/SP.POP.SCIE.RD.P6?end=2018&locations=ID&start=2016 ID: SP.POP.SCIE.RD.P6 Source: UNESCO Institute for Statistics (uis.unesco.org)

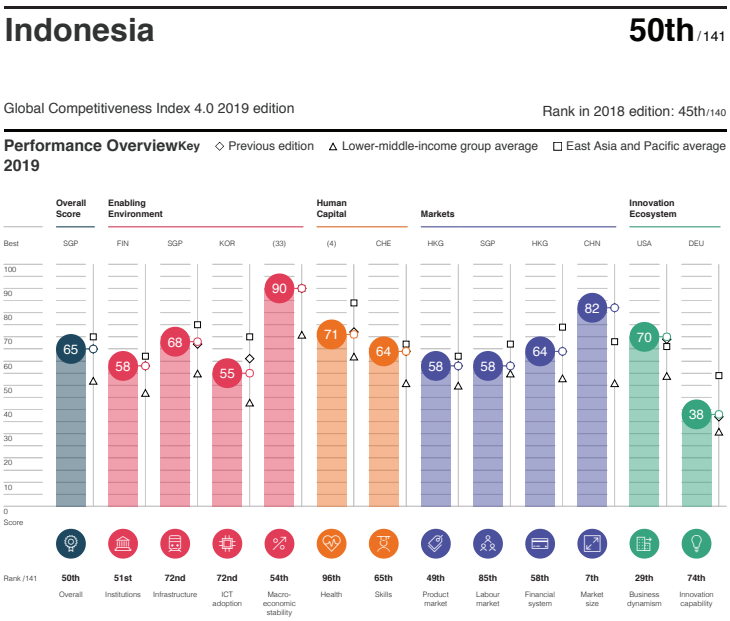
By innovation measures

The Global Competitiveness Index seeks to measure some of the downstream value of research, using indicators such as number of patents, or international co-invention as a proxy for innovation and for a facilitative business and research and development environment. In 2019, Indonesia ranked 50/141 in the aggregate rankings, which compared favourably with peer ASEAN economies such as Viet Nam (57), the Philippines (64). However, if we consider the relative size of the ASEAN economies, Indonesia's performance looks less strong.

Despite the size of its economy and its geopolitical importance within ASEAN and the Asia-Pacific region, Indonesia, with a GDP twice the size of Thailand's, is 10 places behind Thailand (ranked 40) in the Global Competitiveness Index. While Indonesia's economy is nearly 6 times larger than Viet Nam's, Viet Nam ranks only 7 places below Indonesia (at 57) in the same Index.

The elements that make up Indonesia's aggregate score in that Index are broken out in the table below; significantly the lowest ranking indicators are those for innovation capacity and ICT adoption, both of which are key inputs for a knowledge economy.

FIGURE 0.4 **INDONESIA GLOBAL COMPETITIVENESS PROFILE**[a]



[a] Schwab, K, 2019, The Global Competitiveness Report 2019, Insight Report World Economic Forum p. 282

1

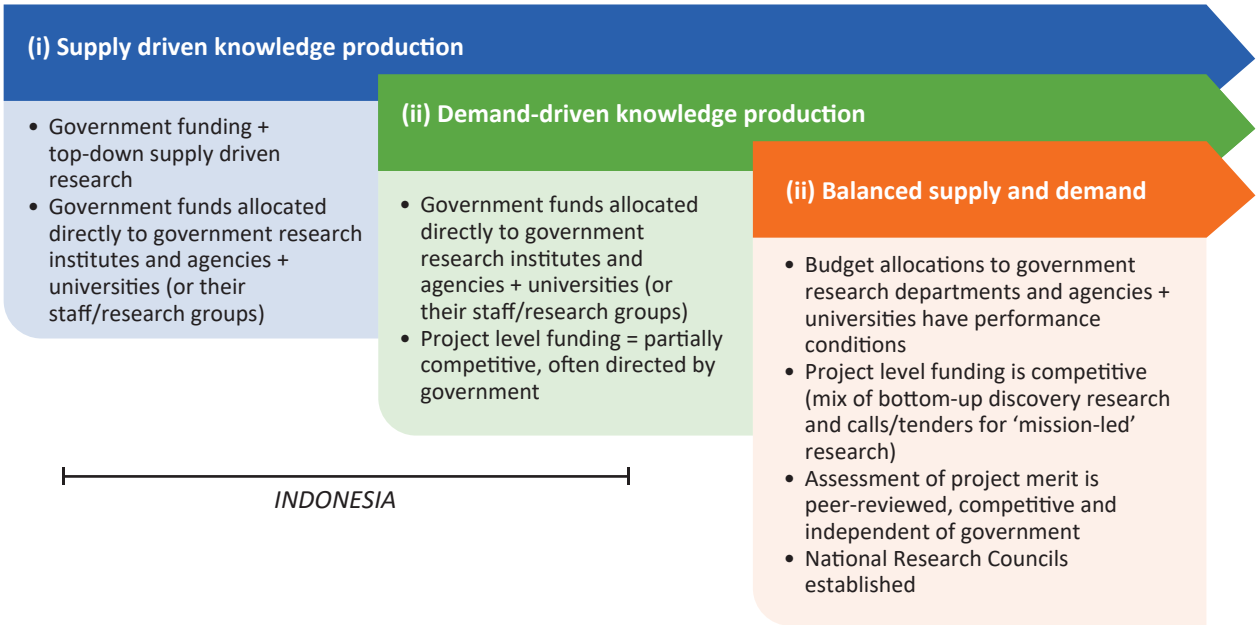
RESEARCH AND DEVELOPMENT POLICIES AS DEVELOPMENT

1.1 How do research and development policies contribute to national development?

National research agendas and priorities are late 20th century forms of public policy. Mature knowledge economies have generated these by making three major transitions in knowledge production:

- direct funding by the government for research and development requested by government - a supply driven, top-down model ('directed research'); that is largely replaced by
- funding through a system of calls and tenders performed by National Research councils or comparable institutions – marking a shift to demand-driven knowledge production; and then
- the articulation of theme-oriented science policies that evolve in addition to general science policies (de Haas 2017: 48). These are resourced by government and non-government funders, although as we will see in Section 3 below, the funding mix is different in different economies. This third stage is what Mazzucato (2018) would call 'mission-oriented research'.

FIGURE 1.1 **THREE TRANSITIONS IN KNOWLEDGE PRODUCTION**



In this scheme, Indonesia is currently sitting between stages (i) and (ii) – but many stakeholders are arguing for a rapid progress through stages (ii) and (iii). The scheme above shows how the supply of government funding for directed research is managed, but in most mature economies, 'blue-sky' or curiosity-driven research ('bottom up' research) proposed by researchers is also an important part of the total research and development effort. The balance of the mix between mission-oriented research and curiosity-driven research is not fixed; we discuss this in more detail in Section 3.

Innovation policy development

A similar pattern of evolution can be seen in how technology and innovation policies evolve, where the general trend is a transition from industrial support to innovation policy.

In the 1990s, many countries supported increases in funding for key industrial sectors (e.g. industries making substantial contributions to export) – this is the stage that Indonesia sits at currently. Globally, we see three key approaches:

- some countries focus on proven strengths e.g. in the Netherlands innovation policy is now partly aimed at nine key industrial sectors;
- some countries focus on innovation. e.g. Israel and the United States; and
- some countries focus on 'broad absorption', meaning that they fund research without tying it directly to specific industry sectors, e.g. Japan (de Haas 2017: 49, citing Soete et al 2012). 'Absorption' also relates to building a general capacity among research actors including industry to absorb and then develop research. As we will see in Section 4, this largely depends on the quality of a country's human capital.

Why is policy coherence important?

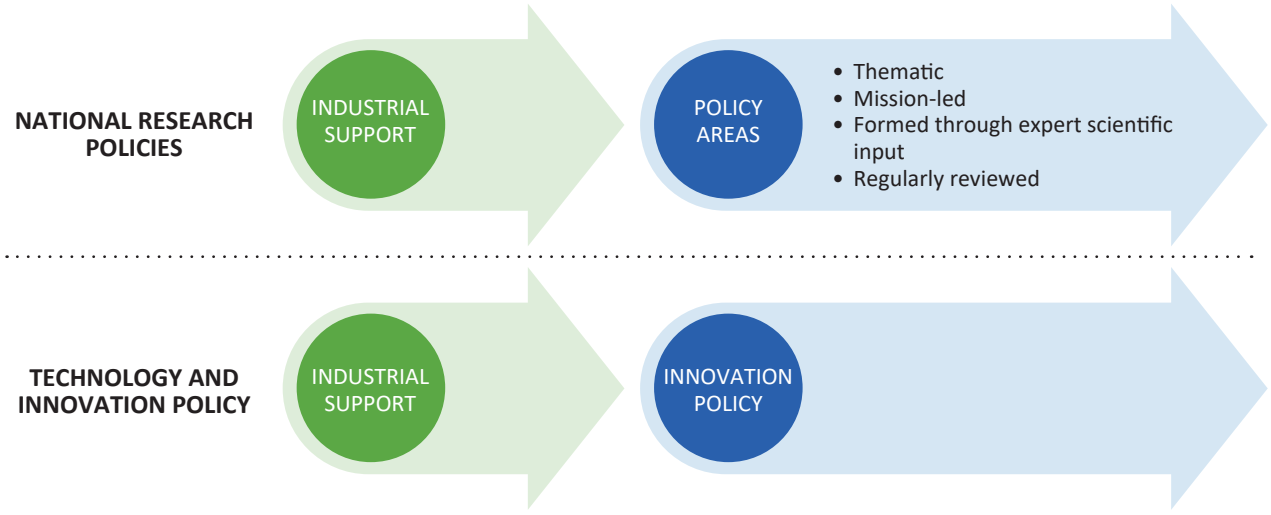
Most mature knowledge economies have a national research agenda. Those policies often include a combination of approaches, such as:

- policy that stimulates general conditions for innovation (e.g. tax incentives for companies spending on research and development, or investment in education in order to increase the national absorption capacity for research and innovation);
- explicit thematic choices, focusing attention and resource on existing and proven strengths (the so-called 'backing winners' approach); and
- fostering networks between companies, researchers and governments so that the national research agenda represents agreements made by network partners (usually includes incentives for different actors for form research consortia and develop 'bottom up' discovery) (de Haas 2017: 50).

Mission-oriented research and development

Mazzucato, currently the world's leading economist writing on the relationship between the state, the economy and innovation, argues for the importance of setting mission-oriented research and innovation

FIGURE 1.2 **PATTERN OF EVOLUTION OF TECHNOLOGY AND INNOVATION POLICIES**



priorities and programs when the government designs its strategies for research and innovation (Mazzucato, 2018). A mission-oriented approach to priorities is essential, so that the available science and technology resources can be directed and utilized effectively, in order to produce solutions, opportunities, or approaches to the problems faced by the public in their daily life.

She argues that a research and innovation mission should be directed towards better public welfare and have 'social relevance', in the form of goals such as higher quality of health, nutrition, or public goods such as the environment. To make sure that the research and innovation activities do create impact and have social relevance, they need (a) a clear and comprehensive framework for their work programs; and (b) flexibility in the process of setting the mission and the priorities.

Developing mission-oriented research requires a roadmap (or a blueprint) that considers all of the relevant regulations and knowledge actors who need to be coordinated and oriented in the same direction, to the same goal.

At the system level, the UK Research and Development Roadmap (2020) is a very clear and comprehensive approach to simplifying regulatory complexity and coordinating funding and actors for more significant results.

At the individual policy level, Miedzinski, Mazzucato and Ekins (2019) give a worked example of how innovation policy could be developed to deliver on an environmental mission that align with the Sustainable Development Goals (SDGs).

TABLE 1.1 **POLICY INSTRUMENT ROADMAP FOR MISSION-ORIENTED INNOVATION POLICIES[a]**

POLICY INSTRUMENT	TYPE	RELEVANCE FOR MISSION-ORIENTED POLICIES
Direct financial support	Institutional finding for public research (universities and research institutes)	funding for research contributing to missions, including blue sky research
	Project grants for public research organisations	
	Grants for business R& D and innovation	grants for business for R&D innovation relevant to missions
	Centres of excellence grants	centres fully or partially dedicated to missions
	Procurement programmes for R&D	funding for procurement encouraging innovation, scaling up and diffusion relevant permissions; procurement with specific criteria encouraging innovation addressing missions including innovation, precommercial and functional procurement
	Fellowships and postgraduate loans and scholarships	funding for fellowships and postgraduate loans and scholarships explicitly focused on missions
	Loans and credits for innovation in firms	funding for loans and credits for innovation relevant for missions
	Public finance	public funding for loans and credits for innovation relevant permissions (e.g. public investments, development loans, guarantees) including "patient finance "
	Feed-in tariffs	payments to the outcomes generate generated by innovations relevant for missions (often applied to renewable energy technologies)
	Equity financing	public funds for venture capital and other forms of equity financing spent on innovative projects relevant for missions
	Innovation vouchers	funding for innovation vouchers for innovative mission projects

[20] https://www.gov.uk/government/publications/uk-research-and-development-roadmap/uk-research-and-development-roadmap

POLICY INSTRUMENT	TYPE	RELEVANCE FOR MISSION-ORIENTED POLICIES
Indirect financial support	Corporate tax relief for R&D and innovation	tax relief for R&D and innovation relevant for missions
	Tax relief the households for R&D or adoption of innovation	tax relief to households for the promotion of innovative goods and services relevant for accomplishing missions
	Debt guarantees and risk sharing schemes	debt guarantees and risk sharing schemes with preferential conditions for investments relevant for accomplishing missions
	Tax on environmentally harmful technologies	levy or tax on harmful products or technologies which counteract mission objectives
Governance and regulatory framework	National strategies, agendas and plans	strategies, agendas and plans fully or partially focused on missions
	Policy Road Maps and long-term action plans	process is to co-design and coordinate mission-oriented innovation policy portfolios with dedicated targets and milestones. Road maps can provide frameworks for national and international collaboration
	Creation or reform of governance structures or public bodies	governance structures or public bodies with specific mandates and tasks related to missions
	policy intelligence (EG evaluation, foresight)	thematic evaluations and foresights focused on missions
	Consultation of stakeholders and experts	formal consultations of stakeholders with a focus on mission
	Horizontal STI consultation bodies	STI coordination bodies that explicitly recognise the role of mission-oriented innovation in horizontal STI (e.g. adding topics related to missions two agendas of STI committees or councils)
	Product and process standards and certification	examples include performance standards relevant permissions for appliances, equipment, and buildings
	Labour mobility regulation and incentives	Labour mobility regulations and incentives designed to encourage mobility of staff with competence is relevant permissions
	Intellectual property regulation and incentives	funding for intellectual property regulation and incentives with a specific focus on technologies and solutions relevant for missions (e.g. promoting Open Access 2 IP or supporting young firms)
	Public awareness campaigns and other outreach activities	funding for instruments to increase mission-oriented knowledge, awareness and training among stakeholders or the general public (information campaigns, training programmes, labelling schemes)
	Science and innovation challenges, prizes and awards	funding for S&T challenges, prizes and awards focused on mission challenges (e.g. prizes for mission innovations)
Technology guidance and advisory services	Technology transfer and business advisory services	centres and funding for international, national or regional technology transfer and business advisory services that are fully or partly focused on missions and business advisory services for innovative business businesses focused on areas relevant for missions
	Business incubation advice	centres and levels of funding for business incubation advice that is fully or partly focused on missions

POLICY INSTRUMENT	TYPE	RELEVANCE FOR MISSION-ORIENTED POLICIES
Collaborative platforms and infrastructure	Clusters and other networking and collaborative platforms	funding for programmes to support clusters and other networks and collaborative platforms specifically focused on missions
	Dedicated support to new research infrastructure	funding for gnu research infrastructure of relevance to research and demonstration relevant for accomplishing missions (e.g. materials testing facilities, emission testing facilities, toxicity testing labs)
	Information Services and databases	funding for Information Services and databases focused on mission-oriented innovation and slash or addressed to innovative companies and other stakeholders active in areas relevant for missions

[a] Adapted from Miedzinski, Mazzucato and Ekins (2019)

1.2 Developing national research priorities

A recent survey of national research priorities across 15 countries shows that most research priorities are expressed as broad fields within a thematic research agenda, including a range of social issues (de Haas, 2017). Areas in which national research priorities overlap in Europe and Asia include energy, sustainability, food, and health-related topics, but significantly, these are framed as pathways to solving important societal problems, e.g. 'using big data responsibly' (Netherlands),' 'healthy nutrition and sustainable food production'(Switzerland), 'the green economy'(Korea) and 'urban solutions and sustainability' (Singapore)(de Haas, 2017:54). In Asia, national research agendas are closely linked to economic and innovation policy – we see this in Singapore and South Korea, for example. But these are not industry sectors, or product types – they are broad fields in which government invites basic and applied research.

How many national research priorities do you need?

The number of national research priority areas varies by country, but something between 6-9 is typical. No mature knowledge economy has as many 'national research priorities' as Indonesia's 47. Japan has 5; Germany 6; Australia 9 and South Korea 30. Thailand has 12 Strategic Research Issues (SRI), including food security, inequality reduction, health and demographic transition, new knowledge and innovation of sciences, social sciences and humanities (TRF, 7). Some mature knowledge economies – notably the United States – have no national strategic prioritization at all, but this is now the target of domestic criticism (Flagg and Harris, 2020).

In every case, where an economy has national research priorities they review and revise them every 3- 5 years.

How are national research priorities set?

Internationally, there are – broadly speaking - three different methods of setting national research priorities:

1. bottom up consultation: e.g. an invitation to citizens and organizations to submit questions to science (e.g. Netherlands);
2. through expert groups: parties outside government from science and industry set the agenda, in consultation with government actors (e.g. Australia, Ireland); and
3. created as part of regular policy process (e.g. Japan, Korea, Singapore) where a government committee is advised by representatives from industries and universities.

No mature knowledge economy uses government actors exclusively to set its national research priorities.

As part of a regular policy process: South Korea and Singapore

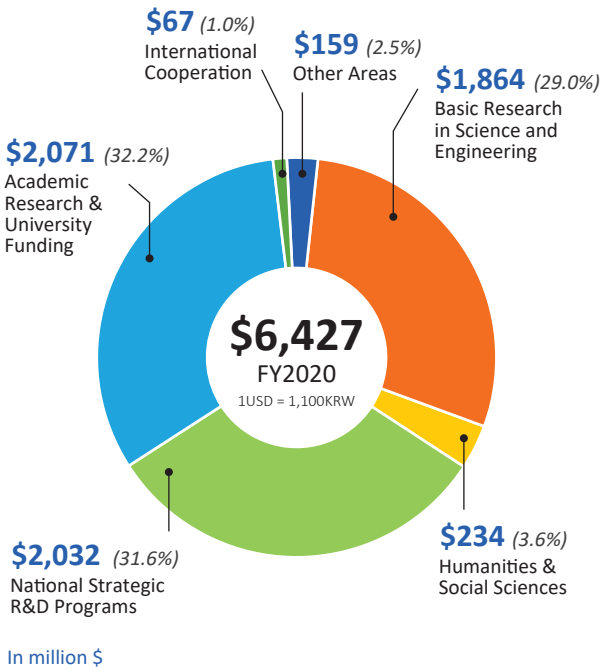
South Korea is an example of top-down, government-directed policy to fund projects intended to boost competitiveness in fields such as artificial intelligence, robotics and materials, often in partnership with the private sector. This is consistent with the post-war focus on applied research that turned South Korea into a leader in semiconductor manufacturing and wireless communication networks. However, more recently South Korean policymakers are pushing for greater investment in fundamental research that meet the practical needs

of South Korean society, such as air pollution, and an ageing population and the government has responded with initiatives to trace and reduce fine particulate matter across northeast Asia, and another to fight dementia.

If we look at the research funding allocation by the National Research Foundation of Korea in 2020, we can see that only about 30% of that expenditure is earmarked for national research priorities. The balance is distributed across basic research in the sciences and the humanities and funding allocations to universities (Figure 1.3).[21]

In Singapore, the National Research Foundation plays the role of both a funding agency and a national policy agency, located within the Prime Minister's office. From there it advises the Research, Innovation and Enterprise Council (RIEC), chaired by the Prime Minister, on the national research and innovation agenda. The national research priorities, however, are relatively streamlined and open-textured (Figure 1.4).

FIGURE 1.3 RESEARCH FUNDING ALLOCATION BY THE NATIONAL RESEARCH FOUNDATION OF KOREA IN 2020



In million $

FIGURE 1.4 **SINGAPORE'S RESEARCH PRIORITIES**[a]

TECHNOLOGY DOMAINS

Advanced Manufacturing and Engineering (AME)	**Health and Biomedical Sciences (HBMS)**	**Urban Solutions and Sustainability (USS)**	**Services and Digital Economy (SDE)**
To develop technological capabilities that support the growth and competitiveness of our manufacturing and engineering sectors	To be a leading centre that advances human health and wellness, and creates economic value for Singapore and Singaporeans through the pursuit of excellence in research and its aplications	To develop a sustainable and liveable city through integrated solutions for Singapore and the world	To develop, integrate and leverage Singapore's digital innovation capabilities to meet national priorities, raise productivity and support key services, create sustainable economic opportunities and quality jobs

Cross-cutting Programmes

Due to the pervasive and cross-cutting nature of digital technologies, AME, HBMS and USS domains will draw on and fund research in digital technology capabilities that support the research agenda within their domains

Academic Research
To build up a significant base of capabilities and a pipeline of ideas that can feed into applied and industrial research to drive the next phase of growth

Manpower
To build a strrong research and innovation community

Innovation and Enterprise
To build up a strong corree of innovative enterprise that drive value creation and economic competitiveness

[a] https://www.nrf.gov.sg/rie2020

[21] https://www.nature.com/articles/d41586-020-01464-9

[22] https://www.nrf.re.kr/eng/page/ea516249-2e9a-49f6-a970-edecb77bd1e6

[23] Total reported in 2020: $5.236 billion (KRW 5.760 trillion) Basic research in science engineering ($1.579 billion), academic research in humanities and social sciences ($205 million), national strategic R&D ($1.669 billion), academic promotion and cultivation of human resources ($1.639 billion), international affairs ($73 million), other ($71 million) https://www.nature.com/articles/d41586-020-01464-9

Significantly, the allocation of budget against these national priority fields also includes a significant amount of 'white space' funding, which can be prioritized at a later stage.

Using Expert Groups: Australia

The Australian Government has 9 Science and Research Priorities, which are intended to be reviewed every 2 years.[24] They were developed in consultation with leaders from industry, research and government, and are designed to focus Australian Government support for science and research on the most important challenges facing Australia. The current Science and Research Priorities are: (1) Food; (2) Soil and Water; (3) Transport; (4) Cybersecurity; (5) Energy; (6) Resources; (7) Advanced Manufacturing; (8) Environmental Change and (9) Health.

Each priority is associated with three to four Practical Research Challenges, which aim to guide investment and activity in areas where the Government considers Australia must maintain a strong research and development capability. So, for example:

Food

- Enhanced food production
- Knowledge of global and domestic demand, supply chains and the identification of country specific preferences for food Australia can produce.
- Knowledge of the social, economic and other barriers to achieving access to healthy Australian foods.

Soil and Water

- Better understanding of sustainable limits for productive use of soil, freshwater, river flows and water rights, terrestrial and marine ecosystems.
- Minimising damage to, and developing solutions for restoration and remediation of, soil, fresh and potable water, urban catchments and marine systems.
- New and integrated national observing systems, technologies and modelling frameworks across the soil-atmosphere-water-marine systems.

Transport

- Effective pricing, operation, and resource allocation.
- Improved logistics, modelling and regulation: urban design, autonomous vehicles, electrified transport, sensor technologies, real time data and spatial analysis.
- Low emission fuels and technologies for domestic and global markets.

Cybersecurity

- Highly-secure and resilient communications and data acquisition, storage, retention and analysis for government, defence, business, transport systems, emergency and health services.
- New technologies and approaches to support the nation's cybersecurity: discovery and understanding of vulnerabilities, threats and their impacts, enabling improved risk-based decision making, resilience and effective responses to cyber intrusions and attacks.
- Secure, trustworthy and fault-tolerant technologies for software applications, mobile services, cloud computing and critical infrastructure.
- Understanding the scale of the cyber security challenge for Australia, including the social factors informing individual, organisational, and national attitudes towards cyber security.

Energy

- Australian electricity grids that can readily integrate and more efficiently transmit energy from all sources including low- and zero-carbon sources.
- Low emission energy production from fossil fuels and other sources.
- New clean energy sources and storage technologies that are efficient, cost-effective and reliable.

Resources

- A fundamental understanding of the physical state of the Australian crust, its resource endowment and recovery.
- Knowledge of environmental issues associated with resource extraction.
- Lowering the risk to sedimentary basins and marine environments due to resource extraction.
- Technologies to optimize yield through effective and efficient resource extraction, processing and waste management.

Advanced Manufacturing

- Cross-cutting technologies that will de-risk, scale up, and add value to Australian manufactured products.

[24] https://www.arc.gov.au/grants/grant-application/science-and-research-priorities

- Knowledge of Australia's comparative advantages, constraints and capacity to meet current and emerging global and domestic demand.
- Specialised, high value-add areas such as high-performance materials, composites, alloys and polymers.

Environmental Change

- Improved accuracy and precision in predicting and measuring the impact of environmental changes caused by climate and local factors.
- Resilient urban, rural and regional infrastructure.

Health

- Better health outcomes for Indigenous people, with strategies for both urban and regional communities.
- Better models of health care and services that improve outcomes, reduce disparities for disadvantaged and vulnerable groups, increase efficiency and provide greater value for a given expenditure.
- Effective technologies for individuals to manage their own health care, for example, using mobile apps, remote monitoring and online access to therapies.
- Improved prediction, identification, tracking, prevention and management of emerging local and regional health threats.

The Australian Research Council (ARC) supports research under the Science and Research Priorities by asking applicants for funding to indicate whether their research proposal relates to one of the priorities and, where relevant, assessing the potential of research proposals to contribute to the priorities. The science and research priorities are guidelines; there are is no absolute or requirement that competitively funded research awards from the ARC conform to the national Science and Research Priorities, but the ARC reports annually on the percentage that do. Currently this is about 60% across all funding schemes (with 50% or less in curiosity-driven schemes and 100% in mission-led schemes).[24]

The long-term view about what research is needed for national development is set out in Australia's National Science Statement, which is developed by the Chief Scientist in collaboration with external experts and government actors.[25] That statement principles to guide government investment and decision-making, including:

- recognizing science as fundamental to the economy
- ensuring scientific research investment is focused on high-quality research
- ensuring support for research is stable and predictable
- encouraging and supporting collaboration across disciplines, sectors and internationally
- maximizing opportunities for all Australians to engage with the science process

Bottom-up consultation: the Netherlands

The Dutch National Research Agenda is administered by the national research agency (NWO), which also has a commitment to 'Open Science'.[26] NWO, an independent administrative body with statutory powers and duties which both produces research through its affiliated Institutes and administers competitive research funding schemes open to researchers at external institutions.[27] The national research agenda is diverse – it follows more than 20 'routes' generated through bottom up questions from citizens.

- Research by consortia, which emphasizes broad, interdisciplinary and transdisciplinary research on subjects relevant for science and/or society which have a clear added value for a broad, national approach. It must involve societal partners (including industry) as well as citizens.
- Thematic programming covers programmes developed in consultation with government ministries
- Innovations and networks foster self-organizing networks within 25 different routes
- Science Communication and Outreach

[24] See: Snapshot of ARC Statistics – National Science and Research Priorities: https://www.arc.gov.au/about-arc/consultations/national-science-and-research-priorities-review (ARC, 2019d)

[25] https://www.industry.gov.au/data-and-publications/australias-national-science-statement

[26] https://www.nwo.nl/en/research-and-results/programmes/dutch+national+research+agenda

[27] Which also has a commitment to Open Science; https://www.nwo.nl/en/research-and-results/programmes/dutch+national+research+agenda

As we will see below, Indonesia's national research priorities do not follow any model currently in use in lead knowledge economies.

1.3 Dynamics of Indonesia's research and development policies

During the New Order regime (1966-1988), the direction of Indonesia's national policies on science and technology were expressly stated in the five-year development plan (*Repelita*). The *Repelita* was designed to describe the State Policy Guidelines (GBHN), which guided the administration of the state for the period 1971-1998. Following the 1998 reform movement, the Repelita was renamed the National Development Program (*Propenas*).

In the *Repelita*, development plans were drafted in comprehensive and detailed manner and broken down into sectors and areas. But in the *Propenas*—and the national long-term and medium-term development plans (RPJPN and RPJMN) that came later—national development plans were drafted by emphasizing the order of priority in defining issues and solutions for them (strategic choices). The *Propenas* prioritized and highlighted the important, urgent, and fundamental policy agendas that would be a priority for the nation over the next five years (*Bappenas*, 2000).

Science and technology were not one of the priority fields of national development in the *Propenas* but became a supporting element for development (Ministry of Research, Technology, and Higher Education, 2017). Science and technology development programs were not described in detail in the *Repelita* in the way that priority policy fields were. A consequence of this is that each government science and technology institution has had to adapt to changing (political) priorities by drafting their own organization's strategic plans.

To help this process, the (then) Ministry of Research and Technology set out the strategic policies on national development concerning science and technology (*Jakstranas Iptek*) (2000-2004) as a reference document for the direction for national science and technology development. The focus of those policies was revitalization of economic development from the impact of the economic crisis, by utilizing science and technology and innovation, through integration of science and technology institution networks.

This period also saw the introduction of Law No. 18 of 2002 on National System of Research, Development, and Application of Science and Technology (*Sisnas P3 Iptek*), which was the only law related to science and technology in Indonesia for 17 years, until the Law on National System of Science and Technology (*Sisnas Iptek*) was adopted in 2019.

Following the promulgation of Law No. 25 of 2004 on the National Development Planning System, the government established the 2005-2009 Medium-Term Development Plan (RPJMN) as the replacement for the National Development Program (*Propenas*) through Presidential Regulation No. 7 of 2005. It established the 2005-2025 National Long-Term Development Plans (RPJPN) through Law No. 17 of 2007. As with the Propenas of the earlier period, science and technology is positioned in the RPJPN as a supporting field, rather than a separate priority: one of the steps to build the nation's competitiveness is increasing the mastery, expansion, and utilization of science and technology.

National Research Agenda (ARN) documents were developed for three periods: ARN 2006-2009; ARN 2010-2014 and ARN 2016-2019.[28] These functioned as the explanation for the strategic policies on national development concerning science and technology (*Jakstranas Iptek*). The ARN was formulated, monitored, and its implementation evaluated by the National Research Council (DRN), an independent agency set up by the Government outside the normal state bureaucratic structure. The mandate of the DRN was to represent the views of the actors with interests in the development of science and technology in Indonesia.[29]

At the beginning of the 2014-2019 development period, there was an idea to develop a master plan for the science and technology sector that would be more structured and have a higher level of legal power. This was because the evaluation of the previous policies of strategies for science and technology (such as the 2005-2025 White Paper on

[28] ARN 2006-2009, ARN 2010-2014, ARN 2016-2019

[29] The establishment of both the DRN and ARN was mandated by the 2002 Law on National System of Research, Development, and Application of Science and Technology (the *Sisnas P3 Iptek* Law).

Research, Development, and Application of Science and Technology; the strategic policies on national development concerning science and technology (Jakstranas Iptek); and the National Research Agenda (ARN)) showed that those policies did not fully serve as reference points for government science and technology institutions (Ministry of Research, Technology, and Higher Education, 2017).

The National Research Master Plan (RIRN) was then drafted as the main reference document for research sector planning at national scale for 2017-2045. The RIRN was expected to not only create harmonious synergies between planning in the research sector and national development planning, but also to support the needs of the business world and the public. The National Research Master Plan (RIRN) was officially introduced by Presidential Regulation No. 38 of 2018 and the 2017-2045 RIRN has been in effect since then.

The vision of the RIRN is a 'Competitive, Sovereign Indonesia, based on Science and Technology'. The RIRN was drafted by taking into account, and incorporating, previous policy documents on research, such as the ARN, the Jakstranas Iptek, Books I and II of the 2015-2019 RPJMN and the Strategic Plans (Renstra) from related Ministries and institutions. The RIRN was also integrated into Master Plans of related sectors, such as the 2015-2035 National Industry Development Master Plan (RIPIN) of the industrial sector; the National Energy Policy (KEN) of the energy sector; and the National Creative Economy Master Plan (RIEKN) of the creative economy sector. The relationship between the RIRN and Indonesia's national research priorities is discussed below at 1.7.

1.4 National system of science and technology (the Sisnas Iptek Law)

Under Law No. 11 of 2019 on the National System of Science and Technology (the Sisnas Iptek Law) science and technology are expressly established as the foundation of, assets to, and investment for, national development (Articles 5 and 6). Article 8 mandates the establishment of the Master Plan for Advancement of Science and Technology, which will serve as mandatory guidelines for running science and technology and also as a reference for long-term and medium-term national development plans. The Master Plan for Advancement of Science and Technology (RIPIPTEK) consists of:

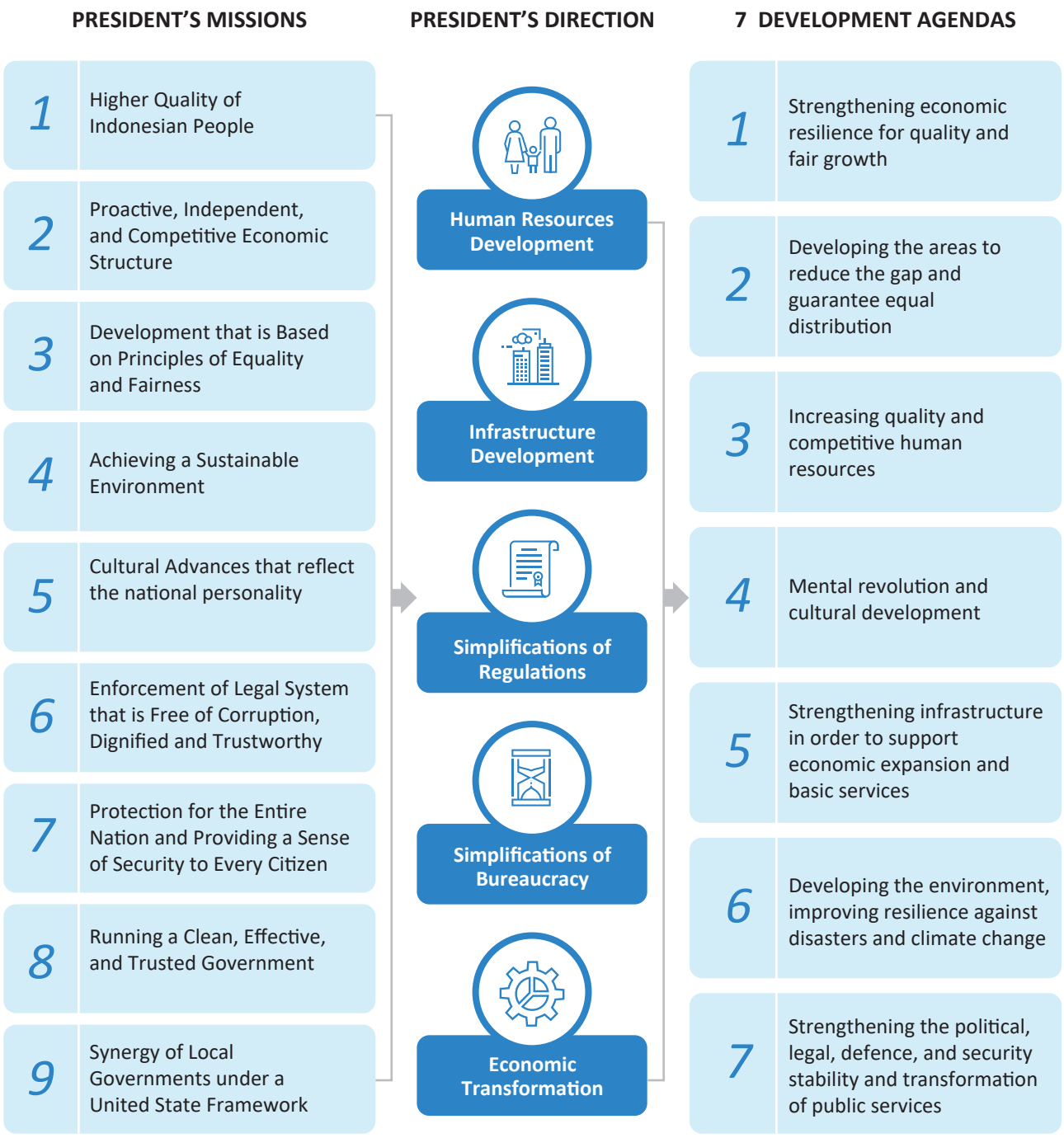
- A Long-Term Master Plan for Advancement of Science and Technology (25 years, reviewable 5-yearly);
- A Medium-Term Master Plan for Advancement of Science and Technology, (for a five-year period), and
- An Annual Master Plan for Advancement of Science and Technology (annual)

The establishment of the National Research and Innovation Agency (BRIN), as mandated by Article 48 of the 2019 Law, showed that the Government of Indonesia has been making efforts to restructure the institutional framework of science and technology. However, one element missing from the plan is the status and role of the National Research Council (DRN), or a follow-on equivalent.

Although 'Development of human resources who are hard workers that are dynamic, productive, skilled, and master science and technology' is the first of the five (5) directions issued by the President in the 2020-2024 Medium-Term Development Plan (RPJMN), science and technology is once again positioned in this as a supporting field, rather than a priority field. Science and technology are expected to contribute to supporting the 7 development agendas set out in the RPJMN as shown in the Figure 1.6.

Some of the public policies referenced above were of a more strategic nature and relate to the directions of science and technology development and general national development in Indonesia. Beyond these there are also other policies that are relevant - directly and indirectly - to research and development and development in Indonesia. For example, Law No. 12 of 2012 on Higher Education is a policy that is highly influential for the research and innovation ecosystems in Indonesia, because it actively regulates important elements for higher education, including institutional status, funding, and human resources. Moreover, there are other regulations of more technical nature, such as Government Regulation No. 41 of 2006 and Government Regulation No. 48 of 2009, which concern Issuance of Research Permits; Law No. 13 of 2016 on Patents; and the Administrative and Bureaucratic Reform Ministerial Regulation No. 34 of 2018 on Functional Positions of Researchers. A list of policies related to research and development and innovation in Indonesia identified in this study is shown as Appendix C.

FIGURE 1.5 **PRESIDENT'S MISSIONS AND DIRECTIONS AND 7 DEVELOPMENT AGENDAS OF THE 2020-2024 RPJMN (ENGLISH)**[a]



[a] Source: 2020-2024 RPJMN Narration (Authors' translation)

1.5 Impact of current research and development strategies in Indonesia

All participants interviewed for this study agreed that strategies for science and technology development was important for Indonesia and that it is necessary to have a reference and guidelines for implementation of research activities. However, most of them admitted that the current strategies have not been able to provide optimum support for Indonesia's research and development institutions and actors.

Comprehensive strategies for science and technology development are crucial, especially for government science and technology institutions, such as non-ministerial government agencies (LPNK) and Ministries' own research and development bodies (*Balitbang*), whose core activities concern 'research, development, assessment, and application' (*litbangjirap*).

Lack of clarity in institutional mission

For government science and technology institutions, the issue of overlapping missions and duplicative activities among them shows that the current strategies for science and technology development had been less than effective:

> *Well, now, why do research institutions overlap nationally, and why are their results not optimal? First, actually -- this is simply about coordination -- why does BPPT overlap with LIPI, is it LIPI's fault, or BPPT's fault? …We [BPPT] make our programs, and LIPI makes theirs. Do we have to communicate with LIPI? …for that, there should be a national research platform. First, we had the national research master plan, and national research priorities [PRN] plan. What about their contents? They are still big. Can they accommodate all research institutions? In truth, research focuses are controlled by their platform, [individual institutional] plans for national research were then translated into national research priorities. - Group interview 01*

Planning rigidity

Speaking about science and technology development plans, Interviewees underlined the importance of such plans being flexible – plans should not be rigid or restrict the types of research activities conducted. The freedom of researchers to determine their research topics and conduct their research should be maintained. Rigid details in the formulation of the development plans often became problems of its own during the implementation:

> *Direction or planning is important, as it gives a sense of direction of where we are going. However, it does not have to be too detailed, because based on our experience, for example, we have RIRN (the Master Plan). IPB has RIP (Research Master Plan) as well. I think what matters here is how we implement them. - Interviewee 05*

It is also important to make sure that the available research resources—especially those from the funding allocated by the government—will not be entirely directed towards priority fields. It is also important to give support to research of a more exploratory nature, in non-priority fields:

> *Research does have to be planned for a long term, in each field. But again, [a research plan] should not become a constraint. So, the plan should include some research [that is listed in the national priorities], and some research that might be of exploratory nature, [so not all research projects] must produce new innovations. - Interviewee 03*

Agreeing with those comments, another interviewee said that both research planning and research activities conducted should be flexible enough to adapt to current developments:

> *It is fine to have direction for research. But the research itself should be more flexible, more agile. And again, we can also differentiate the characteristics or the nature of the research itself. For research of pure science, of academic nature, indeed, we can set some kind of direction, some kind of research priorities. But for research of policy nature, or maybe for applied research, we do not need to set five-year priorities. Those five-year priorities only provide direction, strategic views. As for the plans, we have to make the annual ones, which might be able to be changed swiftly and have adaptable nature. - Interviewee 09*

1.6 Strategies focused on numerical targets

The National Research Master Plan (RIRN) promotes a concept of research 'priorities' that is very different from what Mazzucato describes as mission-oriented priorities. The big goal promoted in the RIRN is not a mission designed to address complex problems of a social, economic, environmental, or public nature now or in the future. Instead, the RIRN promotes two abstract goals:

1. To create an innovative Indonesia society, on the basis of science and technology; and
2. To create the nation's global, competitive excellence.

This is consistent with comments by Interviewee 07, a policy maker at the National Development Planning Agency (Bappenas), who confirmed that the national research priorities in the National Research Master Plan (RIRN) were indeed oriented toward the targets of the 'Indonesia Maju 2045' ('Developed Indonesia 2045'):

> *National research priorities should be set with a view that takes into account what kind of a developed country that Indonesia should become, so we can decide what our country's research should focus on, by considering Indonesia's natural and human resources, and the nation's capabilities. - Interviewee 07*

The National Research Master Plan (RIRN) was influenced by two demands: (a) the need for an effective reference strategy for encouraging synergy in activities of government science and technology institutions; (b) the need to increase the performance of Indonesia's research and innovation, relative to its low ranking in numerical data-driven performance indicators, such as the number of science and technology researchers, number of publications, gross domestic expenditure on research and development (GERD), and total factor of productivity. This also influenced the formulation of targets and indicators for the achievement of the goals set out in the RIRN for each five-year period. These lean heavily toward numerical targets, as shown in the Table 1.2.

Indonesia's targets for gross domestic expenditure on research and development (GERD) set out in the RIRN need to be considered against what its peer knowledge economies in ASEAN are already investing in research and development (Table 1.3).

TABLE 1.2 **TARGETS FOR INDICATORS OF ACHIEVEMENT OF 5-YEAR GOALS**[a]

INDICATORS OF ACHIEVEMENT OF GOALS	2015 (BASELINE)	2020	2025	2030	2035	2040	2045
Number of science and technology researchers per 1 million population	1.071	1.600	3.200	4.800	6.400	8.000	8.600
GERD/PDB (%)[b]	0,20	0,84	1,68	2,52	3,36	4,20	5,04
Ratio of Master (S2) & Doctoral (S3) students to number of undergraduate (S1) students to approximate total 'research candidates for science and technology (%)'	5,6	20	40	60	80	90	100
Number of total publications in globally indexed journals[c]	2	4	8	10	14	18	22
Multi-factor productivity (MFP) (%)[d]	16,7	20,0	30,0	40,0	50,0	60,0	70,0

[a] Source: Presidential Regulation No. 38 of 2018

[b] Data provided by Science and Technology Development Research Center (*Puspiptek*) LIPI

[c] Based on SCImago, the proprietary ranking system for journal impact (Scopus) https://www.scimagojr.com

[d] Multi factor productivity (MFP)—that is also often called total-factor productivity (TFP)—reflects contribution of economic growth outside the growth of capital and work force

TABLE 1.3 **ASEAN GERD EXPENDITURES (IN USD)**[a]

COUNTRY	2009	2015	2019	AVERAGE
Brunei Darussalam	10,815	12,943	13,483	14,629
Cambodia	10,354	18,091	27,102	17,443
Indonesia	**545,854**	**855,020**	**1,121,298**	**884,750**
Laos	5,595	14,420	18,844	12,730
Malaysia	202,627	299,484	364,403	306,260
Myanmar	26,962	59,795	66,500	58,861
Phillippines	168,644	306,213	377,116	280,477
Singapore	192,408	308,002	372,063	303,277
Thailand	282,052	401,658	543,958	412,966
Vietnam	106,018	193,628	261,587	181,514
ASEAN	1,551,330	2,469,255	3,166,353	2,472,908

[a] Data extracted on 25 Sep 2020 08:10 UTC (GMT) from http://data.uis.unesco.org

Significantly, the RIRN targets are not broken down in a systematic way or applied in a strategic manner in the drafting of the national research priorities (PRN). As we will see below, the PRN were developed, instead, to direct efforts toward developing national products.

Policy incoherence

Getting clarity and coherence among the many regulations and policies relating to research and development (including science and technology and innovation) in Indonesia has been a persistent problem. That problem remains, even after the passage of the 2018 *Sisnas Iptek* Law. We see this in the establishment of the National Research Master Plan (RIRN), which was expected harmonized planning in the research sector and planning for national development, but in fact has yet to produce the desired synergies. Interviewee 14, a non-government actor, suggests that at present, the RIRN and the PRN have not been fully aligned with, or linked to the national development plan set out in the 2020-2024 Medium-Term Development Plan (RPJMN):

> *Let me give you an example. It is clear that for development of the next five years, human resources development has been set as its priority. Thus, future research in social science should be directed to support such priority. Human resources include education, health, employment, skills, social relations, etc. If we do not synergize all of these elements with each other, research and development will not head towards the same direction. So, when we need evidence [for formulating the policies], we have to conduct new research, because evidence from hard science only caters to one branch of science, whereas development priorities related to human resources represent many branches of science, many disciplines. As a result, research might not be very useful when it is not synergized with future development priorities. - Interviewee 014*

We can also see the synergy problem in the relationship between the RIRN, the PRN and the National Industry Development Master Plan (RIPIN). Despite an adjustment of the fields of focus fields in both policies, there was no clear explanation on how the industrial sector would utilize the flagship products produced under the PRN in their business model. In the terms of the PRN concept, these national research priorities are considered to succeed – the PRN achieves its targets – when the products that result from research and development activities are produced. In practice, however, those products still have a long way to go before they make any impact or contribute to national economic development:

> *[A]ctually, it is a good idea to make some kind of PRN (national research priorities). But sorry, I have to say that the current contents are still far from what we expect. I hope in the future, they will be*

better. Well, PRN will be better once there have been synergies among policies on science and technology, on industrial matters, on financial matters, on trade, and on other issues. If, for instance, those policies have not been synergized with one another, then this PRN is wasted. Because, let me ask you, who will use PRN? - Interviewee 01

Policy focus on technology and government science and technology institutions

Most participants in the study for this report — and all of those from the non-government sector — thought that the two strategic policies on scientific development (the 2018 National System of Science and Technology Law and the National Research Master Plan (RIRN)) were not adequate for regulating and supporting the full reach of Indonesia's research and development ecosystem. On the contrary, they saw the substance of these two policies as rigid and disproportionately focussed on regulating technology and elevating the role of government institutions. The Law on the National System of Science and Technology does not specifically explain the status and roles of non-governmental and other research actors – or the relationship between these actors and government institutions. On top of that, the Law tends to present private parties as simply applying results of research conducted by government research institutions, and interviewees consider this to be an inaccurate description of how research is generated:

The Law on National System of Science and Technology [UU Sisnas IPTEK] itself still puts too much emphasis on technology. It also focuses more on government institutions. We actually find both points a bit alarming… [The law also states that] the Government shall be the one that conducts basic research. Then the private sector shall play a role in the engineering sector, and applications; really, in practice, it does not always work that way. Because in truth, some parties in the private sector also want to conduct basic research. For example, many of them wish to conduct medical research, and companies may wish to continuously conduct research. So, I think arrangements for those matters are still too rigid. - Interviewee 03

A government policy maker admits that there are problems with the policy focus on technology revealed in the 2019 Sisnak Iptek Law and elsewhere. He stressed that due to the focus on technology, aspects of social sciences and policy studies had been set aside:

[T]here were also many criticisms that later, national research priorities somehow belittled social sciences as well as those labelled as 'policy research'. As if everything must lead to downstream innovation in the manufacturing sector -- basically real sectors -- not to [knowledge development in] social sciences and humanities, etc. - Interviewee 07

The weak position of social sciences can also be found in the organization of the National Research and Innovation Agency (BRIN) and in the naming of the Research and Technology Ministry that hosts it. This is despite the fact that technology cannot exist on its own, without other branches of science, if it is to make a positive impact on, and created benefits for, the public:

[A]lso, BRIN still considerably leans towards heavy science, pure science and technology. The agency pays little attention to social sciences and humanities. We need to take note of this too. Because it will be impossible for technological advances to make a good impact on people's lives, if, for example, there is no social engineering, or no reinforcement of democracy, or no reinforcement of social interaction. In the absence of these social factors, hate speech, hoaxes, and similar things will run rampant. Well, technology cannot stand on its own without other branches of science, without adequate social knowledge. – Interviewee 014

Lack of transparency and public involvement

When government agencies design public policy in Indonesia at present, they tend to factor in the government's political preferences, technocratic considerations, perceptions of public opinion and – in particular - the programs/policies of the previous administration. We can see this in the chronology of science and technology policy outlined above. Several factors contribute to this tendency, including organizational culture, stipulations in the current policies, the position of science in the society and the marginal roles of non-state actors:

We still have not placed any importance on knowledge. Policies are still made based on public opinion, political preferences, and merely technocratic considerations. This means the policies are developed based on the programs of the previous administration, or of the previous bureaucrats or technocrats. We already have these programs from

our predecessors, so we just need to upgrade them a bit. Or, we have these programs from the last administration, so just continue implementing them. There is no effort to make a total overhaul [in the sense of] 'following the related research, they found such and such'. But I see potential for more evidence-based policymaking in Indonesia, due to increasing supply from non-state actors to the government, which in this case serves as the party that demands it. - Interviewee 014

Law No. 11 of 2012 on the Drafting of Laws and Regulations creates an express obligation to disseminate the drafts of laws and regulations and to facilitate public participation in the drafting process (Articles 95 and 96). To some extent the public must be involved in the drafting of public policies -- at least as a formal procedure. The question is how to raise this public involvement to a more substantial level? Without such substantial involvement, actors in science and technology institutions, both those inside and outside the government, are unlikely to have any 'sense of belonging' to, or send of ownership of, the drafted policies. The absence of this shared ownership is something that impacts on the level of participation and support of those actors when the policies are implemented.

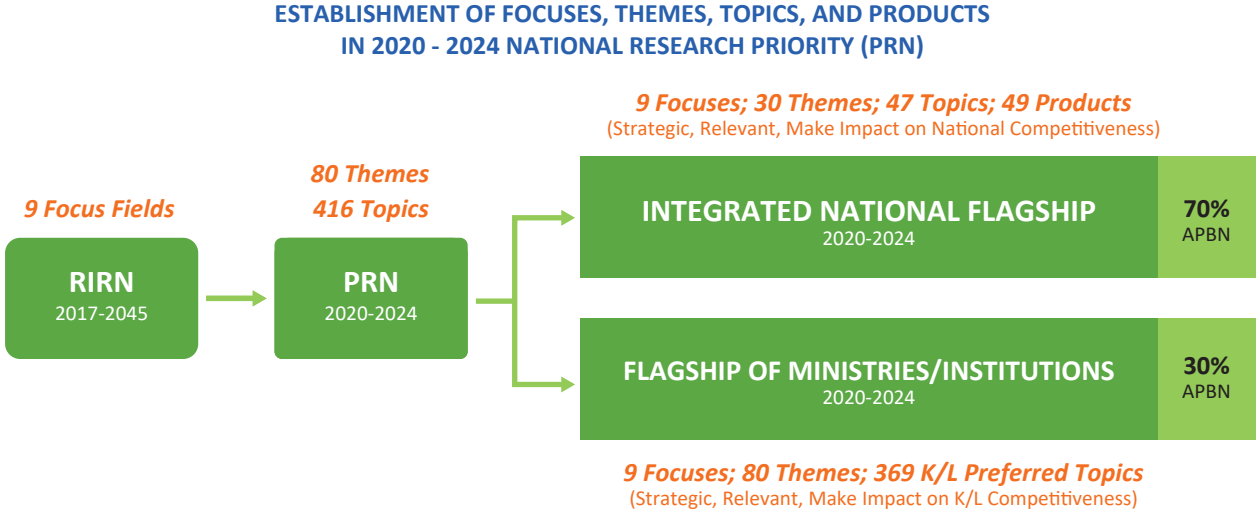
1.7 Indonesia's national research priorities (PRN)

Nine research fields are listed as the focus fields of Indonesia's 2017-2045 National Research Master Plan (RIRN):

1. Food
2. Energy
3. Health
4. Transportation
5. Engineered products
6. Defence and security
7. Maritime
8. Social, humanities, and
9. Other research fields (as determined by the Minister)

The RIRN is then translated into the National Research Priorities (PRN), the first period of which is 2020-2024.[30] The nine focus fields of the PRN are the same nine that appear as research focus fields in the RIRN and these are expected to be able to produce innovative products within a five-year period. The implementation period for the National Research Priorities was adjusted to align with the periods of the Medium-Term Development Plan (RPJMN).

FIGURE 1.6 **FOCUSES, THEMES, TOPICS, AND PRODUCTS OF 2020 – 2024 PRN**[a]



[a] Source: Exposé of National Research Priority, Deputy of Research and Development Reinforcement, Ministry of Research and Technology/BRIN, 2020 National Coordinating Meeting (*Rakornas*)

[30] *Permenristekdikti* No. 38/2019

The National Research Priorities (PRN) form the strategy for scientific development in Indonesia.[31] The RIRN serves as the reference for long-term research development and the PRN are the short-term focus fields that expected to produce innovative products within five years. As we see in the figure below, the 2020-2024 PRN has been established with 9 focuses, 30 themes, 47 topics, and 49 products, for the Integrated National Flagship group; it also covers 9 focuses, 80 themes, and 369 preferred topics of the Ministries/Institutions (K/L) for the Ministries/ Institutions Flagship group.

How Indonesia's national research priorities are generated

The 2017-2045 National Research Master Plan (RIRN) states that top-down and bottom-up approaches shall be adopted in the drafting of the National Research Priorities (PRN). The top-down approach is to be applied by checking state documents relevant to the development process that discuss aspects of research. These include the 2005-2025 National Long-Term Development Plan (RPJPN); the National Medium-Term Development Plan (RPJMN): the White Paper on Science and Technology; the National Research Agenda (ARN); the 2015-2035 National Industry Development Master Plan (RIPIN); and documents concerning plans and achievements of research and development institutions. The bottom-up approach is to be applied by collecting primary data from in-depth interviews; focus group discussions; reviews by independent experts; and public discussion; as well as data submitted online by universities (PT); non-ministerial government agencies (LPNK); ministerial government agencies (LPK); and industry. Results from both approaches will then be combined, and various parties that attend focus group discussion forums will be asked to give their input for further exploration and ideas for improvements.

National research priorities as a collection of ideas

Almost all participants in this study saw the concept of National Research Priorities (PRN) as a positive idea, even though it still needs a lot of improvement. Interviewee 05, who is from a state university with legal entity status (PTN BH), criticizes the PRN as not been managed well, having too many focuses, and being merely a collection of ideas that lack clear priorities:

> *I think PRN is good, because it attempts to integrate collaboration between institutions, although it does not seem to be well managed -- well, at least that is my view. For example, there are 49 flagships now; how were they developed earlier? We were all invited, each of us submitted a proposal, but [it became] simply a collection of ideas. – Interviewee 05*

The same view was shared by industry actor participants, for example:

> *Now we have these flagships, but frankly, let us see whether they will really take us somewhere. So many of them came from energy, health, defence, and the transportation sectors, and then where are we going? All the ideas on the table were selected. – Interviewee 08*

Such views are not entirely subjective, particularly when we consider the stipulations in Research and Technology and Higher Education Ministerial Regulation No. 36 of 2018,[32] which state that the drafting of the National Research Priority (PRN) shall be based on 'ideas' from (government) Ministries/Institutions (K/L). Article 2 of the same Regulation sets out the procedures for drafting the PRN as (emphasis added):

- Preparing the ideas
- Submitting the ideas
- Discussing the ideas, and
- Establishment

The term 'ideas' as it is used in the Regulation includes: Priority research focuses, the research theme for each research focus, the research topic of each research theme, achievement targets, and the proposed estimates of the research costs – all within the research fields set in the National Research Master Plan (RIRN).

With this kind of framework, it would not be surprising if the 'priority' research activities at science and technology institutions are not much different from their 'business as usual', even after the establishment of national research priorities.

[31] As specified in the National Research Master Plan (RIRN), in accordance with the stipulations of Presidential Regulation No. 38 of 2018 on the 2017-2045 National Research Master Plan.

[32] Research and Technology and Higher Education Ministerial Regulation No. 36 of 2018 on Procedures for Drafting National Research Priorities and Mechanisms for Monitoring and Evaluating Implementation of National Research Master Plan

Flagship-oriented research priorities

Although the National Research Master Plan (RIRN) is orientated towards the numerical targets of the '*Indonesia Maju 2045*' ('Developed Indonesia 2045'), the national research priorities (PRN), as an elucidation of the RIRN, are not focused on strategic activities for achieving those targets. As a program, the PRN is instead orientated more towards contributing research and development to economic development. This is clearly demonstrated by the 'Flagship Programs', which are the PRN's preferred programs focused on developing one or more products through activities carried out by institutions: 'research, development, studies, and application'.

The national flagship programs are implemented under a consortium led by a Ministry/Coordinating Agency. The 2020-2024 Medium-Term Development Plan (RPJMN) also states that the number of research/innovation products produced by each flagship program shall be the main indicator of development achievements in the field of science and technology. The fields that each flagship program focuses on are in accordance with those listed in the 2015-2035 National Industry Development Master Plan (RIPIN), in order to align them with the development plan for the industrial sector.

Interviewee 05 expressed his dissatisfaction with the PRN orientation towards flagship products in this way:

> *If you ask me, I do prefer the problems, I would like to see research aimed at addressing them. Now, choose sexy problems, which, let's say, everyone wants to talk about, for example, SDGs. When we discuss SDGs, people will agree with us and the whole world will follow suit. So, when we speak about food, we do not mean production (food production), but we refer to the second goal, zero hunger. So, for instance, that is the direction that we are heading for. Meaning, for example, how to make sure no Indonesian will go hungry, instead of only (producing) food. I think, more or less, it will be more encouraging. - Interviewee 05*

Short-term orientation and product substitution

From an industry perspective the PRN goal of creating products through flagship programs is also problematic it leans toward 'import substitutes' rather than aiming to create 'new products'. Government needs to ensure that flagship programs make economic sense – it will be difficult to attract the industrial sector to be involved in the efforts to develop or to utilize products created by these flagship programs, if those products do not have any economic potential:

> *I imagine that when the flagship programs create products, the products would have globally competitive added value. We currently have more or less two flagships, one concerns import substitutes and another concerns new technologies. If import substitutes dominate the flagships which is what we see now, that means minimum costs for, and other factors related to, the substitutes should be the same as those of imported goods… …But what I regret is that sometimes, we know from the beginning that some PRN's import substitutes are more expensive than imported goods. If that is the case, we should not have tried to produce the substitutes. That is the way we should look at it, shouldn't we? If we knew from the beginning that we would not be able to produce substitutes more efficiently than the imports, then we would have to find another way and should not push for the substitutes. No good would come from it and also, the substitutes would end up unusable. - Interviewee 08*

A second issue with the import substitution strategy is that it is short-term: a better use of research is to generate significant added value from creating new products:

> *Well, for now, maybe the flagship programs should at least create 60 import substitutes and 40 [new products]. However, for the future, the programs should gradually create products that have added value, so we will have [an advantage], but for now, the current situation is fine. In addition, we need to have clear policies, whether we want to create new products or substitutes. Both are important. If we have a huge number of import substitutes, that is all right. I can understand if we still have a sizeable amount of imports for these four years. But if we keep producing substitutes without introducing anything new, actually, that means we do not make something new, do we? We produce what we used to import from other countries and there are some features that one can only find in the import substitutes that we sell, so these substitutes have added value. - Interviewee 08*

Need for 'radical' national development plans

Those observations from industry link to views about the importance of having more 'radical' science and technology development plans. Interviewees suggested that a developing country like Indonesia will be unable to catch up with developed economies if it continues with its conventional development planning, using linear approaches to innovations. Or as Interviewee 1 says, "We need development plans that can make us jump far ahead, not only walk forward one step at a time". Moreover, the linear approaches to innovation needs a significant level of investment, both in terms of time and resources:

> *I am concerned about the Minister, he spoke several times to the papers, and it seems that he only knew about the linear model of innovation. Basic, applied -- and only then comes development. No developing countries take such an approach. Even Japan and Korea have never done that. So, we, as a developing country, should adopt a radical approach. Because linear model innovation needs huge investments and takes a very long time before it produces any innovation. If we apply the radical model, we can transfer technology by -- well, it is like the Japanese model, Japan, Korea, etc. If the same understanding is applied to BRIN, then nothing will happen in the next 10-20 years. We will not have any knowledge capital. - Interviewee 01*

How to decide the substance of national research priorities?

One reason that the national research priorities (PRN) and the research focus areas in the National Research Master Plan (RIRN) have not delivered optimal performance is the absence of a sufficiently clear protocol for determining what those priority research areas should be.

In 2018, the (then) Ministry of Research, Technology and Higher Education (now the Ministry of Research and Technology) issued Research and Technology and Higher Education Ministerial Regulation No. 36 of 2018 on Procedures for Drafting National Research Priority and Mechanism for Monitoring and Evaluating Implementation of National Research Master Plan. However, that Ministerial regulation only explains he administrative stipulations to be satisfied in the drafting, monitoring, and evaluation of the PRN.[33] The regulation gives no specific guidelines on how the substance of the PRN should be formulated.

The result is that, in practice, the mechanism for drafting the PRN is not very different from the mechanism for submitting (proposals and budgets) for any other government working program:

> *In Indonesia, there has been no protocol for setting Research Priority Areas. We only have national research priorities (PRN) and these [were created] recently; none of them ever existed earlier. There is no protocol for how we are going to reach any agreement over something. For example, over next year's research topics, there is no protocol for that. Actually, it is possible to develop protocols if the Research and Technology Minister takes the first step of issuing circulars, developing protocols that guide all Ministries/ institutions on which direction that they should go. - Interviewee 07*

1.8 Issues with implementing Indonesia's national research priorities (PRN)

Funding system

Article 14 of Presidential Regulation No. 38 of 2018 on National Research Master Plan (RIRN) states that 'funding for the implementation of the National Research Priorities (PRN) shall be borne by the budget of the Ministry/agency/local government and participants, in accordance with their respective responsibilities'. Universities —particularly state universities -- feel it is difficult for them to allocate funding for implementing the PRN because their research funds are distributed through the Information System for Research Management and Community Service (*Simlitabmas*) mechanism:[34]

[33] Monitoring and evaluation, for example, 'shall be conducted by those who hold positions of no lower than mid-level senior officials, or other titles of equal rank, at the Ministry, other ministries, non-ministerial government agencies (LPNK), local governments, and stakeholders, for a minimum of once a year' (Article 8(a)) and the monitoring and evaluation of indicators of achievement of RIRN goals, as referred to in article 8 (b) shall be conducted by the Minister at minimum of once in every 5 (five) years.

[34] A university's budget for research is distributed through the '*Simlitabmas* mechanism'. This mechanism is based on research proposals that have been submitted prior to the budget allocation and distribution. At the point at which the university receives its budget, those research proposals have already been approved and so they are unable to redirect or reallocate the budget for research directed towards the national research priorities (PRN).

Well, for ministries, it is easy for them to convert the funds that they receive now into PRN funds. But for us at universities, our funds have already been distributed through the Simlitabmas mechanism, for specified purposes, so, where are we going to find the budget for PRN? That is just one example. PRN is like priorities that are not prioritized at all. I mean flagships are chosen out of PRN, (but) even those flagships are not funded. I heard they were still looking for (the budget allocation). - Interviewee 05

The weakness of the PRN drafting process identified above also raises the prospect that any new research budgets created under the state budget (APBN) process will (simply) be directed towards supporting the PRN:

But I think, maybe we should not use up everything for national priorities, because given the way we set those priorities, it has actually raised my concern. It is a little risky to do that when determination of the national priorities is still far from perfect. - Interviewee 07

Ineffective implementation

Although the PRN has been officially implemented as policy, industry actors report that, so far, they have not seen any changes or any new incentive schemes that they could utilize that relate to the PRN, even where they conduct research and development activities within fields listed as national research priorities:

[T]he presence of research flagships has made us aware of the prioritized fields, for example health and defence, and of what those fields need, so we can steer research towards those directions and offer incentives [to research in those fields]. But this has not taken place. We have not seen the downstream either. - Interviewee 08

1.9 Rethinking Indonesia's national research priorities

The current process of forming the national research priorities (PRN) in Indonesia is not really about research priorities at all – it is about dividing actual (or anticipated) government income and reinforcing the status of particular (usually government) institutions and parties affiliated with them. Not surprisingly, the actors involved see themselves as representing the political and budgetary interests of the institutions that they work for. They fear that if their activities do not feature as PRN fields, they could become obsolete or no longer enjoy support from the government.

A suggested solution to this is to shift the perception of national research priorities away from 'fields' and towards 'taglines' into which different types of research could be fitted, as the participant comment below suggests. Taglines are not quite the mission-oriented research that Mazzucato (2018) advocates for (as outlined above), but it would move Indonesia a step further toward these:

We think Indonesia needs taglines to bring together all research in this country. People are afraid to make taglines because they are worried the taglines will prevent their research from being included in the list. That is why, if you look closely, you will find that national research priorities are not priorities. Because you would still see a lot of national research priorities. RIRN is not a master plan either, as it still has a great deal of contents. This is because many people are disappointed upon discovering their research was not included. They do not understand that there is something called the tagline concept.

A tagline means something that brings us together, but the research can be about anything. For instance, during the cold war between the United States and Russia, both countries competed for missions to the moon. So, the tagline for the US research world was how they could reach the moon. Were results of their research only about men going to the moon? As a matter of fact, no. Their research produced many results that have been useful to the present day. Their findings, in their efforts to visit the moon, could be used for mobile phones, GPS, in aerodynamics, for medicine, mathematical calculations, and had effects on other disciplines. The researchers came from various disciplines, but they came together in order to develop science, since they wanted to go to the moon. - Interviewee 06

Elevating social science within the national research priorities

The current national research priorities are clearly dominated by branches of science and technology considered to be 'hard' science. Social sciences and humanities appear as a kind of 'afterthought' category in the RIRN and the implication is that they are not connected to broad areas of research such as food, energy, health, transportation, engineered products, defence and security or maritime affairs. That is not a view that is shared by policy makers in most mature knowledge economies: they see social science as an essential contribution to solving urgent problems in all of these fields, as well as others such as climate change and environmental management. The position in Indonesia

may have developed because policymakers in the science and technology field have STEM backgrounds. One participant proposed an immediate fix to the problem by embedding social sciences in all the research priority fields, rather than simply adding more focus fields that represent social sciences.

> *But if you want to improve the quality, other than competition-based affirmation, [maybe you could set] requirements for each research team to achieve an agenda, to involve social-sciences researchers, and to show how their research will make a social impact, in order to encourage people or shape people to directly connect themselves with social science. Thus, if [in] the agenda… simply embed [social science] as requirements of grants [for other research priority fields], so those [who submit proposals] will find their own ways to satisfy these requirements." - Interviewee 04*

The need for a science and technology council or research councils

To balance the pressure of including the interests of institutional representatives, participants suggested that there should be some kind of a board, or council, or organization that is given more authority to facilitate the formation of the national research priorities. Members of this organization should consist of people who do have the skills and capability to debate and set the direction for Indonesia's research priorities. So, they should not come exclusively from academic circles, or exclusively from government research and development organizations. [With a more inclusive setting and membership] the national research priorities would really become a list of prioritized research areas and not merely the accumulation of program proposals from each implementing organization, which is what we currently have:

> *[I]deally, research priorities should be developed …by the National Science and Technology Council whose members include extraordinary figures. For example, some time ago I met Mochtar Riady. He was 90 years old, but he was amazing -- his thoughts, his views; they were remarkable. Even Jack Ma invited him for a meeting, to seek his opinions. The meeting had been planned for three hours, but it went on for 13 hours instead, because Mochtar Riady was able to open Jack Ma's eyes to many things. Well, we need those kinds of people to get involved when we are making our decisions on what we would like to do in the future. - Interviewee 01*

Involving the market and the public

Participants from private research institutions emphasized the importance of room for negotiation between the government, the market and the public in determining the direction of national development, particularly science and technology development. It could be very dangerous if this process was only dominated by one of the parties, whether it was the government or the market. China and the United States of America as extreme examples of both of those imbalances:

> *I think if that is the situation [where the government heavily steers and sets the direction], it will be terribly authoritarian for the government to do so. I mean, we could always administer psychological tests [to determine one's career], like what China does, and guide the test participants to certain directions, but I do not agree with that, because such measures will only take us backward. On the other hand, without any direction at all, we will end up like America with its free market, where market determines everything. There is also a downside of America's free market… prices of diabetes drugs in Canada are much cheaper than those in the US; they could be two times lower or even less. Because all drugs in the US are released to the free market, the Government does not play any role in the market and there is no insurance to cover the drugs either, so US patients have to go to Canada in order to buy insulin medications at prices that could be multiple times lower than those charged in their home country. We do not want that situation either. So again, there should be negotiation here. - Interviewee 02*

2

RESEARCH ECOSYSTEM GOVERNANCE: ACTORS, STRUCTURE AND REFORM

The issue in most economies – even in mature knowledge economies (e.g. Flagg and Harris, 2020) -- is that there are multiple research and development actors and that they compete, rather than cooperate, particularly in an environment where funding for research is finite.

Government cannot fully command or control those actors: first, because it has relatively few policy tools with which to mandate or encourage coordination (Glaeser, 2019; de Haas, 2017), and second, because the actors themselves have control over the content of research and the researchers who produce it, so they are co-regulators of knowledge production.

The issue for Indonesia, as we have seen above is that, for the past decade, research and development has not been a high priority for government and historically research actors (government, universities, industry and civil society) have been structurally separated and subject to different regulatory frameworks. The challenge is how to bring those actors together collaboratively and how to transition through a 'top-down' regulatory culture of limitation to a more dynamic regulatory culture of flexibility and distributed responsibility

2.1 Research sector governance

As our understanding of research and development (and innovation), evolves, so do our institutions and policies. The idea of 'research governance' is relatively new. It emerged from new public management thinking in the 1990s, which emphasised efficient use of public funds and the idea that government Ministries are not always the most effective or efficient actors in regulation and service delivery. A key idea was that government should delegate, or devolve, some specialised oversight functions to independent agencies or the private sector (or hybrid organisations combining both kinds of actors) where actors outside government had superior expertise.

How do knowledge economies govern their research and development?

Mature knowledge economies all developed their research governance institutions and systems in different ways and at different times. Coordinating across this mix of new and old research, regulation and funding bodies is a governance challenge. For example, we see:

- Centralized models (direct government control of different parts of the research governance system) e.g. Singapore
- Coordinated, distributed governance models (more than one research governance institution that is independent of government): United Kingdom and Australia

Singapore

Singapore's research governance is relatively centralized, but it has multiple streams.[35] The Research, Innovation and Enterprise Council (RIEC) is chaired by the Prime Minister and decides on the overarching research and development strategy and national funding envelope.

[35] http://sea-eu.archiv.zsi.at/facts/sea/singapore.html

The National Research Foundation (NRF) was set up in 2006 under the Prime Minister's Office to support the Council.[36] The NRF is responsible for the implementation and support of Singapore's research and development strategy and overseeing national research and development activities.

It allocates its budget through a combination of top-down and bottom-up instruments, higher education institutions and public research institutes. Top-down NRF Strategic Research Programmes include biomedical sciences, environment and water technologies and interactive and digital media. NRF's bottom-up programmes include the Competitive Research Programme, and a funding scheme for multi-disciplinary cutting-edge research teams and Research Centres of Excellence: long-term investments to create world-class research centres in Singaporean universities.

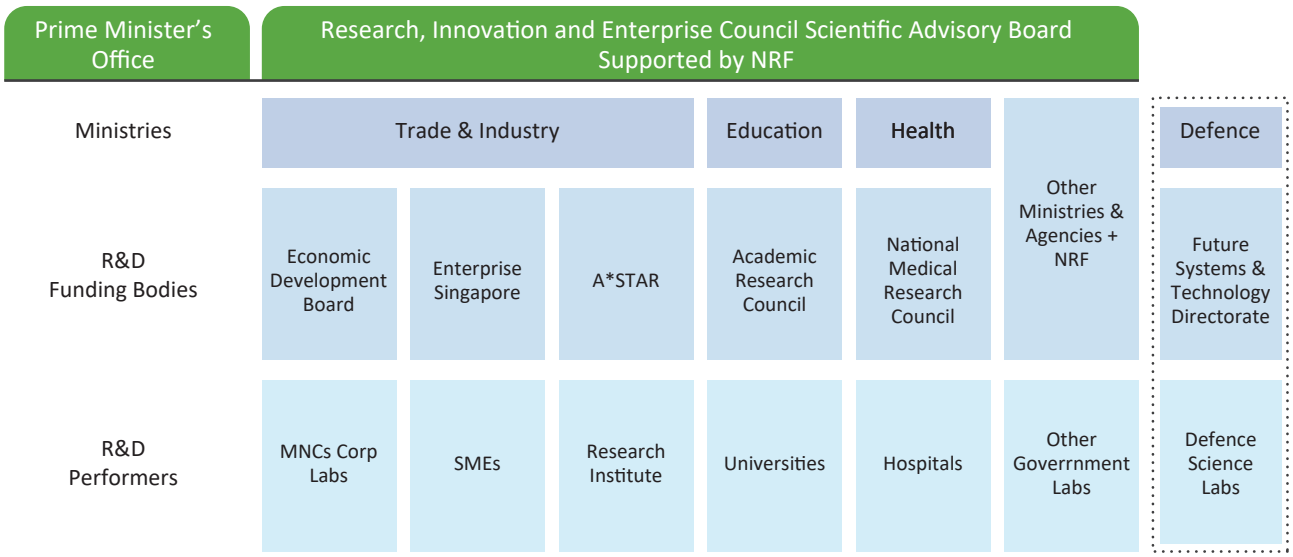
Science and technology policy in Singapore is part of a larger economic development strategy and it sits under the Ministry of Trade and Industry (MTI), as well as the Ministry of Information, Communications and the Arts and the Ministry of Education. The main statutory boards under MTI implementing research and development-related policies are the Economic Development Board (EDB), the Agency for Science, Technology and Research (A*STAR) and SPRING Singapore.

A*STAR has the mandate to foster world-class scientific research and talent for an innovative Singapore and is a main source of public R&D funding and has a key role in setting the priorities for research. It comprises 2 Research Councils (under which 18 research institutions sit), 6 consortia and 3 centres. It provides competitive funding programmes for researchers in publicly funded institutions (within and outside A*STAR) in areas of national and A*STAR priority (biomedical science, physical sciences and engineering).

SPRING is a funding agency, which promotes entrepreneurship and small and medium sized enterprises' (SMEs) development R&D efforts through various financial schemes. SPRING aims at: 1) helping to catalyze technology projects; 2) providing seed funding for technology start-ups; 3) financing a project workforce; and 4) investing in infrastructure.

EDB aims at enhancing Singapore's position as a global business centre by attracting inward foreign direct investment and multinational corporations and corporate research and development laboratories to Singapore.

FIGURE 2.1 **SINGAPORE'S RESEARCH GOVERNANCE**



[a] Kutipan

[36] https://www.nrf.gov.sg/about-nrf/rie-ecosystem

United Kingdom and Australia

The United Kingdom and Australia distribute their research governance in different ways. In the United Kingdom, UK Research and Innovation brings together 9 different research bodies and funding agencies and multiple policies under a single umbrella (UKRI 2018). Australia governs most of its competitive research funding through two parallel independent bodies: the Australian Research Council (ARC) and the National Health and Medical Research Council. What each of these national systems have in common is a strong emphasis on the Haldane Principles (discussed below) which include designs to keep research and research funding decisions separate from political influence.

Thailand

Thailand's research governance is through a national research organization network (TRON), which is made up of 7 research funding agencies:

1. National Research Council of Thailand (NRCT)(which includes the National Research Strategy and the National Research Repository)[37]
2. National Science and Technology Development Agency (NSTD)
3. Health Systems Research Institute (HSRI)
4. National Science, Technology and Innovation Policy Office (STI)
5. Agricultural Research Development Agency (ARDA)
6. Office of the Higher Education Commission (OHEC)
7. Thailand Research Fund (TRF)

The Thailand Research Fund (TRF) was established in 1993 response to the 1992 Research Endowment Act. Although it is part of the government system, it is functionally independent and operates outside the government administrative bureaucracy.[38] This freedom allows great efficiency in research support. The TRF supports research in thematic areas and funds basic research in all disciplines.

The TRF Research and Researchers for Industry (RRI) program supports research the solves industrial problems or creates new technologies; supports commercialization supports industry/academic networks and partnerships.

Which governance design is better?

Overall, the international trend is towards putting multiple funding sources and research governance bodies under a single umbrella. But the actual form of national governance is different in every case, depending on national institutional histories. There is some suggestion that networked governance as is operates in Thailand at present is not the most effective model (Schiller and Liefner, 2007). That is consistent with critiques of the least-coordinated model the United States (Flagg and Harris, 2020) and this seems obvious if we think about the importance of mission-oriented research and the process of creating and implementing national research priorities.

What we can say, however, is that – regardless of the governance model adopted – most systems distribute the functions of research governance (priority-setting funding, decision-making and monitoring) among more than one institution. No mature knowledge economy today has a single research governance entity that performs all the functions of:

- producing research and development policy;
- setting the national research agenda;
- deciding how to distribute research funding;
- monitoring research projects and their budgets; and
- collecting data on research publications and outputs.

This is true even in small economies that are centralized, like Singapore. Most systems have a mixture of government agencies and newer research councils that are functionally independent from political decision-makers.

Why do research councils matter?

When we say 'research council' in this context, we mean something different from 'learned society' or scientific association. A research council for research governance purposes is a body of scholars from both STEM and social science and humanities disciplines, supported by a public service secretariat and technical team, that functions as (a) an advisory body for government on emerging research needs and trends; (b) an expert body of reviewers who are entrusted with the task of evaluating

[37] https://www.nrct.go.th/en/tnrr

[38] https://www.trf.or.th/eng/

new research proposals – particularly for competitive funding opportunities – and recommending the best research programs and projects for funding.

In countries like the United Kingdom and Australia, research councils are also tasked with (c) evaluating the performance of the research sector as a whole – usually through systematic reviews – and rankings -- of university and research institution disciplines. In the United Kingdom this is through the Research Excellence Framework (REF)[39] and in Australia the Excellence in Research for Australia (ERA)[40] system.

Arguably the most important role of a research council is to be an independent voice that can advocate to government on behalf of research institutions, without being either part of government or a research institution itself. Having that kind of arm's-length, expert advisory function, where research professionals are constantly scanning the horizon, comparing national performance with that of peer economies and looking for efficiencies and ways to promote excellence is a significant factor in the growth of most knowledge economies.

Can better governance improve research content and quality?

Mature knowledge economies believe that research actors who are supported by an investment of public money needs to be accountable for that investment. Designing the governance system is relatively easy; funding its operation and changing the behaviour of actors within it is much more difficult. The challenge for most systems is that there are relatively few tools through which actors interested in changing research content can influence researchers (Glaeser, 2019).

The Haldane Principle (UKRI, 2018) heavily influences research policy in countries like the UK and Australia. It asserts that the knowledge actors best able to assess research quality are scientific experts and that the choice of research focus (particularly for curiosity-led research) should be free from political interference.

From that idea flows research governance that assesses the originality and significance of research (and the need to fund it) through:

- transparent, merit-based competition;
- systems for managing funding applications and review;
- peer review by researchers within the same or proximate disciplines;
- fully developed systems of research integrity (e.g. ethics approvals);
- systems of research methods and ethics training;
- professional research budget management and fraud control;
- obligations to publish (ideally through Open Access platforms);
- systems for distributing publications and evidence that research outcomes are being used (e.g. through highly cited journal articles); and
- systems for storing data and obligations to make that data public, after publication.

In the table below we can see an approximation of how closely different national systems of research governance adhere to these design features. Indonesian policy makers are well aware of the design features that we outline here; the issue is how to implement them more quickly, for better effect.

[39] https://www.ref.ac.uk

[40] https://www.arc.gov.au/excellence-research-australia

TABLE 2.1 **COMPARATIVE TABLE OF HALDANE PRINCIPLE APPLICATION**[a]

Research and development governance systems alignment with Haldane principles

	Political independence. transparency, access, and equity				Peer review		Professional responsibiity for research quality and ethics				Public accountability		
National system	Research funding body independence	No political interference with research funding decisions	Transparent merit-based competition	Nationally consistent systems for managing funding aplications and review	Peer review by researchers with the same proximate disciplines	Regular use of international peer review	Systems of research integrity (e.g. institutional ethics boards and processes for review, approval, and sanctions}	Mandatory research methods and ethics training	Professional research management	Budget management and fraud control systems	Obligations to publish (ideally through Open Access platforms)	Systems for tracking research impact (citation and non-non citation evidence)	Systems for storing data and obligations to make that data public, after publication
UK													
US													
Australia													
Singapore													
Japan													
Korea													
Thailand													
Indonesia													

[a] Authors' design: the intensity of the colour block indicates relative strength/alignment with the principles.

2.2 Indonesia's research actors, structure and reform

Overview of research production actors in Indonesia

Research and development activities in Indonesia are conducted by different kinds of actors and institutions, both within and outside the government, including: (1) Higher Education Institutions, (2) Government Research and Development Institutions, and (3) research and development actors in the private sector including industry, and non-government civil society organizations (CSOs) such as Policy Research Institutes (PRIs). Each research institution has its own characteristics: focus, research activities, funding sources and quality of its researchers.

2.3 Research in higher education institutions

Higher education institutions defined

Law No. 12 of 2012 on Higher Education (the Dikti Law) defines higher education as *"the stage of education after mid-level education. It includes diploma, undergraduate, postgraduate, and doctoral programs, as well as professional and specialized programs which are run by higher education institutions on the principles of Indonesian culture (art 1)".*

Every higher education institution—public or private—has an obligation to undertake the *Tri Dharma Perguruan Tinggi* (the three pillars of higher education): Education, Research, and Community Service. This obligation to observe the *Tri Dharma Perguruan Tinggi* is one of the main characteristics that sets Higher Education Institutions apart from other research and development agencies in Indonesia. It also underlines the fact that the primary role of higher education institutions is still conceived as being education.

> *On the other hand, universities [around the world] should focus on basic research, but in practice, they do not. One could say that universities [in Indonesia] concentrate more on education and pay only little attention to research. - Interviewee 01*

Higher Education Institutions in Indonesia consist of:

- State universities (PTN) and private universities (PTS)[41] organized within the Ministry of Education and Culture;
- Higher Education Institutions with Religious Affiliations (PTA) organized within the Ministry of Religious Affairs; and
- Higher Education Institutions of other Ministries/ Institutions (PTK/L).

Currently, there are 4,670 higher education institutions in Indonesia.

TABLE 2.2 **NUMBER OF HIGHER EDUCATION INSTITUTIONS, BASED ON THEIR FORMS AND TYPES[A]**

INSTITUTION TYPES	PTN	PTS	PTA-PTK/L[B]	TOTAL
Universities	63	500	18	581
Institutes	12	79	123	214
Schools of Higher Learning	-	1,449	1,076	2,525
Academies	-	973	81	1,054
Community Colleges	4	14	1	19
Polytechnics	43	156	78	277
Total	122	3,171	1,377	4,670

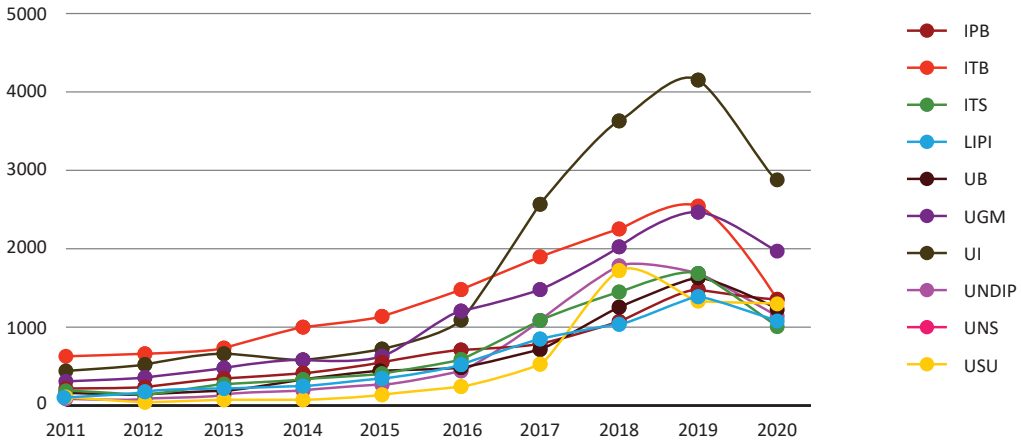
[a] Source: 2018 Statistics on Higher Education Higher Education Database (PDDikti) https://pddikti.kemdikbud.go.id

[b] Higher Education Institutions within the Ministry of Religious Affairs and Higher Education Institutions of other Ministries/Institutions (PTK/L).

The distribution of Higher Education Institutions in Indonesia is still concentrated in the western part of the country with 74% in Sumatra and Java: Regions like Bali, Nusa Tenggara, the Molucca Islands and Papua, have only 9% of the total number of institutions. Almost 69% of all higher education institutions in Indonesia are private. While 17% of institutions in Indonesia take the form of a university or institute, this small group represents those institutions with highest research capacity and productivity.

[41] Both are within and under the auspices of the Ministry of Education and Culture, except for the 2014 – 2019 period, when they were under the auspices of the Ministry of Research, Technology, and Higher Education, due to the merger between the Ministry of Research and Technology and the Directorate General of Higher Education

FIGURE 2.2 **TOP 10 INDONESIAN RESEARCH INSTITUTIONS BY SCOPUS PUBLICATION AFFILIATIONS**[a]



[a] Source: https://sinta.ristekbrin.go.id

State universities research producers

Despite representing less than 2% of the total number of higher education institutions in Indonesia, state universities dominate the production of number of scientific publications in Indonesia. At present, 9 of the 10 institutions in the country with the highest number of SCOPUS indexed publication affiliations come from the higher education institution sector, and most of these are state universities (Figure 2.2).

Higher education institution governance

Most higher education institutions in Indonesia are under the coordination and administration of the Ministry of Education and Culture. For the period 2014-2019, this regulatory authority was turned over to the Ministry of Research and Technology and Higher Education (*Kemenristekdikti*) on the heels of the then-merger between the Ministry of Research and Technology (*Kemenristek*) with the Directorate General of Higher Education (*Dikti*) through the introduction of Presidential Regulation No. 13 of 2015. The objective of this merger was to encourage synergy between the research world and the higher education institutions. The presence of two functions under this one Ministry was expected to facilitate management, supervision, and control of research activities in Indonesia. However, during the period 2020-2024 period, the Directorate General of Higher Education was separated from the Ministry of Research and Technology, and once again joined the Ministry of Education and Culture. One of the reasons behind this decision was the establishment of the National Research and Innovation Agency (BRIN)(discussed further below). Later, the Ministry of Research and Technology was renamed the Ministry of Research and Technology/ National Research and Innovation Agency (*Ristek*/BRIN).

State universities in Indonesia are classified by their level of autonomy in planning, managing, and carrying out activities:

- state universities with legal entity status (PTN-BH)[42]
- state universities with public service body status (PTN-BLU); and
- state universities with working unit status (PTN *Satker*).

The PTN-BH represents the highest category of universities have full autonomy in managing their financial affairs and human resources, including lecturers and educators – they operate like state-owned enterprises (BUMN). In terms of research activities, the PTN-BH have the authority to manage the allocation of research funds received from government, including the selection of the research proposals submitted to them. Other types of state universities do not have this authority. PTN-BLU have limited authority in their financial and resources management but have full authority over all their non-tax income (PNBP). The PTN-Satker, as Ministry working units, have no authority in relation to revenue management; all revenue, including tuition fees paid by students, must be paid to the state account of the Ministry of Finance.

[42] To date these include: *Institut Teknologi Bandung (ITB); Universitas Gadjah Mada; Institut Pertanian Bogor; Univesitas Indonesia, Universitas Pendidikan Indonesia; Universitas Sumatra Utara, Universitas Airlangga (under Law 12/2012 on Higher Education) and then from 2014, Universitats Padjadjaran; Universitas Diponegoro; Universitas Hasanuddin; Instut Teknologi Sepuluh Nopember*

Research actors and support units

Lecturers (*dosen*) are the main actors for research activities conducted at Higher Education Institutions. In Indonesia, especially at state universities, a lecturer is a civil servant (PNS). In accordance with Article 4 of the Administrative and Bureaucratic Reform Ministerial Regulation No. 17 of 2013, lecturers have three principal duties: (1) providing education; (2) conducting research; and (3) performing community service.

In 2018, of the 294,820 lecturers across 34 provinces of Indonesia[43] 14% had doctoral degrees (PhDs). A high proportion (39%) of these PhD qualifications are in Social Science (20.31%) or Educational Science (18.77%). Significantly, 50% of those with PhDs who hold a professorial title (Dosen Profesor) come from three fields: Educational Science (19.96%), Agricultural Science (16.79%) and Social Science (15.00%). That has consequences for capacity for future PhD supervision within Indonesia in STEM disciplines.

Within Higher Education Institutions, there are units that support lecturers to undertake research activities such as the Research and Community Institute (LPPM), which can be found at state universities with legal entity status (PTN-BH), state universities with public service body status (PTN-BLU), and state universities with working unit status (PTN Satker). The LPPM is responsible for the administration and distribution of research funding (although lecturers remain accountable for all reporting and financial matters), providing assistance to lecturers for proposal writing and review for international and national research grants, and ensuring research activities conform to the research proposal and the terms of the agreement on which the research funding was awarded.

> *As for the main administration of research activities implementation -- including accountability for reports and finance -- lecturers do have to take care of it themselves. But LPPM facilitates this for them, so we have staff and divisions with whom they can consult. If a DRPM contract states [for example] a fund worth IDR 20 million, then the fund will go straight into the researcher's account. LPPM only coordinates the implementation. For reports, financial matters, indeed, they are all handed over to the researchers. – Interviewee 017*

At some large Higher Education Institutions classified as the PTN-BH, there are other units that also play a role in supporting research activities conducted by lecturers, for example, at the Bandung Institute of Technology (ITB), the Innovation and Entrepreneurship Development Institute (LPIK) focuses on downstream research and development activities (Technology Readiness Levels [TRL] 6 to 9). At Gadjah Mada University (UGM), the LPPM is divided into two directorates: the Directorate of Research and the Directorate of Community Service. The University's Directorate of Research is engaged in the upstream part and is responsible for research management and research ethics whereas the Directorate of Business Development and Incubation focuses on the downstream. Other support units include the centre for Lecturer Scientific Publication and Scientific Work Services and the Centre for Patent and Intellectual Property Rights Services.

Significantly, no Higher Education Institution has a support unit responsible for sourcing research funds; rather, this role falls to lecturers who are expected to actively seek research funding opportunities for themselves.

Disparity between higher education institutions

There is a disparity between PTN-BH Higher Education Institutions and others in terms of research resources, especially those classified as PTN Satker. When it comes to funding resources, the PTN-BH do not have to compete with other Higher Education Institutions for research funds because they receive allocations from the Higher Education Institution Endowment Fund from the Ministry of Education and Culture. Higher Education Institutions outside the PTN-BH category have difficulty making research plans or road maps because they do not have the same level of funding support or autonomy.

> *[F]or [state universities] BLU, we… for example at the national level, we participate in national competitions. This means that we have to compete with UNS (Sebelas Maret State University) Solo and other Higher Education Institutions outside the PTN-BH category. But if a university becomes a PTN-BH, it will receive block grants. – Interviewee 022*

[43] Sumber: Statistik Pendidikan Tinggi 2018, Pangkalan Data Pendidikan Tinggi (PDDikti) https://pddikti.kemdikbud.go.id

Collaboration between higher education institutions

The autonomy and resources PTN-BH create opportunities for research collaboration with other Higher Education Institutions, for example, the Indonesia Research Collaboration (RKI) which is made up of four PTN-BH: the Bogor Agricultural University (IPB), the Bandung Institute of Technology (ITB), Airlangga University (UNAIR), and Gadjah Mada University (UGM).

> *So, in one location, the focus is on, for example, cattle farms, and there are 8 themes. Some conduct research on water sources, or food provision, or the farmers' income, or tourism, in accordance with their respective disciplines, but the research activities are coordinated as one project, so they all work together. – Interviewee 05*

By contrast, research carried out by the PTN Satker located in the eastern part of Indonesia may only takes place when research activities are conducted in that part of the country by other institutions and the contribution made by local researchers tends to be focused on data collection.

Research funding sources for higher education institutions

Research funding comes from four sources in accordance with the form of the higher education institution:

1. Internal funds of higher education institutions:
   Funds from the annual budgets of higher education institutions which are set aside specifically for implementation of research activities by the institutions' internal researchers (for PTN-BH and the PTN-BLU). For PTN-Satker, this might be a combination of funding allocations from organizations that support the institutions – such as particular Ministries - and companies or foundations.

2. Research funds from the Government:[44]
   Research funding schemes offered by government institutions (mainly the Ministry of Research and Technology/National Research and Innovation Agency (BRIN)) for research activities in Indonesia.
   The funds are managed through the Information System for Research Management and Community Service (Simlitabmas) and can be accessed by both state and private universities (PTN and PTS). The government research funds encompass a variety of Research and Community Service schemes provided on a nationally competitive basis and on the grounds of Decentralization and Assignments.

3. Competitive schemes
   There are different selection processes for higher education institutions in different institutional clusters, and of different autonomy levels. The authority to propose research is exercised based on the classification that divides higher education institutions into four clusters based on their research performance, including Independent, Leading, Mid-Level, and Binaan ('targeted' institutions in the lowest cluster that are under the guidance of the Education and Culture Ministry).

   Those in the Independent cluster that also have the institutional status of state universities that are a legal entity (Independent cluster PTN-BH) can make their own selection of Nationally Competitive and Decentralization Research proposals, based on the targets and funds allocated by the Directorate of Research and Community Service (DRPM) of the Ministry of Research and Technology/National Research and Innovation Agency (BRIN) in the form of block grants. Internal reviewers select the research proposals.

4. Other funding sources:
   Funding sources from outside the institution and non-governmental sectors such as international research grants, research cooperation with private and industrial sectors, philanthropic funds, and research cooperation with Local Governments and other Government Institutions.

One of the constraints of the funding sources that several project participants identified is the underfunding of research infrastructure (in STEM disciplines this often means equipment and laboratory facilities, but in the social sciences and humanities it can also mean the

[44] Under such schemes, research is conducted through eight phases: Announcement, Proposal Submission, Selection/Nomination, Designation (of the Fund Recipients), Implementation, Supervision, Reporting, and Assessment of Research Results.

quality and location of libraries and access to digital databases). One of the distributional problems is that the infrastructure that does exist tends to be concentrated in Java and the western part of Indonesia:

> *For us who work on campus, to tell you the truth, we do have equipment, but it is very limited, and most is out of order. Why is it broken? We bought in the equipment, but we did not have any technicians, or any laboratory technicians, so the equipment was broken before we had a chance to use it. Then, due to limited lab facilities, it is a bit difficult for us to conduct in-depth studies, since we have to send the materials from here, Papua, to another area for analysis. That means we need to spend money for the delivery costs and other necessities. Another obstacle is the lengthy completion time. In my recent experience, I had to wait for more than five months for results of soil analysis. – Interviewee 018*

2.4 Government research and development institutions

Litbangjirap institutions (government institutions that conduct 'activities concerning Research, Development, Assessment, and/or Application')[45] are under the coordination of Ministries, Non-Ministerial Government Agencies (LPNK), and local governments throughout Indonesia. There are currently 263 *Litbangjirap* institutions in Indonesia with Ministries controlling the largest proportion (124 institutions), followed by the LPNK (105 institutions), and local governments (34 institutions).

The Indonesian Institute of Sciences (LIPI) and the Agency for the Assessment and Application of Technology (BPPT) are the LNPK that have the highest number of research and development sub-units; each has 37 centres (*Pusat*) and Agencies (*Balai*) under its umbrella. The Ministry of Agriculture manages 55 research and development units; the Ministry of Industry, 27; and the Ministry of Environment and Forestry (KLHK) 19.

Definition and classification of research activities is not clear

Not all Litbangjirap Institutions actually conduct research[46]: the current classification of *Litbangjirap* Institutions tends to be based on the nomenclature of the institutions, rather than their core function. For example, Research and Development Bodies (*Balitbang*) under certain Ministries primarily support policy formulation and development; any research activities that they undertake tend to be in support of policy creation. Some government Institutions, despite being *litbangjirap* institutions, undertake very limited research related to policy or standardisation (e.g. Nuclear Energy Regulatory Agency (*Bapeten*) and the National Standardization Agency (BSN), which exist under the coordination of the Ministry of Research and Technology/National Research and Innovation Agency (BRIN)).

As one of the interviewees in this project pointed out, research should have broad definition, not limited to work that supports invention and innovation in product development. However, what is missing in Indonesia is a definition and classification of research that are clear and can cover different types of research. Each type of research should have its own standards and indicators of success – those should be specific, rather than general:

> *[T] here are several categories here. Some research is indeed designed to build scientific structure. Such research tends to produce more publications. There is research that is directed to be applied to technologies. [There is also] …research designed to develop policies. There is even research whose output might simply be social engineering; it does not result in any products, but it socially engineers an area to become a better place, so the research is dedicated directly to the community. Now, all types of the research described earlier should receive equal appreciation. But currently, there is a misconception that all research projects should produce publications, and that efforts should be made to gain a better Scopus index. Of course, it is good to have some measures. But these measures are applied to all fields, although not all research fields generate publications as their output. Another new measure is patents. But not everything has to be patented. – Interviewee 06*

[45] As referenced in the Sisnas Iptek Law

[46] Either as referenced in the Sisnas Iptek Law, or in the sense of the OECD definition

Research actors and support units

Research actors at government research and development institutions are those who hold functional positions as researchers and engineers. In 2019 Indonesia had 9,669 researchers and 2,439 engineers in this sector.[47] Only 13% of those researchers had doctoral degrees, while 45% had a master's degree.[48] Their career paths as civil servants within government research and development institutions is considerably influenced by their research productivity:

> *Researchers are functional positions, so in order to get promotion, they have to accumulate some kind of credit points. They receive these points, or KUM (credit), from research that they have conducted. For instance, if the research gets published internationally, the researcher will receive 50 or 25 points. One needs 100 points to be promoted from first-level to junior-level researcher. If he does not achieve 100 points, s/he cannot be promoted. And if s/he fails to accumulate 100 points, s/he will be demoted and no longer hold any functional position. Then, it will become a problem. – Interviewee 021*

Research and Community Institutes (LPPM) each have Scientific Supervisor Committees (PPI) at their respective research centres (*Puslit*) that conduct internal reviews of proposals and research results.

No clear scope of research activities

There is no definition or standard applied to the 'research activities' conducted by these institutions and it is not unusual to find their funding allocation by government, or their spending, calculated on the basis of the institution's nomenclature, rather than on the actual nature of their activities:

> *[The] budget allocation for research is small and spread across all Ministries/Institutions. As it is spread across so many recipients, we no longer have a clear idea on what is called as research; what is considered to be research at each Ministry. For example, some deem research monitoring and evaluation as research activities. Not only are the research activities scattered across Ministries/ Institutions, but there is also no consistent strategy for the research activities. One Ministry wishes to conduct research in this field, under this model, whereas another Ministry wants to conduct research in a different field. – Interviewee 025.*

Research funding sources for government research and development institutions

The main source of research funding provided to *Litbangjirap* institutions comes from the annual state budget (APBN) which is determined according to the National Medium-Term Development Plan (RPJMN) and the institutions' Organizational Work Plans. Non-Ministerial Government Agencies (LPNK) receive research funding directly from the Ministry of Finance, whereas Ministerial Research and Development Bodies get their research funds from the Ministries under which they are located.

Some government institutions also receive research funding from international research grants sourced from the World Bank, WHO, UNICEF, or the National Science Foundation (NSF). The use of these international funds is also subject to the provisions of budget execution lists (DIPA).

> *We do receive a lot of funds from abroad. Indeed, the mechanism for the funds itself is a little complicated now because the funds should go to DIPA [national budget plan] first. [The reason for] that is to prevent any leakage of funds and make optimum use of the funds. It is a bit time- consuming. The problem with this procedure is that honorariums for researchers are adjusted to DIPA, making it impossible for them to receive honorariums as per international [standards], which are two or three times higher than those set by DIPA. – Interviewee 021*

Outsourcing research

Although they conduct their own research and development activities, *Litbangjirap* institutions also often outsource research:

> *I think a lot of research and development institutions outsource most of their research and development activities to universities, so it is we who actually carry out those activities. They even outsource activities at a policy level. What does this mean? It means they do not have the capability. If they want to outsource all activities, then, they are no good. Some research institutions have funds and a number of projects, but they are not capable of carrying out the projects themselves and end up outsourcing that work to several universities, so they only play coordinating roles. I think this is something that we also need to evaluate. – Interviewee 05*

[47] Source: data collected from the Centers for Development, Education, and Training (Pusbindiklat) of the LIPI and the BPPT

[48] Source: Data in the Landscape of Science and Technology in Indonesia (2017)

Many of their research activities consist of large-scale surveys and *Litbangjirap* institutions possess a wealth of primary data that is not utilized. Interviewee 03, who has considerable experience working with government institutions, believes this is due to the limited capability of *Litbangjirap* institutions to process and use data in policy development:

> *The same can be said about Bappenas, except that it is still able to instruct people outside the organization to take a look at this and that. But inside the institution itself, for example, Bappenas may hold some data, but it does not have the capability to process it. For instance, its Pusdatin [Data and Information Center], they cannot…[W]e were once asked to give training to personnel of Bappenas' Pusdatin. Then, in order to extract [the desired data], we cannot use Excel, can we? [We must] use SPSS -- at least SPSS -- but even Excel had already made them confused. – Interviewee 03*

Interviewee 021[49] believes this is not a result of the limited capacity of the human resources in government, but rather due to complex factors that restrict researchers' freedom.

> *Well, it is actually complicated, from all kinds of aspects. Including the aspects of human resources quality and the Satker [working unit] itself,[50] which does not provide too much guidance. Usually, when officials, for example a second-echelon official, a Satker Head, wants to get a researcher involved [in a certain agenda], he would not care whether that researcher is busy conducting his research or not, and the researcher would not dare to refuse him. If the researcher declined the Satker Head's request, he would not get the latter's signature when he needed it one day. That is the obstacle, so the situation is slightly complicated. Researchers are not given complete freedom to conduct research without any external interruptions. – Interviewee 021*

Litbangjirap need to become think tanks

Interviewees for this project did not express positive views about government research institutions. One strong view was that they did have value, but that their role needs to change to better support Indonesia's research and development ambitions: government research and development Institutions need to play the role of a government think tank focused on research that helps to develop and expand policies in certain fields.

In this formulation of their role, government institutions should not be focused on academic research – that should be conducted by universities, not by government institutions where the bureaucracy is rigid. One interviewee[51] cited the example of South Korea, where the Korean Development Institute works on development, social, economic, and political issues. The Institute produces quality research, especially in the form of policy analysis. It had a very strong position and provides input on direction for macro policies for the Government of South Korea (one being the 'New South Policy'). However, that interviewee also recognized that the bureaucracy of government institutions in Indonesia is an obstacle to them becoming and performing effectively as think tanks.

> *Well, probably its nature bears more resemblance to Bappenas. But Bappenas is too bureaucratic compared to the Korean Development Institute. If that is the case -- if it is difficult to do it with Bappenas -- why do the Government not turn research institutes into government think tanks? For example, it can turn LIPI into a government think tank that focuses on policies, instead of academic research. Leave such research to the academic world, to universities. So, if we want to boost research in academic fields, we need to improve the quality of research conducted at universities. As for research institutions outside universities, guide them to focus more on policies, or applied research. Interviewee 009*

2.5 Research and development actors in the private sector and in industry

Non-government research and development actors

Non-government, or private-sector research and development actors in Indonesia include think tanks, Non-Governmental Organizations (NGOs) that conduct

[49] An employee of a Health Research and Development Body

[50] Satker is the abbreviation for *Satuan Kerja* (Working Units)

[51] Interviewee 09

research including Policy Research Institutes (PRIs) and private research institutes with an industry focus. The research from this group is diverse: it ranges from product development to studies that inform public policy. Most of the work produced by these actors takes advantage of existing research results and tries to apply these for innovation in products or repackage them for policy development purposes It tends not to include basic scientific research or take the form of scholarly publication: these are often intermediary or 'translational' activities.

Research by industry actors in Indonesia

A 2016 survey[52] established there were at least 210 research and development institutions in the industrial sector, spread across 17 provinces in Indonesia. One hundred and ninety-one (or 91%) of these were located in Java. The survey also found there were at least 4,778 people (or human resources) involved in these institutions, and that 94% of them were also concentrated in Java Island. Of those employees, only 50% were researchers, with the remaining being technicians or administrative staff. Nearly 10% held a master's degrees (9.54%) and less than 1% held a doctoral degree (0.46%).

These qualification levels are important, because they also point to industry's 'absorption capacity' for research – the better qualified industry employees are, the better able they are to both produce – and use – research for industrial purposes (cite). This is why South Korea and Thailand have both put considerable effort into producing PhDs for and with industry.

The Government of Indonesia faces challenges in collecting data and research information from the industrial sector (the Ministry of Research and Technology and Higher Education (*Kemenristekdikti*), 2017). A contributing factor here is how research by industry is viewed: as we saw in Section I, the Law on the National System of Science and Technology (the *Sisnas Iptek* Law) does include Business Entities as part of science and technology institutions (Article 42), but it positions them as parties responsible for utilization of research results, not as knowledge producers (Article 46). Despite government wanting to utilize more financial support from industry for research, industry itself is still not seen as an important actor in knowledge production.

Research funding sources for private sector and industry institutions

Actors from the private sector and industry rely on their organizations' internal funds—or funds allocated by parent companies under which they operate—as well as international research grants. Although they do not take advantage of the competitive research funding schemes currently available from the Indonesian government, some undertake research in partnership with government research institutions. Presidential Regulation No. 16 of 2018 on Government Procurement has also supported cooperation with government.

> *Now, in this period, it is possible for mass organization [and/or non-government organizations] to perform activities for the procurement of goods and services for the government. So, it allows mass organizations to receive allocation from APBN or APBD [regional budgets] and carry out programs or activities funded by APBN or APBD. Now, this issue has been addressed following the introduction of the relevant regulations." – Interviewee 014*

2.6 Establishment of BRIN and system reform

Establishment of BRIN

Following the end of New Order administration regime in 1998, national development planning in Indonesia became less top-down and centralized and more bottom-up and decentralized process. For government research actors, in particular, this has resulted in new institutional problems of coordination, disconnection, and overlapping activities among the institutions.

[52] A self-assessment survey of respondents who represented participating companies conducted by the Ministry of Research and Technology and Higher Education (now it is the Ministry of Research and Technology/National Research and Innovation Agency [BRIN]).

What has been happening so far is that institutions are not connected with each another and their roles are not clear. Universities, as education institutions, also receive a lot of demands to perform downstream (hilirisasi) activities. BPPT, which should have entrusted many projects on basic research to LIPI and universities, in fact, conducts some research too. Well, those are past examples of overlapping among the institutions. In the past, the functions of research and development agencies also did not match their main tasks and functions[53] – Interviewee 006

Those concerns crystallized in a 2018 speech by President Joko Widodo, which questioned the efficiency of Indonesia's spending on research by Ministries and government institutions.[54] This perceived lack of budget efficiency was connected to the absence of national performance standards for Government Research and Development Institutions. Until this point, the process for planning, executing, and evaluating research activities conducted by government institutions tended to be undertaken internally and external audits were limited to financial audits conducted by the Supreme Audit Agency (BPK). The clear signal was that future state research budgets would be more strategically distributed.

In order to address institutional problems of fragmentation among government institutions and the inefficiency of the budget allocation, the National Research and Innovation Agency (BRIN) was established in 2019 with the Presidential Regulation No. 74 of 2019 on the National Research and Innovation Agency.

Now, BRIN is actually an interesting idea. Why? Because BRIN will be directed to take care of all problems, from fragmentation among the institutions, lack of synergy between them, to the evidence-based policymaking process that has come to a standstill. It is assumed that the presence of BRIN will address all of these. – Interviewee 07

As we saw in Section 1, the Law on the National System of Science and Technology (*Sisnas Iptek* Law) states that the BRIN shall be established to conduct integrated Research, Development, Studies, and Application, and Invention and Innovation (art 48). With this it was envisaged that the national research agenda and funding management would be centrally coordinated, however as our interviews noted, in order to 'coordinate' effectively, BRIN needs to have the power to make decisions on the use of the research budget.[55]

Participants in this study were unanimous that the depth and complexity of problems in Indonesia's research ecosystem in Indonesia mean that it will be impossible for BRIN to address all of the problems at once. Instead, it should decide on its initial focus and deal with the problems sequentially:

Which problems would we like to solve? Is it budget efficiency and effectiveness or is it allocation, or institutional downsizing? Do we translate efficiency into institutional downsizing as its consequence, or do we improve the coordination and the protocol, or do we build the collaboration? Now, there are no right or wrong answers for those three problems. We could address problem number one, or problems number one and two, or numbers two and three, or number one and three, or number one, two and three altogether. So, dealing with the root causes of this inefficiency problem. Whether it is the lack of coordination, or the lack of collaboration, or an excess of human resources, or because there are too many institutions. Now, these are the issues that we would like to tackle. – Interviewee 07

Participants from the Ministry of Finance welcomed the establishment of BRIN, as they considered the agency to be the solution to the inefficiency of the distribution of the research budget. The introduction of BRIN was expected to result in an annual or triennial national research strategy which would provide a strategic focus for all research institutions and make optimum use of the available funds.[56]

[53] *Tupoksi stands for "Main Tasks and Functions", which are the main goals or the main job that an organization should achieve and perform.*

[54] In his opening speech for the Cabinet Plenary Session on 9 April 2018, President Joko Widodo questioned the efficiency of the research component (IDR 24.9 trillion) in the State Budget (APBN) to be distributed to almost all ministries/institutions. https://bisnis.tempo.co/read/1077794/jokowi-pertanyakan-hasil-riset-dengan-anggaran-rp-249-triliun

[55] Interviewee 06

[56] Interviewee 25

2.7 What stakeholders expect of BRIN

Coordination

Some stakeholders saw BRIN's role as 'coordinating' through reducing duplication in government institutions missions and research activities, but importantly, ensuring that knowledge produced by these institutions is properly accumulated and shared in ways that outside actors can use it. Overlap between research activities is not entirely a bad thing. There is a risk to reliability and accountability for research results, when research in certain fields is conducted by just one research institution. Indonesia also needs to guard against weakening competition, which is an important factor that supports the production of quality research:

> *[T]here will be no overlap, meaning it guarantees the accumulation of knowledge from all research institutions because sometimes research activities need to overlap with each other for the sake of reliability and accountability. But we have to make sure that this knowledge will be in the public domain and then it can become the accumulation of knowledge. For example, how can I improve my methodologies if I am not aware that other universities have tested certain methodologies and have no idea about the results? Now, those are the matters that BRIN needs to focus on. – Interviewee 03*

Acting as an intermediary between research and policy formulation

There link between research and policy in Indonesia remains weak, despite efforts to build these knowledge pipelines and relationships.[57] BRIN has the potential to perform the role of intermediary that serves as a bridge between research actors and policymakers:

> *[R]esearch that can give very precise recommendations is the one that has strong theoretical grounds. A research project studies a social problem in a precise, logical and thorough manner, and when the research team has produced a synthesis from their study—for instance, they have published or is about to publish articles about it—the finding is also disseminated right away in the working group, which can be mediated or facilitated by Kemenristek/BRIN. So Kemenristek/BRIN serves as a kind of matchmaker or intermediary organization that brings together Ministries expected to be potential users of the research results. These results do not have to be in the form of products, they could also be insights that will provide a more comprehensive outlook to the ministries (that need the research results). – Interviewee 04*

BRIN can also play an active role in identifying research and database needs during the process of policy creation by Government ministries/institutions – and communicating these to the research actors that work actively in the fields that could contribute to that policy.

Acting as an intermediary between research actors and industry

The downstream (*hilirisasi*) process of utilizing research results is still a significant issue in Indonesia: the relationship between research actors and industrial actors needs to be much stronger:

> *Why is the downstream (hilirisasi) stuck? Because sometimes universities do not see that when it comes to commercialization there are requirements that they need to meet. For example, the results have to be registered, and the research should have standards. Oftentimes [research results] are ready, but when they are about to be registered, sometimes researchers feel they have done a good job when they have discovered the results once. On the contrary, if we want to register our results, we have to make sure that we have discovered them three times, that the results are correct, and they are not coincidences. Here, sometimes [researchers] feel that their results are ready, but actually, when the results are about to enter the industry, the industry would say that their results are far from ready because they still need to be validated, and there should be this data and that data. – Interviewee 09*

BRIN could act as the intermediary between research actors and industry by creating guidance on standards and processes to follow and assist in establishing mutually acceptable research agreements. This would ensure better quality of results and minimize the possibility of the results being rejected by industry sector. BRIN could also use its convening power to help identify the needs of the industry and help them connect to and communicate with, research actors.

[56] E.g. Knowledge Sector Initiative (KSI) https://www.ksi-indonesia.org/id

Funding and Research Activity Management

Participants in the project expect BRIN to manage and distribute the government research budget, particularly the Research Endowment Fund and the National Research Priorities program:

> *[W]hat I mean with variations is this: it is possible that once it has been managed [by a specific institution], the institution produces an investment return of, say, IDR 100 billion. Then it sends that IDR 100 billion to BRIN and BRIN distributes the fund, channels it, etc. Another alternative: the fund is managed and gives an income of IDR 100 billion, then BRIN will decide the selection and set the criteria. 'Oh, study A, research B, and research C win the funding and each of them will receive an amount of X rupiah'. Then they will deal directly with the fund manager for the financial matters. This is also a possible scenario. – Interviewee 025*

They also expect it to play a pivotal role in the management of research activities conducted by Government Research and Development institutions.

3

THE ROLE OF RESEARCH AND DEVELOPMENT FUNDING

All knowledge economies suffer from limited, or diminishing, government funding for research and development. It becomes critically important to squeeze as much value from the available public funds as possible, by generating high quality research while building the system's capacity to collaborate at the same time.

3.1 Key characteristics of international research and development funding schemes

There is no single model internationally for how governments can fund research and development most effectively. But there are some key characteristics that are common to most mature knowledge economies and we discuss these here.

'Dual support' model

Most mature knowledge systems use a 'dual support' model for universities and research institutions. They receive institutional support ('block grant' funding) for research, which they have discretion to use internally, and then are also eligible to apply for competitively-allocated grant funding (project-level funding). The degree to which a system can build 'dual support' is a critical factor in building its capability (Nurse, 2015: 6). A significant change in recent years is the block grant funding is increasingly tied to performance (Liefner, 2003). The UK has been an early (and arguably successful) innovator in this regard – what was once 'block grant funding' is now known as 'quality-related research funding (QR), which explicitly rewards institutional research performance based on the Research Excellence Framework ((REF). The REF is a cyclical assessment of output, environment and impact which measures the links and contribution of research to economic, societal and public outcomes (UKRI, 2018a:23). The EU is also rolling out stronger recommendations that member states institute competitive funding for institutions or performance-based funding based on institutional assessments (Zacharewicz et al, 2018). While acknowledging that there is no single model of institutional performance assessment in use within the EU the authors are fairly unequivocal that performance based funding is correlated with better research performance (2018:10). Sandström and van den Besselaar (2018) show that positive correlation between the level of institutional funding and performance – meaning that institutional funding is essential for a research system, and that increasing project funding may lead to over-competitiveness. They also find that academic freedom is important. What they also find, however, in highly efficient systems such as the UK, Australia, Sweden and Finland, systems of institutional evaluation ensure that the institutional funding is used wisely (2018:373).

While the government is the 'first resort' funder in mature knowledge economies (Miedzinski, Mazzucato, and Ekins, 2019), as well as in developing knowledge economies, most of these systems encourage research funding contributions from non-government sources. Those include philanthropic bodies, industry, and international funding bodies. In mature knowledge economies, the diversity of funding sources that researchers rely upon is generally underestimated, and the importance of 'co-funding networks' when researchers collaborate

internationally is important (Aagaard et al, 2020b). It also links to the research about international collaboration beings positively correlated with domestic research productivity (Cimini et al, 2016), discussed further in Section 5, below.

Mature knowledge economies with efficient research governance are able to attract and manage external funds from industry, or from international partners. As a general rule, those funds are not mixed with (host) government funds; they are managed by the host government research council (or research agency) for a particular purpose (e.g. scholarships or research grants tied to a particular theme). An example of this is the National Science Foundation (NSF) in the United States, which acts as an agent when it manages research funds for other actors (domestic and international) and also manages the selection and distribution process. Part of the appeal of entrusting the NSF with these tasks is that it is independent and has demonstrably high levels of ethics, accountability and financial controls.

Indonesia's capacity to act as a manager of non-government and external research funds will increase once the building blocks of a research governance system (discussed in Sections 2 and 6 of this report) are in place.

Tax incentives

Incentives for industry to conduct research and development are now a standard policy 'solution' to boosting national investment in research. Most countries, whether they are mature or developing knowledge economies, have now adopted tax incentives (as deductions or credits) – for industry expenditure on research and development (Appelt et al, 2019; OECD, 2017). A 'super' deduction indicates that 'income tax is reduced by deducting R&D expenses from the tax assessment basis by more than 100% ('super deduction') or from the tax liability ('tax credit')'(KPMG, 2016). This is a direct benefit to the company applying for the tax benefit: they can usually select what research and development they want to undertake and self-report that expenditure. Because the government forgoes this tax income, this is in substance a form of government expenditure on research that it delegates to industry.

Indonesia announced its 'super tax deduction' as part of the *Sisnas Iptek* policy package in 2019[57] and introduced the implanting rules for this in late 2020. This is an attempt to boost industry expenditure on research and development (and thus the gross expenditure on research and development for Indonesia),[58] but the regulations indicate that eligibility is linked to producing intellectual property in eligible industry sectors.

These policies tend to be popular with industry, but the OECD data survey suggests that it is unclear whether they actually generate transformative innovation at the national level (Appelt et al, 2019). An secondary purpose of these policies (particularly 'super tax deductions') is as a signalling effect for foreign investors (e.g. KPMG 2016).

As policy instruments, these tax incentives have a number of issues:

1. the tax incentive is actually public money (money that would otherwise be paid in tax);
2. government cannot control the type or the amount of research and development that the company carries out – some of which might be routine improvements to products or processes that the company should have been performing in any case;
3. to be effective, industry needs a certain level of absorption (meaning ability to host and use researchers who will actually create intellectual property and breakthroughs, rather than just improve a product or process ('innovation within company');
4. there is a question about their sustainability if offered for an extended period of time; and
5. tax incentives, by themselves, do not promote collaboration with other research actors.

These were some of the reasons that Australia reviewed its research and development tax incentive in 2016, seeking the views of industry, government and the

[57] Indonesia has published Regulation No 153/PMK.010/2020 which provides implementing rules in relation to the super deduction for R&D costs introduced by Government Regulation No. 45 of 2019. Under Regulation No. 45 a deduction up to 300% is provided for costs incurred for eligible R&D activities carried out in Indonesia, including activities carried out for the production of inventions/innovations, to master new technologies, and/or for the transfer of technology to develop/increase the competitiveness of national industries. Regulation No. 153/PMK.010/2020 clarifies the application of the 300% deduction. See, for example, https://www.orbitax.com/news/archive.php/Indonesia-Publishes-Implementi-44066

[58] Regulation No 153/PMK.010/2020

Chief Scientist.[59] In 2020, it revised its policy in an effort to increase the 'intensity' of business research and development[60] and lift the national expenditure on research and development. Currently this is 1.8 per cent of GDP, but many policy makers would like to bring it closer to the 3-4% averaged by top-performing countries like Sweden, Germany and Israel.

Co-investment by government

Some economies (generally those with highly developed industrial sectors and/or very high levels of foreign investment) have been successful in securing significant research and development spending by industry. But as Schiller and Liefner (2007) point out in relation to Thailand, 'university-industry cooperation in developing economies cannot be expected to work in the same way as in developed economies' (2007:548). After surveying 136 industrial university-industry collaborative projects in Thailand, they found that the net benefits of the project flowed predominantly to industry; the share of joint labs or spin-offs was negligible and genuinely joint research became possible if the industry partner was bigger (more than 500 employees), which is consistent with Brimble and Doner's (2007) analysis for university-industry linkages in Thailand and what we know about industry capacity to create and absorb research.

Simply providing incentives for industry does not guarantee that all research actors are collaborating and producing the highest quality research possible. A strategy used with some success in mature knowledge economies is to invite more industry expenditure on research and development by co-investing government funds. An example from Japan is the Cross-Ministry Strategic Innovation Promotion Program[61] which invites consortium bids, including industry partners to engage in world-class research and innovation in nominated priority areas.

Co-investment is different from simply asking industry to spend on research and development (for which the tax incentive policy tool is available). Co-investment (or 'matching funds') is an undertaking by government to contribute research funding at the same level -- or as a multiple of – funding that is committed by industry for research that will be carried out jointly by industry and a university of a research institute. The key condition is the partnership between industry, university and/or government or non-government research actors. In this way, government encourages industry, but uses its investment to link research actors from different parts of the knowledge sector. Today, these 'linkage' schemes are seen as a mainstream form of research funding, for STEM disciplines, humanities and social sciences, and interdisciplinary projects.

These 'linkage' or 'consortium' or 'collaboration' schemes are quite often linked to national research missions and have a substantial amount of research funding available for that purpose. An example would by the UK 'grand challenges' that track the government's industrial strategy: AI and the Data Economy; Future of Mobility' Green Growth and Ageing Society (UKIR, 2018a: 32)

Simple modes of government funding

A clear trend in mature knowledge economies is to simplify the way that government funds can be accessed, and how they are distributed. An example is the Netherlands' use of 'funding simplicity',[62] in which the Netherlands Organisation for Scientific Research (NOW) offers a limited palette of funding lines and a limited range of budget building blocks:

- Open Competition
- Curiosity-driven research
- Talent Programme
- Curiosity-driven, responsive-mode research aimed at research talent
- Knowledge and Innovation Contract/KIC
- Projects or programmes in partnership with external public and/or private parties
- Dutch National Research Agenda
- Facilitate science making a contribution to economic and societal challenges

[59] https://www.industry.gov.au/data-and-publications/2016-review-of-the-rd-tax-incentive

[60] https://www.industry.gov.au/funding-and-incentives/research-and-development-tax-incentive. The revised R&D Tax Incentive applies for years of income commencing on or after 1 July 2021. The revised policy allows companies with annual aggregated turnover of less than AUD 20m to access a refundable offset pegged at 18.5 percentage points above the corporate tax rate (25% from 1 July 2021), so a 43.5 percent refundable tax offset. Companies with an annual aggregated turnover of AUD 20m or more will have a two-tiered research and development intensity (R&D spend compared to total business expense) framework, providing a premium intensity benefit of 8.5 percent above the corporate tax rate for research and development intensities up to 2 percent, and 16.5 percent above the corporate tax rate for intensities above 2 percent.

[61] https://www.jst.go.jp/sip/k03/sm4i/en/outline/about.html

[62] For example: https://www.nwo.nl/en/about-nwo/funding+lines

- Research infrastructure
- Realizing large-scale infrastructure
- Project Modules
- Personnel
- Researcher in training/PhD, postdoc, researcher, non-scientific personnel
- Materials
- Investments: infrastructure and data files
- Knowledge exchange
- Internationalisation
- Citizen Science

This kind of simplification is also found in the most recent approach in Australia's National Health and Medical Research Council, where, for example, budget items are simplified (and provided in detail after the grant is successful) and the salary costs for research staff are standardized as 'packages'.[63]

Size of the funding 'packet'

A common policy temptation in developing knowledge economies is to spread the (limited) available resources thinly. This can have the effect of creating research funding 'packets' at both the institutional and project level that are too small to result in any research of consequence.

This includes the problem of underfunding research infrastructure (whether laboratories and equipment or digital library resources).

So a key learning from mature knowledge economies is to create fewer funding 'packets', of larger size and longer duration. Larger packets of funding tend to have the effect of attracting serious research effort (although in mature systems, well-qualified people are not responding to financial incentives as such: they work according to their individual motivation and scientific interests)(Liefner 2005:486). If continued over very long periods of time, however, it is not clear that they result in decisively higher levels of research productivity or knowledge breakthroughs (e.g. Liefner, 2005:480). This 'large packet' mode of funding is sometimes criticized as disadvantaging early career researchers (e.g. Nurse, 2015: 13) or of strengthening legacy advantages within the system enjoyed by larger institutions – each country's equivalent of what in the UK is called the 'golden triangle) (Oxford, Cambridge and London)(Nurse, 2015:6).

The equity question of how to encourage researchers who are not yet competitive enough to earn those large packets can be addressed through universities' and research institutes' internal 'seed funding' schemes, if these are designed to help build individual and team capacity to compete for larger grants. The equity question of how to distribute funding throughout a national system is discussed below.

Competitive funding principles

Mature knowledge economies use peer-review and award funding (whether at the institutional or the project level) on the basis of competition. Even highly centralized knowledge systems such as Singapore's, which historically used government funding in a top-down style, have moved to competitive funding as the fundamental distribution method.[64] This is the case for both curiosity-led research and also for mission-oriented research.

The advantage of competitive funding are:

- A tendency to increase the quality and relevance of research project proposals;
- A way to ensure that research awards meet a minimum standard of quality;
- Providing researchers and opportunity to test their ideas among peers; and
- Building trust in the community that awards are made fairly (OECD, 2018:7)

The last of these factors is particularly important in developing knowledge economies.

Competitive funding also has disadvantages

- An increasing reliance on competitive funding can (but may not necessarily) result in shorter-term, lower-risk projects, rather than longer-term, higher-risk research;
- The resources and time burdens of applying for and reviewing competitive grants are not small; and the inability of researchers and institutions to do long-term planning because of uncertain future funding (OECD, 2018: 7)

A key recommendation of the OECD's comparison of competitive funding system design (2018) is that peer review makes funding schemes legitimate in the eyes

[63] For example: https://www.nhmrc.gov.au/funding/find-funding/ideas-grants

[64] For example: https://www.nrf.gov.sg/funding-grants/competitive-research-programme

of researchers; the costs of designing and administering competitive schemes are significant and so each design needs to efficient and to genuinely cost the time of researchers and institutions in applying for and managing competitive awards.

A typical requirement of competitions for 'large packets' of research funds is that they are conditioned on building teams that can carry out multidisciplinary, mission-oriented research that relates to a national need or social problem.[65] It is very common for these competitions to also require applicants to form consortia, and that those consortia include domestic universities, domestic research institutions, relevant industrial partners and international partners (e.g. Nurse, 2015: 8)

Distribution of research funding

Policy makers in developing knowledge economies often worry about how to distribute research funding in a way that is equitable, within a system where research institutions had very different profiles and opportunities. One way to address this is a staged introduction of full competitive funding.

For example, you can build capacity by focussing funding for Stage 1 on PhD scholarships and postdoctoral fellowships for a period of, say, five years. This may also include funding for regional Doctoral Training Centres, to promote domestic collaboration and support institutions that would struggle to offer doctoral training in one or more disciplines at a nationally competitive level. At Stage 2, funds are allocated to a competitive funding stream for early career researchers (as a 'follow-on' stage from PhD or postdoctoral work). This addresses the issue that most general competitive funding schemes will be harder for early career researchers to succeed in, simply because they have fewer publications and career achievements than more established researchers. That then enables those researchers to mature to Stage 3, which is participation in general, fully competitive funding.

Another, additional method is to build in a geographic or clustered status for institutions, so that within the system researchers from similarly-situated institutions compete against each other, rather than those from peak institutions.

A further way of building capacity into the system is to require all funding proposals for 'large packet' funding at the institutional or project level (e.g. for collaborative research centres) to include international partners (and thus build in competitive capacity through international networks).

Balance between 'curiosity driven' and mission-oriented research

Researchers and government both recognize that 'research is a continuum, where both curiosity-driven research / investigator-led and strategically-targeted research have their place' (Nurse, 2015:13). There is no single perfect ratio of how much government funding should be spent on 'bottom-up', curiosity-driven research and how much on 'top-down' directed (or mission-oriented research). Mature knowledge economies tend to adjust their funding allocations to these two categories in cycles : sometimes 60% in favour of managed or directed (mission oriented) research and sometimes 60% or 70% in favour of basic, or 'blue-sky' curiosity-driven research. Some proportion of funding also needs to target translation of research, but an observation by respondents to the UK study of its own Research Councils was that the more important goal is probably 'to connect activities by different actors across the full Technology Readiness Levels chain to most effectively exploit research' (Nurse, 2015:13). The same report also underscores the point that changes to the balance of a funding portfolio need to be made gradually – both to take account of planning made on the basis of the current system and to avoid the risk of over-specialization (if, for example, funding starts to align very closely with government research priorities)(Nurse, 2015:13). Research breadth and the ability to respond to new societal challenges from a wide range of disciplines is also a national strength.

At the moment in Australia, the ratio is about 60:40 for mission-oriented research or research that is intended to explicitly respond to national research priorities. The suggestion is that, in developing knowledge economies, the balance of funding should be in favour of directed research or research that speaks to the national research priorities. But this assumes that the national research priorities are genuinely mission-oriented and likely to result in meaningful, transformative research. This makes the process and outcomes of setting national research mission priorities critically important.

[65] For example: https://www.nrf.gov.sg/funding-grants/competitive-research-programme

Concentration of research funding

There is no conclusive research that shows that consistently funding a smaller number of research actors ('backing winners') producers' better outcomes in the long term (Aagaard et al, 2020a). By 'better outcomes' we mean measurably efficient use of research investment, demonstrated through outputs such as highly-cited internationally peer-reviewed outputs and patents. While it is the case that having secure research funding of the right scale can make an institution or a team more competitive internationally (and thus more likely to continue to win research grants), there is a risk that it can also blunt their innovation and productivity over time. Beyond a certain point, a systematic review of empirical research funds concentration of funding leads to decreasing marginal returns (measured by the number of citations and impact factors)(Aagaard et al, 2020a:126). This is why competitive funding is important and why funding to 'centres of excellence' or 'collaborative centres' is usually time limited.[66]

Some studies of research funding efficiency suggest that distributing funds more widely, on a competitive basis, is more likely to result in high quality outputs (if we assume that not all of a country's research talent is located in a small number or institutions or teams) (Aagaard et al, 2020a). However, at the same time, establishing and operating a competitive funding scheme is itself a system cost, and so the question is how to do that most economically at the national level (OECD, 2018), which is why mature knowledge economies are seriously implementing simplified funding schemes, application procedures and budget frameworks.

Efficiency of funding governance

Internationally, governments are not very effective at assessing and critiquing the efficiency of the policies and institutional governance that they create. We get some sense of that, however, in evaluative reports such as Nurse (2015), where research system actors describe the funding landscape as complex and the need for consistent, standardised and streamlined process and systems for managing funding schemes across multiple research councils (2015: 15). The UKRI umbrella that is then created over the research councils in 2018 promises ' We will ensure that both funding and investment services for industry and academic are effective. We will ensure that we are an organisation that is easy to deal with. We will develop our processes and our people to ensure the successful delivery of the Industrial Strategy Challenge Fund and Strategic Priorities funds …[because] there is a complex landscape of legacy information technology systems and approaches across the organisations forming UKRI' (2018:49). In other words, if you had the opportunity to build a research funding scheme, you would probably try to keep it streamlined and make one or two key institutions responsible for its governance and ensure that their systems and processes were interoperable, consistent and aligned. The moment Indonesia's research and development expenditures are efficient in comparison to many of tis ASEAN peers (Dobrzanski and Bobowski, 2000), but that is largely because the total investment is small and the outputs (int eh form of patents and cited papers) are also small.

3.2 Government funding for research and development in Indonesia

Mature knowledge economies all developed on the basis of strong funding support from government. Gross expenditure on research and development (GERD) by Indonesia in 2016 was IDR 24.92 trillion and this had increased to IDR 30 trillion by the end of 2019. This increase looks positive, but the funds came from the national education budget -- which means that Indonesia had not established a separate fund for supporting research. This changed to 2019, when in accordance with article 59 of Law No. 11 of 2019 on National System of Science and Technology (the Sisnas Iptek Law), the government established a research endowment fund.

In announcing this in 2019, Finance Minister Sri Mulyani outlined a plan to increase the IDR 990 billion budgeted in 2019 from the state budget (APBN) for the Endowment Fund to IDR 5 trillion in 2020. Actual expenditure of those amounts was subsequently affected by the COVID-19 pandemic. Nevertheless, the total budget remains relatively low compared to the research funds allocated by peer knowledge economies.

[66] In Australia two funding cycles of 7 years each for a Centre of Excellence would be a maximum of 14 years.

TABLE 3.1 **GERD COMPARISONS**[a]

	GERD AS A PERCENTAGE OF GDP						
	2013	2014	2015	2016	2017	2018	2019
Australia	2.2		1.9		1.9		
Indonesia	**0.1**			**0.2**	**0.2**	**0.2**	**0.3**
Japan	3.3	3.4	3.3	3.2	3.2	3.3	3.5
Malaysia		1.3	1.3	1.4			0.4
Singapore	1.9	2.1	2.2	2.1	1.9		
Thailand	0.4	0.5	0.6	0.8	1.0		
Vietnam	0.4		0.4		0.5		

[a] Data extracted on 25 Sep 2020 08:10 UTC (GMT) from http://data.uis.unesco.org

The issues related to research funding in Indonesia are not new. Interviewees in this study raised questions of funding effectiveness and efficiency. Everyone is disappointed that the government's investment in research funding is currently far short of 1% of GDP. They are even more disappointed that the results of recent funding injections are not clear. This points to the need to further review the measurements actually used for assessing the effectiveness and efficiency of government research funding in Indonesia. For example, if we look at the breakdown of the budget used as research funds, we find that the amount used for research activities is no more than 50% of the total funds available (Katadata, 2019). A considerable proportion of research funds in Indonesia are still used to cover operational costs, science and technology services expenditure, capital expenditure, and education and training.

This also raises the question of why earlier studies for government that recommend ways to make research funds more 'fruitful' have been ignored.

Management of research funds

The amount that Indonesia budgets for research and development as a percentage of its GDP is one issue – how it manages those funds is another. Management of the research budget emerged in this study as the main obstacle to optimum use and absorption of research funds.

Currently, there are many agencies that have the authority to regulate and manage government funding for research. Initially these funds were distributed to research and development divisions of government, which are spread across various Ministries/institutions. These are primarily run by the (now) Ministry of Research and Technology (*Ristek*)/the National Research and Innovation Agency (BRIN) and the Higher Education Directorate General of the Ministry of Education and Culture (*Kemendikbud Dikti*). Major non-ministerial government agencies (LPNK) that receive the research funds include:

- the Indonesian Institute of Sciences (LIPI);
- the National Nuclear Energy Agency (BATAN);
- the Nuclear Energy Regulatory Agency (Bapeten);
- the Agency for the Assessment and Application of Technology (BPPT);
- the National Institute of Aeronautics and Space (LAPAN); and
- the National Standardization Agency (BSN).

Given that the amount of the budget is limited to begin with, when it is distributed to those research and development agencies, the amount that each agency manages is not large. This has a direct effect on the quantity and quality of outputs that the institution can produce.

Strengthening and streamlining the Indonesian system

In Indonesia, the state budget (APBN) is drafted by the Ministry of Finance every year, and then the research funding component of this is carried out by Ministries/institutions that have the function and authority to manage research funds. Each Ministry/institution is required to propose a plan for its budget for the following year. According to the Directorate General of Budget (DJA), Ministry of Finance[67] the small total of the budget available for research is also the result of budget proposals submitted by various Ministries/institutions. The DJA of the Ministry of Finance does not itself have the right to propose the budget amount; they only review and approve the proposals.

This course of action often leads to clashes between Ministries/institutions, who feel that their budgets are inadequate, but the Ministry of Finance maintains that it adheres to its main duties and functions in budget planning. On the other hand, other Ministries/institutions feel that they do not have any power to receive budgets of a scale that would give them freedom to deliver excellent research implementation.

[67] Interviewee 015

It is also possible that the small size of research budgets is a consequence of individual Ministries/institutions simply collating diverse internal budget requests without prioritizing them or without linking them to the national research priorities (discussed in Section 1 of this report). These gaps in communication and perception suggest a lack of clear coordination within and between Ministries/institutions; possibly some lack of trust in each other's processes and capabilities; and problems with the national research priorities.

Making budgets too small

The effect of this style of budget-setting is that, at the individual researcher level, research quality always has to be compromised and adjusted to the amount of the available funds:

> *[B]udget allocation or research, development, assessment and/or application (Litbangjirap) activities are scattered across almost all Ministries/Institutions. So, I guess, indeed, for Ministries whose core business concerns Litbangjirap and LIPI and BPPT and maybe the Ministry of Research and Technology, they do receive large budgets, but on the other hand there are Ministries that have research and development (R&D) bodies. Some of these bodies do have substantial funds, such as those belonging to the Ministries of Health, of Agriculture, etc, but for R&D bodies of other Ministries, their funds are relatively small. The reason for their small budgets is not due to the government's decision to distribute only small amounts of funds to them, but as stated earlier, it is due to the Ministries' working plans, and their plans for Litbangjirap activities that do not match with the scales of national priorities, that is my guess, so their planned activities are considered as downright marginal, simply a kind of supporting activity. - Interview 025*

This process leads to a vicious cycle. The Ministry of Finance focusses on analyzing the inflow and outflow of state funds, and so may not consider the purpose of the budget in detail. Research budgets are conceptualized as funds to be spent on tangible items. As one interviewee explained, research can be measured or evaluated based on its output, outcome, or even its impact.[68] The current method employed by the Ministry of Finance is output-based evaluation. The Ministry looks at the use of the budgeted funds based on the research outputs (which include journals, publications, citations, prototypes, or products). These quantitative criteria are currently used to judge whether the research investment is a success or not. One consequence is that it could hamper exploration of some types of more basic research, or assess them as non-productive, where no tangible outputs are produced within the budget period.

This style of quantitative measurement is understandable, given Indonesia's low level of research productivity, but it does not take account of research quality – or of its impact – and so is not optimal for supporting future forms of research. The unintended effect may be to depress both supply and demand for government research funding and to reinforce the idea that research budgets have a low priority. This in turn can be a negative influence on the overall research ecosystem. As we saw in the discussion of mature knowledge economies above, 'large packets' of funding tend to have the effect of stimulating serious research proposals. They work best when the schemes offered can be flexible and are designed to support basic research and curiosity-driven research (as well as mission-oriented research) over time frames longer than an annual budget cycle. Research that aims to tackle complex problems needs this mode of funding.

Budget opacity

Public records of how the government budget is allocated to research are difficult to access in Indonesia: there are no actual figures or percentages on how the specified budget was spent. It is also very difficult to determine, on the basis of public documents, what percentage of current research budgets are spent on what types of research. The existing allocation does not specifically state the amount allocated to basic research in comparison with applied research, and whether there is a policy view about whether one of these should be larger than the other. When the research budgets is allocated government research and development agencies (balitbang) and non-ministerial government agencies (LPNK) – as it tends to be – we need to take a closer look at the financial reports of those respective bodies. This quantitative analysis is outside the scope of the study for this report.

[68] Interviewee 25

Nevertheless, we can get a sense of how research priorities are viewed from a budget standpoint by looking at the 2017-2045 National Research Master Plan (RIRN), which identifies macro research groups (or priority groups) based on research areas that are classified by three aspects: economic added value; leverage; and level of complexity. These priorities are then broken down into six macro research groups:

- Natural Resource-based Applied Research (RT-SDA)
- Natural Resource-based Advanced Research (RM-SDA)
- Manufacturing Applied Research (RTM)
- Manufacturing Advanced Research (RMM)
- High Technology Research (RTT)
- Advanced pioneering Research (RRT)

Each macro research group has a score, correlated with the percentage of the budget allocated to it. These scores are assigned a numerical sequence, 1-2-3-4-5-6, which correlate to 40%, 20%, 15%, 12.5%, 7.5% and 5% respectively of the total budget. For example, for the 2017-2019 period, the National Research Master Plan (RIRN) set RT-SDA as the first priority, so it was entitled to a 40% budget allocation. The priority scores will keep changing during the period of 2017– 2045, so their budget percentages will also change. By the end of the RIRN period, RT-SDA is targeted to be the sixth priority with 7.5% of the budget, and RRT is scheduled to be the main priority, with 40% of the total budget. In practice, this planned budget implementation for these priority sectors may also change.

The allocations expressed in the RIRN document may help to guide the distribution of research funding in the long term, but the implementation relies on strong cooperation among Ministries/institutions, under the coordination of the (new) National Research and Innovation Agency (BRIN).

The RIRN can also serve as a reference document to accommodate many types of research and development. However, at the moment, the RIRN reveals that Indonesia still views applied research, rather than the basic research, as its main priority. It also clearly shows that 'research' in Indonesia for the purposes of national planning leans heavily toward hard science and seems to exclude social science and the humanities (see also Siregar, 2020).

> *Basic research and applied research need to be complimentary and do not negate each other. However, both types of research cannot be conducted by separate institutions because there needs to be one main objective that later can be broken down into various supporting researches orientate towards the same direction. - Interviewee 012*

This kind of macro-level notional allocation of future budgets also tells us nothing about the way in which agencies managing research budgets identify their priorities and allocate budget internally for certain types of research. The Agency for the Assessment and Application of Technology (BPPT), for example, is in theory focuses more on developing applied research, but we do not have insight into its internal funding priorities; the same is true of the Indonesian Institute of Sciences (LIPI), as well as research and development divisions of Ministries/institutions (K/L).

Collating and tracking that institutional-level research budget data would be useful for helping to evaluate what types of research funding may needed in the years ahead, and also for creating a feedback loop with the Ministry of Finance, so that it can see what improvements to its own and others' budget patterns may be needed.

Better budget management

President Joko Widodo began his policy overhaul of Indonesia's research and development by stating that the (national) quantity of research funds was big, but its results were nowhere to be seen. This is what prompted the establishment of the National Research and Innovation Agency (BRIN), which was mandated by the 2019 Law on National System of Science and Technology (the Sisnas Iptek Law).

> *[O]ur focus is not only to increase the budget allocated for research, but also to make the research budget more effective and so it can bring concrete results, concrete benefits, and we have to immediately put an end to the overlapping research agenda, which has squandered the budget. The research budget, which is still spread across ministries and institutions, when combined with the right roadmap, will produce measurable output and outcome that will be highly beneficial for the advancement of our country" - Joko Widodo, in his speech delivered before the limited*

meeting on strategies for research and innovation development and the structuring of the National Research and Innovation Agency, Jakarta, 11 December 2019.

This concern about funding overlaps became the basis for the establishment of the National Research and Innovation Agency (BRIN) – where in his speech, President Widodo stated, "[L]ater, we will need a large agency that manages all research funding, in order to make it more effective." This seems to assume that the 'large amount' of research funds becomes small when it has to be distributed to Ministries/institutions that have research and development divisions. However, the plan to establish such an agency came with many pros and cons, and potentially unintended consequences. As the idea of the establishment of this agency developed, it was no longer focused on its role as manager of the funding, but often reinterpreted as a measure to merge all research bodies within Ministries/ institutions. The process to establish an agency with that broader mandate would take a significant amount of time, and many parties wished to have the plan reviewed.

Regardless of how BRIN's mandate and anatomy evolve, effective funding that aims to support the spirit of research and development is needed to break the chain of problems in the research ecosystem in Indonesia. It is possible to achieve this goal, through strategic coordination among the Ministry of Finance, the Ministry of National Development Planning/the National Development Planning Agency (Bappenas), the Ministry of Research and Technology/the National Research and Innovation Agency (BRIN) and related institutions. There is an urgent need to get research into the agenda of the medium-term and long-term development plans, and for each of these regulatory actors to advocate for that. Without better research budget management, research results that lead to accelerated national development will remain a distant dream.

3.3 Research endowment fund

Unlike the research funds that come from the state budget (APBN) as annual allocations, the new research endowment fund is managed under a different mechanism. The endowment fund is not tied to the state budget and this gives the party which manages it wide latitude, because the use of the funds is not limited by the fiscal year. LPDP is the public service agency (or BLU) that is authorized to manage the Endowment Fund for Education. It has been over 10 years since LPDP received the mandate directly from the Ministry of Finance to manage education funds taken from the in the state budget. Since then, the funds managed by LPDP have been used for various needs, mainly to award scholarships to students who will pursue postgraduate studies or doctoral degrees at universities in Indonesia or abroad. LPDP also awards research grants under several schemes.

Endowment funds are a good policy solution for managing budgets for research needs. The principal amount that is kept intact yields investment income that can be used for long-term research needs. If the endowment funds are invested well and if the market cooperates, the draw-down of available funds should increase every year, so making the mechanism sustainable. Another benefit is a more flexible spending scheme. Research grants awarded from an endowment fund are not constrained by the fiscal year, so the grants can be multi-year and the researchers have some flexibility about when to spend those funds within the project timeline.

As we saw earlier, the amount of the research endowment fund is projected to increase every year. However, as yet there is no confirmation of who will manage the fund and the mechanism for its use. The directive in Law No. 11 of 2019 on the establishment of a National Research and Innovation Agency (BRIN) has triggered speculation that one of the agency's duties would be to manage the research endowment fund. At the time of the writing, the outcome of the government's design for BRIN is not known.

Possible roles for BRIN in research fund management

Interviewees in this project discussed different possible roles for the National Research and Innovation Agency (BRIN) in relation to research funds management and research governance. Each of the proposed roles (or models) was a slightly different combination of functions that are usually performed by a research funding body. Those functions, in the different combinations identified by interviewees, are set out in the Table 3.2.

TABLE 3.2 **POSSIBLE KEY FUNCTIONS FOR BRIN GERD COMPARISONS**[a]

NATIONAL RESEARCH AND INNOVATION AGENCY (BRIN)	POSSIBLE SHORT-MEDIUM TERM ROLES FOR BRIN				FUTURE NATIONAL RESEARCH COUNCIL OR AGENCY
	MODEL A	MODEL B	MODEL C	MODEL D	FUNCTIONALLY INDEPENDENT (DISCUSSED IN SECTION 6, THIS REPORT)
Sets research strategies and directions					in collaboration with other actors in the knowledge ecosystem
Manages research funds	Performed by another agency	Performed by another agency	Performed by another agency		Manages its annual budget allocation from endowments and other sources; not responsible for investing endowment funds
Announcing funding schemes to eligible research institutions and individuals					
Submits funding proposals to the institution that manages the research funds					Submits annual funding proposal directly to government
Runs competitive selection processes for funding schemes					
Selects successful proposals					
Awards competitive funds to successful grant applicants					
Distributes research funds to Ministries/institutions (K/L)					Institutional funds for Ministries/ institutions (K/L) are either direct budget allocations by their supervising agency or (ideally) awarded on a partially competitive basis. Project funding is awarded competitively by the national research council/agency.
Responsible for receiving reports on use of research funds			Performed by another agency		
Assesses outputs and impact of funded research					

[a] Data tabulated from multiple interviewee responses in this study

As we show in the right hand side of the table and discuss in more detail in Section 6 of this report, most mature knowledge systems have national research agencies that become functionally independent from government over time. This also prevents the conflict of interest that arises if an agency is administering a competitive funding system but is also required to oversee (and fund) one or more government research institutions being funded from the same budget.

3.4 Access to the Research Endowment Fund

A crucial matter concerning the research endowment fund is its allocation. Currently, government research funding from the state budget (non-endowment) is provided directly by the Ministry of Finance to Ministries/institutions that perform Ministry-specific or sector-specific research and development functions. By contrast, the research endowment fund is expected to facilitate more inclusive research projects. Most participants in this study said that the research endowment fund should be made accessible to anyone, whether government or non-government, and whether individual researchers or teams.

Non-government policy research institutes (PRIs), for example, want access to this endowment fund scheme because they frequently conduct studies and policy analyses for government and make recommendations that benefit government policymaking. Policy research institutes (PRIs) are relatively new in Indonesia and their funding base is insecure. Their view is that, to date, the grants or the competitive funding that they had received have more often came from international donors than from the Indonesian government. When government does provide funding, the amounts are frequently small and do not cover their personnel costs. Unlike Ministries/institutions whose researchers hold civil servant (PNS) status, the PRIs struggle to pay their researchers from grants they receive. Research conducted within Ministries/institutions is subsidized in the sense that salaries are met as part of the recurrent budget, so research funds can be fully used for covering research. PRIs seek access to this scheme in order to support more advanced research processes and quality

Efficient utilization of research funds

Indonesia has multi-year funding schemes that in theory enable researchers to conduct research over a flexible timeline.[69] In practice, this is still not well understood (or its implementation is lacking). Researchers still complain that they could not continue their research unless there are tangible results after the first year and that this evaluation should not be overly rigid.[70] However, without this, those who manage these funds consider that the research project had failed to meet the required deliverables and no longer qualifies for support. The perverse outcome here may be that researchers prefer the certainty of short-term research schemes (that run within the fiscal year).

One step that the government can take to support the researchers is moving to output-based research schemes. What these researchers are calling 'output-based' schemes is the research funding design that is in place in most mature knowledge systems: the financial reporting and report on the research outputs is done primarily when the project is finished; annual reports are fairly brief and the annual financial report that accompanies this is prepared by the receiving institution (or where funds are managed directly by, say, a philanthropic foundation, internally) – rather than by the researcher.

> *Output based: [H]opefully the paradigm shift from process-based research to an output-based one will not cause any problems for researchers, indeed, that is what they have been complaining about. We spend maybe around 70% of our energies on financial reports, more than what we put in the research itself. Yes, that is the complaint that the researchers have. But we are not decision makers, so that is what we have to do. If the funds came from non-tax revenue (PNBP), which is always referred to the Finance Ministry Regulation, then indeed, we still will… but hopefully, in the future, when research is based on output, the situation will be easier for researchers. - Interview 022*

3.5 Institutional funding v competitive funding

There has been endless discussion about institutional funding versus competitive funding in Indonesia. In this study almost all of the participants spontaneously nominated competitive research funding as their preference. They saw competitive funding as more attractive because it could help them achieve the desired research quality. Competition makes research teams develop and write the best research proposal that they can, because they have to convince a funder. The more active and more competitive the research team, the more likely it would be to win funding.

[69] Available since 2018, through Perpres 16/2018

[70] Interviewee 25

The problem in Indonesia today is that research funding is distributed to Ministries/institutions that have research and development divisions, which are assigned the task of conducting research. Recurrent funding that is virtually automatic – and that must be used within the fiscal year -- often diminishes the researchers' level of effort. Interviewees noted that their research plans, in particular, do not need to be of high quality. It would be very different if they were competing for those research funds; the poor-quality proposals would simply be thrown out. Exposure to competition could trigger positive changes in capable researchers; they might be incentivized to improve their quality. We note however, that simply introducing a requirement of competitive funding cannot change the fundamental problem identified in Section 4 below – that many civil servants occupy 'research' positions but are not actually skilled or specialized in research.

All interviewees in this study said that the competition for research funding should also require teams to consist of researchers from various academic disciplines (multidisciplinary teams). The presence of heterogeneous research teams would lead to diverse research perspectives, which could offer more inclusive points of view. For example, research on innovation in rice hullers, besides requiring machinery experts, certainly also needs researchers from the social sciences who can provide input on how this machine should be created, by taking into account the characters of its potential users. Those team members with social science backgrounds can also provide input concerning marketing, so when this machine is ready for mass production, there will demand and a positive reception from its potential users.

Competitive schemes requiring involvement of teams of researchers from various academic disciplines, are expected to produce more competitive, better quality research processes and better applied outcomes.

Making competition open and fair

Is it necessary to design competition schemes for every type of research funding in Indonesia? Probably not. Interviewees in this study noted that the downside of a competitive funding system would be that it would be dominated by experienced and credible institutions or researchers. Rigorous competition could raise the quality of research results, but this would not contribute to the quality improvement of the researchers and institutions with less strength or experience. For example, state universities with legal entity status (PTN BH), whose researchers are experienced and enjoy easy access to research facilities, and so are have a competitive edge over state universities with working unit status (PTN Satker). This structural inequality still requires system repair at the national level.

One solution to boosting competitiveness through research funding might be to design schemes that consists of several tiers and several schemes. One scheme might prioritize research (projects) that aim for high quality, with credible and seasoned researchers, but be tiered so that applicants from similar institutions are clustered together at the same level of the competition. Another might be focussed on raising the quality of young researchers and affirmation for institutions in 3T regions (the outermost, frontline, and disadvantaged regions). Under tiered funding schemes, one will be able to see healthy rivalries in the competition arena. Each participant and scheme are selected according to their respective tiers, so there will be more opportunities for each researcher to conduct his/her research.

> *Maybe in the current situation, if we offer funding through a competitive process the funding will be won… today, our top researchers usually include those working on palm oil and economic issues, and the funding will just fall into their hands once again. On the other hand, the national strategies that we need now include, for example, those on pharmacy and vaccine. Well, this is an affirmation. So actually, instead of competition we affirm that funding is open for such and such fields. That is our view. Yes, the main idea is competition, but there is also room for affirmation. - Interview 025*

Interviewees also agreed that not all research funding can be awarded through competition, and some research funds still had to be provided directly to institutions. Some types of research, such as research on state defence (conducted by the Ministry of Defence) or concerning state strategic research projects are highly confidential and many not need to be opened up to competition. Even so, interviewees supported better long-term planning to determine the types of research that actually qualify or direct, non-competitive funding from the government, as well as greater transparency about their award. Indeed, to be able to set research planning, the state also needed research and data collection that were comprehensive and managed systematically, in order to conduct more focused research mapping.

Operating costs vs. research costs

Efforts to optimize research budget are often hindered by allocation of the budget itself in the course of the research implementation. For instance, in universities, when a research grant is awarded for a fiscal year, the larger portion of this is often allocated to operational costs, rather than to the costs of the research itself. Research processes certainly require administrative support that cannot be performed by the researchers themselves. In large-scale research projects, the research teams often need help from additional personnel, who should be compensated adequately.

The research budgets provided by the Indonesian government have a detailed scheme for permitted expenditure. They usually specify the percentages or the maximum amount of funds to be used for capital expenditure on services, on consumables, laboratory and/or equipment rent, review costs, and printing. A key limitation of research grants from Ministries is that they cannot be utilized for capital costs (such as Equipment), only for materials. The ceiling imposed on each of these expenses is designed as a guide for researchers, so they can use their budget as needed and not use it for other purposes. The drawback of applying such ceilings is that researchers often encounter obstacles in the field, as well as the costs to address them, but these costs are either not covered by the scope of this funding, or the funding formula is too rigid to allow for variations of the budget.

University researcher interviewees in this study candidly disclosed that they manipulate their reports on how they spent their budgets. One interviewee described the way to work around this problem as two sets of reports. The first one was a financial report that followed the stipulations set by the funder. This one was made to meet administrative and audit demands. He also had a separate book that recorded all expenditure of funds in accordance with the situation in the field, and this book showed a different record from that of the first one. This was done to observe his moral accountability to fellow researchers.

One Interviewee said that the amount of the research funds did not favour researchers located far away from research facilities. In his regional location, if they wanted to conduct testing on samples, sometimes they had to send the specimens to laboratories located in Java, due to lack of local facilities. Just getting results from the sample testing was already very expensive, but he reported that such costs could not be entered into the research budget.[71] To produce the best research, he would need the capacity to conduct such testing himself, but the capital expenditure required is a structural problem that cannot be addressed through an individual research grant; it requires support from universities, local governments, and also the central government.

In the examples above we see some of the effects of inadequate research budgets, including projects being trimmed to fit the budget, with an impact on quality and the differential treatment of researchers in regional locations.

[71] Interviewee 02

4

DEPLOYING RESEARCHER HUMAN CAPITAL EFFICIENTLY, EFFECTIVELY AND RESPONSIVELY

4.1 Human capital and national research capacity

The most important element in national capacity for research and development is the quality of human capital – this is why numerical indicators such as qualifications and number of researchers are used to evaluate national research competitiveness. An equally important issue is how those researchers are created, developed and deployed across research-producing and research-consuming institutions. Their numbers and the way that they are deployed across an economy is a factor that determines national 'absorption capacity' for research and innovation (e.g. Ambashi, 2017:226).

Universities play a vital role in creating the talent pool of future researchers. Thus, this section draws on data from universities at the individual academic staff member level and at the institutional level to ask whether and how Indonesia is producing the kind of high-quality, competitive researchers who will drive its future research and development. It also draws on interviews with researchers based at policy research institutes (PRIs) and in government research institutes.

4.2 Establishing quality research human capital: international best practices

Mature knowledge economies have shifted, over the past 30 years or so, from having researchers and institutions that worked in a relatively autonomous way, to a researcher 'workforce' that is now much more directed and that works within a higher education and research environment that is heavily regulated. The technocratic aspects of this regulation, including demands that researchers be productive and efficient is often criticised as the 'corporatization' of the university (and other research institutions). It is a direct consequence of 'new public management' ideas about how to make public expenditure on public goods such as research and development, more accountable. Whether the regulatory frameworks achieve those goals is intensely debated within each national system.

The top-ranked research institutions (universities, government research institutes and private sector think tanks) in mature knowledge economies in Europe, as well as the United State, the UK and Australia share some key features in how they develop and deploy their human capital. The following sections briefly outline those institutional design features as they apply in the countries that we have identified in this report as mature knowledge economies.

PhD as basic qualification

A key predictor of research and development quality is the capacity of the researcher who is producing it. The most efficient way to control researcher quality is at the point of entry - first but creating high quality PhD training programs that align with national research priority areas and curiosity-led research and second, by requiring entry-level researchers to have PhDs from high quality institutions.

Universities and research institutes generally will not appoint a researcher who does not hold a PhD (or equivalent professional qualification and experience in fields such as law or medicine). PhDs are increasingly important for government employees as well: many countries now have schemes that allow talented government policy makers to study for a PhD part time or full time, to enhance their professional capacities.

The PhD qualification, regardless of discipline, is seen as the process through which researchers learn the techniques and norms of research for their own field or discipline. On average that that training takes about 4 years (sometimes longer in the United States and Europe) and typically includes formal training in research methods important for that field (experimental, qualitative, quantitative and/or mixed); research design; research ethics; and writing and publication. PhD students may also receive practical training through, for example, working in a laboratory environment under the supervision of postdoctoral researchers and senior team leaders, or in fieldwork as part of a team led by a senior researcher. Some of their training will be in how to manage the everyday tasks of large-scale research, research reporting and publication.

The convention in many disciplines is that the PhD supervisor will co-author one or more journal articles with the student during her PhD candidature, as a way of reinforcing good writing and publication practices, but also to contribute to a publication profile for the emerging researcher, helping to make them competitive in the academic job market. Practices differ across countries, but in markets with relatively high mobility PhD students after graduation tend move to a new institution for a postdoctoral position, or to a new employer.

Research training

Universities and research institutions provide continuous professional development and research training for researchers in two ways. The first is targeted support for postdoctoral researchers or early career researchers. The second is continuous training for researchers at all levels, to take account of changes in the field of knowledge, research technology and government policy. 'Research training' here means not only the technical skill required to design and carry out an experiment or empirical social science research, but the full set of skills required to secure funding for the project at the beginning and then publish and then communicate the results and significance to a public audience at the end.

Research training is typically a mix of informal, peer-led activities and formal institution-led activities. Examples from top-level institutions might include:

Research project design

- Workshops to review peer researchers' draft grant proposals and research designs
- Larger meetings to review and workshop large scale research collaborations
- Rehearsals to present large-scale collaborative designs to government or business partners

Data management

- Training on digital resources and data management software [often by libraries and librarians]
- Professional guidance about grant application requirements and designing research budgets

Writing and publication

- Events or workshops at which participants write journal articles in a concentrated way (writing retreats)
- Workshops on how to write and publica academic blogs
- Workshops to present new ideas for projects to their peers for critical review
- regular presentations by researchers within the group, or from or invited from outside, to report on latest developments in their field or to present the results of a project 'pre- publication'

PhD training

- Courses in research methods and design
- in research ethics
- Thesis proposal review events, where a whole Department or discipline group will gather 2 support and critique PhD candidates who are presenting early or mid-project or end of project reports on their PhD research
- 'Three-minute thesis' competitions, in which PhD students present their project publically; designed to build the ability to explain a complex project to a non-specialist audience in a quick and engaging way (in the United States sometimes called the 'elevator pitch' or what you say in an elevator when someone asks 'What do you work on?

Ethics and ethics training

Research accountability and integrity are now critical elements in how universities and research institutions conduct their work. At a minimum this includes requirements that:

Research integrity

- Individual researchers responsible for maintaining an accurate and true summary of their qualifications and research outputs
- Ethics approval is obtained for all projects that involve human subjects
- Research results reported accurately, in line with the conventions for that discipline;
- Researchers who contribute to a research report or publication named as authors and credited in proportion to their actual contribution; and
- Research complies with the OECD definition of research .

Ethics

- Research designed to minimize harm to or provide adequate protections where human beings are the subject of that research or will participate in it;
- In some cases, members of a group or community that are the subject of the research will participate in the co-design of the research and ensure that some benefit flows to the community;
- Research is designed to impose minimum burdens on participants and to actively avoid causing distress or trauma to participants;
- Research protocols ensure that participants in the research are fully informed about its purpose and use; and
- Research participants' consent is obtained before the research process commences and participants are given options for anonymity and confidentiality.

Research project design ethics requirements are sometimes criticised as applying a 'medical model' to research of all kinds; it is true contemporary research ethics had their origin in concern about protecting individuals participating in medical and pharmaceutical clinical trials as well as evidence of research carried out in the 20th century during wartime and in relation to vulnerable populations (e.g. indigenous or first peoples, or people with disabilities) that clearly violated fundamental human rights. The institutional review boards (IRB) in universities and medical research institutions in the United States and their equivalents in other countries developed in response to these problems. Current research ethics protocols and processes now make meaningful distinctions between high-risk research involving human subjects (e.g. clinical trials or research involving vulnerable groups) and low-risk research (e.g. where the participants are public officials or elites).

Academic freedom

The idea of academic freedom is that a competent researcher should be free to ask questions, to pursue their answers, and to debate these, regardless of whether the research question itself is popular or congenial to government, to business, or to other interests. This is a feature of universities and is institutionalized in the 'tenure system' which protects academics from being dismissed for reasons that might relate to their choice of research question. Although in practice, universities now employ significant numbers of researchers on contract, rather than in 'tenured' positions, the ideal of academic freedom and freedom of speech remains strong. The opposite considerations tend to apply for government agencies and private institutions – researchers employed there may have much less autonomy and may be bound by codes of conduct and/or employment contracts that prevent them from participating in public debate.

With freedom comes responsibility, and in recent years there has been an increased focus on the importance of ethics in design of research and in publishing. The ethical obligation of research is present a design and results that are robust and replicable, regardless of whether the project succeeded or not. It is also accepted that research designs need to take into account the rights and interests of 'human subjects', particularly vulnerable groups and other interests, such as those of the environment.

Codes of research ethics for particular disciplines or for national systems, are part of researcher communities', universities' and research institutions' attempt to demonstrate their duty of social responsibility to government and to the wider community.[72] The emphasis on research integrity may be weaker for government agencies and for private or non-government research institutions – this is also a significant point of difference between these research providers and universities.

[72] See for example, Australian Code for the Responsible Conduct of Research (2018): https://www.nhmrc.gov.au/about-us/publications/australian-code-responsible-conduct-research-2018; and the UK Code of Practice for Research: https://ukrio.org/publications/code-of-practice-for-research/

Performance reviews

Academic freedom does not mean freedom to work as the individual researcher wishes. An employer (university, government agency, private research institution), has legitimate expectations of researchers as employees. Those expectations typically found in a code of conduct and/or contract of employment. Employers regulate work through setting targets (or key performance indicators, KPIs); whether a researcher or their team has met their targets is assessed in an annual performance review. Annual performance reviews may have a direct impact on the researcher's salary; they will almost certainly affect his or her promotion prospects or the prospects for continuing their contract. Those individual performance targets are aggregated at higher levels to ensure that the right quantity and quality of work is being produced by the institution.

Career pathways

How researchers allocate their time depends on the kind of institution that they are employed in and the disciplinary area in which they work. As a general trend, universities in mature knowledge economies have, in the last decade or so, put greater emphasis on individual academic research performance (driven by the incentives of external research funding, government formula for institutional funding that are based in research output indicators, and the perceived prestige that flows from proprietary ranking systems). What that has led to is a relaxation of the older, fixed formulas for academics use their time.[73]

In universities, when a researcher or a team is successful in attracting large scale research funding, the usual consequence is that the members of that team are released from some of their other work to spend proportionately more time on research. They may stay in a 'research intensive' role for an extended period of time. Their teaching is either covered by a budget line in that external funding or absorbed by the university Faculty because the financial and non-financial benefits of the research grant are seen as more valuable.

Achieving an institutional-level balance is not easy; contemporary research institutions have to manage their human capital in a way that is flexible and yields maximum incentives for talented researchers and maximum returns to the institution (whether financial or reputational).

Promotion and career development

Researcher performance is evaluated through data, and promotion is the most important opportunity to do this after the initial appointment. In a well-designed promotion system, criteria promotion to each level in the system are announced in advance, evaluated by peers who are more senior in the system, and applied fairly. Most systems have quantity - and importantly, quality – criteria for research in that field. These criteria are gradually revised upwards over time. As a researcher gains seniority, they are expected to be internationally visible and internationally competitive, measured in quality of outputs, research funding success, and increasingly, impact of their research.

The fairness of promotion systems has been strongly debated in recent years. Most institutions now recognise that women are disadvantaged in their academic careers if they also have family responsibilities (such as caring for children or other relatives). There is also fairly clear evidence that women in many countries experience discrimination and sexual harassment in their research workplace (Bondestam and Lundquist, 2020).

The dramatically low number of women appointed at professorial levels in the STEM disciplines in the UK led to the development and adoption of the Athena Swan programme,[74] which is set of principles that are operationalized as an accreditation scheme. Universities and other research institutions that seek to be reviewed and accredited as conforming to the principles need to thoroughly review their institutional structures and practices to ensure that women researchers have equal access to appointment, professional development and promotion opportunities.

[73] In Australia the general formula is 40% teaching; 30% research; 30% administration or service.

[74] See: https://www.advance-he.ac.uk/equality-charters/athena-swan-charter#more. The Athena Swan programme has been adapted and adopted across Australia as the SAGE programme and is sponsored by the Australian Academy of Sciences (https://www.sciencegenderequity.org.au/the-athena-swan-accreditation-framework/.

The concept of 'relative to opportunity' is now routinely used to assess individual researcher performance -- for women this might include interruptions to a career for pregnancy or for childcare reasons. It might also relate to career interruptions for reasons of illness or relocation with a spouse/partner, or care responsibilities a family member, and these considerations could apply to either men or women.

Early career researchers

Having recruited high quality PhD graduates, research institutions in mature knowledge economies deliberately invest quite heavily in the first few years of a researcher's professional life. High quality institutions will provide a work environment that supports early career researchers in multiple ways, through:

- funding opportunities targeted for their career stage;
- research training opportunities;
- small budgets for field work and international travel opportunities;
- structured guidance on how to write high quality journal articles and develop a publishing strategy;
- mentoring that is additional to formal supervision (a senior researcher assigned to meets regularly with the researcher to answer questions and help them think through important choices in their work and career).

Because researchers are mobile in these economies, the good practices of the top institutions tend to become sector wide norms and workplace expectations of the researchers who are moving from one institution to another.

Retirement and workforce renewal

Labour market conditions differ by country; some have fixed retirement ages, and some prohibit mandatory retirement (to avoid age discrimination). Within research institutions, senior researchers are often at the peak of their productivity in the later years of their career, for example when leading research teams supported by large scale competitive research grants. Their citation rates also benefit from having a large body of work that is being read over many years.

Where a senior researcher remains productive, meeting the annual individual and institutional targets for their institution, there is no problem. But as research productivity declines (at whatever age), the institution needs flexibility to move that employee into a non-research or a less research -intensive role. Most institutions engage in planning to renew the workforce because employing early career researchers keeps the research ecosystem dynamic and reduces salary costs. Performance data matters for this kind of strategic planning. It is also critically important when the budget environment changes; if an institution needs to restructure or reduce its workforce, one criterion for that decision-making is the productivity of individual researchers or research teams. Government also plays a role in that strategic planning through research quality assessment exercises (described above in Section 2).

4.3 Indonesia's Research Human Capital

Recruitment

The quality of research institutions—both state and private—is inseparable from the quality of their internal human capital – the academic and administrative staff who support their operations. High quality staff make a research institution competitive, nationally and internationally levels. Building a cohort of high-quality researchers and research administrators begins with the recruitment process. In a system that is oriented towards high quality research, every research institution would want to recruit top people. However, Indonesia's system for recruiting and developing researchers is not designed to support that objective.

The majority of people in Indonesia who work as full-time or part-time researchers have a state civil apparatus (ASN) status. This is connected with the dominant presence of state research institutions in Indonesia; government institutions, including Ministries, non-Ministerial government agencies (LPNK) and state universities. Researchers employed at those institutions have a civil servant (PNS) status.

Recruitment rounds for civil servants are held concurrently across the nation and generally goes through the following stages (Figure 4.1):

FIGURE 4.1 **STAGES OF RECRUITMENT FOR INDONESIAN CIVIL SERVANTS**

This recruitment process is generic; all candidates undertake the same tests at the same time to become civil servants. Only at the final stage of recruitment can an agency influence the final selection (including whether a candidate is qualified or suitable to be a researcher).

Universities that belong to the independent cluster (those with legal entity status, or PTN BH) (discussed in Section 2, above) have the authority and freedom to recruit their own lecturers, researchers, and administrative staff. They are supported by funding that is more flexible, since they manage their funds independently and do not need to go through the red tape of the relevant Ministries. This recruitment freedom also enables those universities to decide their own recruitment process. They can define more detailed selection criteria and requirements, making it more likely that they can match candidates to their needs. Because they decide the timing of recruitment, those universities can, in theory, hire personnel with specific qualifications immediately. The contrast with the rigid timeline and process for government agencies is clear, but we should also note that this level of autonomy only applies to less than a dozen of the 63 state universities (see Section 2).

> *It is the same, [in Indonesia] by being a lecturer, you automatically become a researcher. So, researchers are recruited through the recruitment of lecturers. Once you are a lecturer, your job is to teach, to educate, then to conduct research, and perform community service [Tri Dharma Perguruan Tinggi]. Thus, that is how the recruitment works because according to the law, that is the task of individual*

researchers, not institutions. Later, if the task is handed over to institutions, indeed, there will be separate recruitment for educators and researchers, respectively. The portion for each task might be arranged, but for now, we cannot do that, because every lecturer has an obligation to conduct research, perform community service, and provide education. So, they are recruited as lecturers. – Interview 022

Policy research institutes (PRIs) have the most flexibility in their recruitment systems: PRIs such as SMERU, CSIS, and Prakarsa can set their own criteria and design their own, preferred recruitment process at times that suit their organizational strategy.

Indeed, one of my tasks is performing employment screening. I will certainly check an applicant's educational background, whether he/she has a master's degree, and also his/her previous research experience and I will ask about these matters in the interview." - Interview 011

Personally, I think one's background is highly influential, meaning that it is all right for an applicant to only have a bachelor's degree but he/she must have a lot of research experience. Or, if he/she has a master's degree, usually that means he/she has more in-depth research experience, which is also going to be one of the considerations when the organization wishes to recruit employees, especially for developing its research division. - Interview 011

Each style of recruitment process has its own strengths and weaknesses. What is clear, however, is that the long and costly recruitment undertaken as part of the government's general procurement of staff to the state civil apparatus (ASN) is not designed to pinpoint specialist skills, and may result in recruiting the wrong candidates, or those not suited to research roles. Many observers hope that recruitment for staff with civil servant (PNS) status will be decentralized in future. A better system for state institutions recruiting researchers would be if the procurement costs are covered by the state budget (APBN), but the control of the whole process is delegated to the institution seeking staff, with maximum flexibility in its implementation by each institution.

Managing civil servants

A side-effect of the current government recruitment process is the appointment of people who are not suited to research roles, but who – because of their PNS status – have become 'immune' to the situation. However, no follow-up action can be taken, even to simply move them to another division, which fits better with their fields and capacity, because of the complicated, bureaucratic way in which civil servants are managed. Removing them from their institutions is usually not an option: the authority to manage civil servants does not automatically become part of the responsibility of the institutions where they work; instead, it is the government's duty to manage them.

Yes, it is a trap that will make that institution suffer for years. Now, this is the root cause of many problems in a lot of institutions, especially state universities, which have long performed recruitment that is, well, less than excellent. They are not wrong, but they have not made maximum efforts, probably because many recruitment staff were approached by family members who asked for a favour etc.. So, they recruited the wrong candidates, people who did not have the right motivation. - Interview 012

A second, and important, issue is that universities, in particular, have not been able to create research-intensive roles or pathways for their academic staff. Formal provisions concerning this functional position of lecturer seem to tie them to the tri dharma division of time. An interviewee comments:

So, actually, based on the results of our evaluation for the last 5 years, we will need a lot of such researchers, researchers who are not lecturers but who are career researchers. But so far government rules have not allowed universities to have career researchers… [I]f we do not have that [career pathways for researchers] in the future, ITB will not be able to go further either, because the number of its personnel will not increase. So, I think, we do need career researchers to work there, in addition to lecturers. - Interview 020.

4.4 Human Capital Development

To deal with personnel whose capacities do not match the positions they hold, research institutions set up human resources development divisions. The name of this division may vary from one institution to another, but its presence has become a mandatory element in efforts to hone the skills of researchers at both government agencies and private organizations.

In universities, the programs to develop the capacity of researchers are managed by the LPPM (research and community institutes). The activities of the LPPM include planning for research projects, managing research funds, and taking care of research administration. Beyond those activities, research and community institutes at various state universities also provide services for building human resources capacity, as follows:

- Training on how to write research proposals
- Training on how to write scientific journals
- Socialization on research grants
- Socialization on intellectual property rights (IPR)

From that list, we can see that, in general, efforts to build the capacity of researchers are still limited to the administrative or basic task level and technical or 'hard' skills. More comprehensive support, such as developing the soft skills to become more independent and competitive researchers, are not yet available.

> *LPPM used to have programs, too, about how to develop proposals, especially for young lecturers, because their proposals have to be competitive and excellent, and the programs also provided guidance [pembinaan] to those lecturers. For senior researchers, such programs were usually orientated towards research output, about how to write international publications. There were also programs that accommodate the UB [Universitas Brawijaya] level, which provided support [pendampingan] for them as well. We have a journal clinic too, and for information about how to file patents on research results, we have an IPR [Intellectual Property Rights] centre that also provides guidance. Moreover, we give support to researchers when they prepare the applications. - Interview 024*

LPPM interviewees agreed that their capacity and scope of work in building researchers' capacity were limited to socialization and giving training that tends to focus on hard skills. Further, they revealed that at university level, rectors have their own human resources development programs, which lie beyond the LPPM's authority. Beyond those university-level programs, there are more training activities held at faculty and department levels, or even training conducted by focus groups (communities of researchers who have interests in the same fields). Interviewees commented that the capacity building efforts at this micro level do answer researchers' needs better, because they target specific topics or issues, particularly those in certain branches of science.

> *From inside the institution we happen to have enough resources that enable us to do that. Most programs are still carried out using internal resources, but we do not rule out any possibility to invite outside speakers if we need to. For example, we once invited LPPM Chairman from UNDIP to speak about community service because the university had the best performance in community service among all PTN-BH. Since ITB [Institute Technology Bandung] is a member of the PTN-BH forum, we also make good use of the network. If we happen to have competent overseas guests we will take them as well. We have a network of professors at ITB, from our partners abroad, so when they visit Indonesia, sometimes we will hold workshops on writing for publications, how to develop proposals, how to build good laboratories, and so on. - Interview 020*

Broadly speaking, the LPPM at all state universities (PTN) interviewed for this study stated that they did not have any road maps for human resource capacity development in the future. These plans might be a part of the more centralized authority at the university level. The current situation seems to be that LPPM spend more time on research administration, rather than conducting strategic or forward-looking activities.

In contract to the situation faced by the LPPM in state universities, we found some best practices being adopted by private universities. The Ma Chung University in Malang described its community development programs in detail, as follows:

> *Ma Chung university has so many programs. At MRCPP [Ma Chung Research Center for Photosynthetic Pigments] itself, I also give freedom to researcher members. So, when a researcher needs certain skills, he/she can submit a request to me, for example, saying that he/she wants to learn a new technology, or a new method, by attending a workshop held in a particular city. Next, I will consider his/her request, whether it will be really good for him/her. Then how is the follow-up to his/her job, how the workshop matches his/her work, we have a system for that. - Interview 019*

Policy research institutes (PRIs) reported the most proactive position on developing their human resources. Interviewees from Prakarsa, SMERU, CSIS, and Rikolto, said that building their researchers' capacity was one of their main focuses. They were aware that having a Human Capital Development Plan (HCDP) was an important element that would directly impact the quality improvement of their institutions. They also said that

human resources were important assets to organizations, so organizations need to manage them well. By considering human resources as assets, the PRIs felt that they had a big responsibility to continually improve the quality of those assets.

For example, while they are working at a PRI, researchers may take short classes related to capacity building. When they do, the PRI gives them support by allowing them to take leave, or providing a specific proportion of time — within their total working hours—that researchers can use for activities towards personal development. PRIs may also provide funding and facilities for researchers to do further study. They recognize that research activities are inseparable from the activities of learning, reading, observing, and updating analytical and writing skills. CSIS, for example, has a human resources development program aimed at working on novel issues, so researchers will be aware of trends that may become the research focus of the institution.

> *At Prakarsa, we try to do that as efforts to create a friendly atmosphere for researchers and research activities. We offer incentives for those who give presentations at national or international conferences. We even cover their transportation and accommodation expenses for attending events whose themes are highly relevant to Prakarsa agenda. Then if they want to take courses to improve skills related to research methodologies, or attend short courses abroad, on or off campus, we will support them, too. Moreover, we carry out regular, internal capacity building activities, for example, on methodologies, or data or information processing, and so on.*
>
> *Further, we offer partial scholarships for those who wish to pursue postgraduate or doctoral studies, in order to support their educational activities. When they go back to school and have to take time off from the office, we will give them dispensation, for instance, they can take leave without pay, assuming that once they have finished their postgraduate or doctoral studies, they will return to our institution, or they could also develop the knowledge that they have received for their personal growth or the institution's advancement in the future. What we mean is, we adopt a nurturing approach since we want to cultivate fledgling researchers, so they will be comfortable working for us and have better capacity, and become productive researchers, and so on. - Interview 014*

By contrast, researchers at universities decide on an individual basis whether to engage in continuous learning and personal capacity building. Motivation at the individual level varies and so the results will be varied also. Interviewees in this study did not see evidence that developing all researchers' professional skills was a strategic institutional goal of their institution, or that it was being pursued in a systematic way.

Institutional support for researchers

Along with lack of investment in the skills and knowledge of researchers (except by PRIs), interviewees in this study were also critical about the lack of institutional support for research and systems that made research efficient. They cited, for example (i) inadequate research funding (as described in Section 3, above). In some cases, research has to be abandoned due to lack of funding; and (ii) absence of professionalized research administration and finance functions and being burdened by administrative work. Researchers accept that the research process always involves administrative tasks. However, they report often having to spend a disproportionate amount of time taking care of administrative tasks than for carrying out the substantive research activities. Almost all the researchers in this study working for universities (especially those with civil servant status) complained about this situation.

Accountability for expenditure of the government funding is important, but so is building the professional capacity to do this efficiently:

> *When we spend funds from APBN, remember that APBN represents public money, so we have to be accountable for our spending. In principle, we must be accountable even for an expenditure of one rupiah. Public funds are different from our personal money. We do not have to be accountable for our personal money. However, since we are speaking in the context of state funds, accountability continues to be present here. The problem is, if the [researcher] is not able to do it, there should be staff dedicated to taking care of administrative matters. Let researchers conduct research, however, there must be, in every campus, well, not campus, but in every working unit, treasury officials who are normally asked to complete the paperwork, because it is also impossible to not give any accountability.*

In terms of accountability, we keep trying to make simplifications, without reducing the accountability itself. Thus, the accountability remains in existence. One of the principles in the management of state finance is that it has to be accountable. Because this is public money. …To whom are grants awarded? To state-owned enterprises (BUMN), or to institutions? But if they are awarded to peer government institutions, that is not applicable either. If grants are awarded to religious institutions, receipts alone will be enough to show what they did with the grants. - Interview 025

4.5 Rigid timelines

Implementing research projects needs flexibility in the timeline. University researchers who conduct their research with funding from the state budget (APBN) are very dependent on the timeline set by the government. They complain that the research process cannot be adjusted to gain the best momentum because, more often than not, it must follow the budget's one-year timeline (as discussed in Section 3, above). This places an artificial handicap on the research being produced with that source of funds. Interviewees hoped for more funding schemes that allow researchers more flexibility when they plan for the timeline of their research process.

The problems identified above are structural, rather than individual, ones. To motivate researchers to achieve the expected quality, it is necessary to have a more open and flexible ecosystem and institutional arrangements where researchers are encouraged to develop themselves as a professional group. As long as the issue of human resources is merely viewed as an individual problem without considering the influence of structural factors, it will be difficult to get the behavioural change at the individual level that will aggregate to stronger performance across the system.

4.6 Researcher workforce Planning, Monitoring and Evaluation Systems

Assessing individual researcher quality

When we speak about the 'quality' of researchers, it is of course closely related to the tools and processes that are used to assess and measure this. The most commonly used criteria and measurement tools in Indonesia at present mirror some of those in use internationally:

- Publications produced (number, quality, and level of the journals)
- Number of the research projects conducted
- Citations

These are quantitative measures, and they are also sometimes an indication of career stage – the longer the experience as researcher, the greater the numerical results are likely to be.

For a country like Indonesia, where research productivity has not been high up to this point, establishing quantitative KPIs at the departmental and institutional level may be very important. Mature knowledge systems have used and continue to use these because they are easy to administer and function as a quick proxy evaluation of how a researcher is using their time – and whether other researchers are reading their work. It is difficult for someone to assert that they are a 'researcher' if they are not publishing, have no research projects underway and have no research grant income.

However, assessment based solely on quantitative criteria are not always reliable indicators of quality. Key performance indicators (KPI) that only focus on the number of publications will merely keep researchers busy making sure that they achieve that target number. For this reason, mature knowledge systems are moving away from quantity and toward measures of quality and impact – where the work is published, how original it is, who reads it and what demonstrated contribution it has made to knowledge, or public policy, or to the benefit of society,

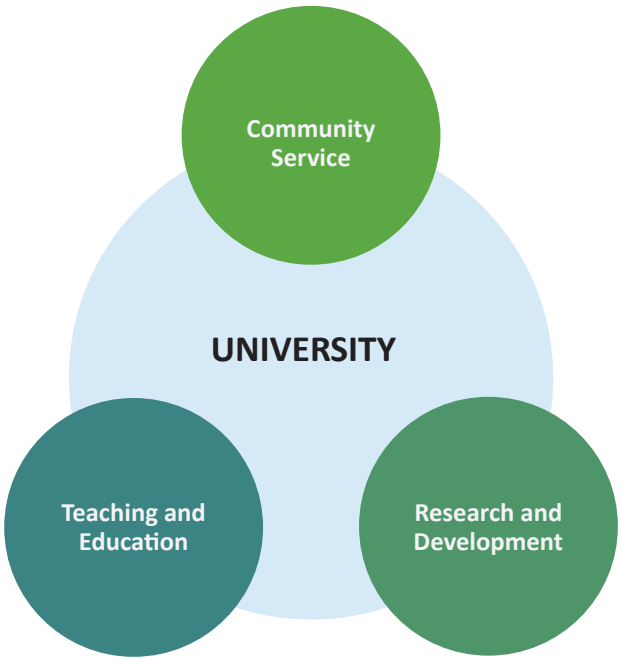
In Indonesia, we currently have a chronic, unresolved problem: researchers who conduct research activities as mere formalities in order to gain credits that would support them for promotion. At universities, the term for these credits is KUM. Basically, the government intended KUM as an incentive to develop researchers' passion for conducting research. However, KUM represents a system that delivers an external incentive, and, in the end, many researchers make fulfilling KUM their goal, rather than building their personal research capacity. Those researchers give the impression that research is a forced activity and only conducted to meet the demands of their job. Sitting behind this is the structural problem of universities requiring most academic staff to be on the same pathway, with the same performance expectations, regardless of their talent and capacity.

Incentive schemes for individual researchers

Research activities at universities are conducted under different schemes from those applied at research and development divisions of the ministries, non-ministerial government agencies (LPNK), and policy research institutes (PRIs). Each institution has a different style of management due to the status and main tasks of its researchers. Despite the difficulties of recruitment outlined above, Ministries and the LPNK do recruit researchers to perform the full range of tasks and functions of their profession. Researchers in the Ministries' research and development divisions and within the LPNK do (in theory) allocate most of their time to conducting research, outside their other tasks, which are more administrative in nature.

University academic staff have a different situation – they are essentially recruited as lecturers and so their core task is carrying out educational activities. This is in accordance with *Tri Dharma Perguruan Tinggi* (the three pillars of higher education) mandated by government for universities (Figure 4.2).

FIGURE 4.2 **THE THREE PILLARS OF HIGHER EDUCATION (*PERGURUAN TINGGI*)**



As lecturers, the pay and promotion prospects for most academic staff at universities are tied to their duty to carry out teaching and learning, with research and community service activities next in line. The percentage of time allocated for each of these activities (or pillars of the Tri Dharma) is stated in a Regulation issued by the Directorate General of Higher Education (Ditjen Dikti). However, the actual time allocation for these activities performed by university lecturers is subject to local level decisions.

> *They will surely make rough calculation whether the time is reliable or not. For our friends who do not hold any structural positions, actually they have more time to spare, well, it also depends on their teaching responsibilities. But we have to give them understanding that research is an obligation. By conducting research, we can receive a good amount of funds that later can be used for writing articles to be published in journals. Journal articles would put us on the path to promotion. So, conducting research would produce a multiplier effect on researchers. Even though they have a lot of teaching duties, usually researchers are still eager to submit proposals for research funding, because if we want to get funding from Dikti, for example, we normally submit proposals for next year's funding between July and August, during summer break, so it is the perfect time to do it. - Interview 024*

One way to encourage more quality research activities and outputs is to offer more structural incentives that are tied to quality. Many universities are currently experimenting with these, and they include:

- Monetary incentives for researchers who can produce journal articles and publications. The better and more credible the journals, the higher the value of the incentive payment
- Awards for researchers, given to several categories of recipients
- Priority to receive (internal) research grants
- Gaining KUM for promotion (ultimately to professor level)

An interviewee from a private university comments:

> *In general, Ma Chung has some incentives for its human capital. Usually, every year we give awards for the best lecture of the year, and so on. Unfortunately, we have not had such awards for researchers. So, we still use assistance from the government for them because if we publish articles, we can request around IDR 25 million from the government. Then we will distribute this fund equally among the researchers listed in JAD. But it is a shame that for researchers not listed there, they will not get any share of the fund. - Interview 019*

4.7 Researcher mobility

Another facility that researchers need to receive is freedom to collaborate with other institutions from different sectors (cross-sector collaboration). This kind of scheme is expected to give them mobility, so researchers from government research and development agencies can perform their duties at universities, or even in the private sector. On the other hand, researchers at universities also hope that they can have opportunities for transfer, from their universities to the industrial sector or government research and development agencies. The mobility under such scheme is designed to upgrade the quality of research results, including that of human resources development process.

At the moment, mobility of researchers has yet to be a priority for most research institutions. Some government agencies, such as the Ministry of Research and Technology and Higher Education/the National Research and Innovation Agency and the Ministry of Administrative and Bureaucratic Reform, have designed plans for this scheme. However, the implementation of such scheme has not been optimized. There are already some rules concerning the scheme, but they are limited to the job transfer and job rotation process, which has been running well.

In essence, in all interviews, researchers expressed that they agreed with the presence of flexibility, in order to enjoy this cross-sector mobility. Each researcher was already aware of the benefits that he/she could reap from it. At the moment, their biggest obstacle is employment status; this is especially true for researchers with PNS status. Moreover, there should be further discussion on this talk about mobility, and the implementation of the mobility should be easier and has no complicated administration.

> *Mobility always makes a good impact on the achievement of transdisciplinary goals, because when meeting different people, everyone would surely adapt to those people who came from different institutions, or who have different ways of thinking, and so on. - Interview 04*

5 RESEARCH COLLABORATION: STRATEGIES AND CHALLENGES

The fourth pillar of a knowledge economy assumes a tightly-knit network of public and private research organisations. In practical terms that means that the full range of research and development actors (which includes the national government, regional and local government, government research institutions, industry, philanthropic actors, universities, think tanks, civil society and international partners) share the responsibility for research and development 'inputs' (funding, human capital, infrastructure and policy and regulation) as well for the quality and relevance of research 'outputs' and their distribution and use.

5.1 International experience: domestic collaboration

Across mature knowledge economies, we see a range of tools that governments use to mandate or encourage collaboration and knowledge transfer and to reduce the inefficiencies in the system that come from 'siloed' or separated research actors and institutions. Collaborative tools are also used to reduce inequalities that come from individual actors' and institutions' geography, socio-economic status, gender, language, race, or field of research.

Among the tools designed to promote collaboration are:

- Centres of Excellence and Collaborative Research Centres (e.g. Australia, Netherlands), where a condition of competitive government funding is that the lead university/universities partner with lower-ranked or regional universities (e.g. to work together to, train PhD students);
- Industry 'linkage' or 'partnership' grants (e.g. the Netherlands, the U.K and Australia) that require universities to partner with an industry, government agency or non-profit partner, who will make a cash or 'in-kind' contribution (e.g. employee time) to the joint project;[75]
- Large-equipment grants (e.g. Australia), where universities are eligible to apply for research grants to fund the purchase and/or use of large equipment only if they can show that multiple institutions will be able to access and share the facility;
- Tax incentives for industry (discussed in Section 3, above);
- Partnership arrangements for health and medical research, where grant applications that have merit but for which there is insufficient government funding are referred to non-government partners for funding[76]

5.2 International experience: international collaboration

A number of the mechanisms listed above, particularly the Centres of Excellence and Collaborative Research Centres are usually structured in order to require participation by an international partner. This is international collaboration

[75] See, for example: https://www.nhmrc.gov.au/funding/find-funding/partnership-projects

[76] See, for example Australia's NHMRC Policy on partner recognition: https://www.nhmrc.gov.au/about-us/publications/policy-recognition-supporting-partners-2019

is deliberately designed into the funding schemes in most mature knowledge economies. A direct cause and effect relationship between international collaboration and national research performance is difficult to show conclusively, but it is clear that there is a direct positive correlation between international collaboration and international co-authorship and national research productivity (measured in citations and journal placement) (Cimini et al, 2016). Levels of international co-authorship also feed into the systems of international rankings described in the Introduction section of this report. This kind of collaborative productivity is also influenced by geographic proximity to one or more mature knowledge economies, by shared languages, and by funding schemes that encourage and support international collaboration.

5.3 Factors constraining collaboration in Indonesia

Indonesia has a unique set of circumstances, analyzed in many prior studies that make system-wide coordination and cooperation in research and development challenging (e.g. Aminullah, 2020; Siregar, 2020; Ekatjahjana et al, 2019, Hertz et al, 2020; Pellini et al, 2018; and Rakhmani et al, 2020). Those include, but are not limited to:

- national (government) research institutions that are not resourced at, or performing to, internationally competitive levels;
- a national system with too many universities, and too many of low quality, regulated through separate mechanisms for state, private and Islamic institutions;
- funding incentives for universities that make research less valuable than teaching;
- state university and government research institutions staffed by public servants (with all the inflexibility and incentive problems that this implies);
- a private sector that does not esteem domestic research capabilities; and/or
- an 'intermediary' group of policy research institutes, think tanks and non-government entities with precarious funding, variable skills and a 'servicing government' posture (e.g. Pellini et al, 2018).

Sitting behind these institutional arrangements are historical legacies and political economy factors that affect the style of Indonesian policy-making more generally (e.g. Ekatjahjana et al, 2019; Datta et al, 2011) Among those factors are:

- a political legacy of highly centralized regulation in a command and control style;
- a high degree of government control of, and influence over, universities;
- a geographically dispersed country in which research actors and policy makers are acutely conscious of the disadvantage for regional institutions outside Java;
- tension between the political desire of the national government to advance Indonesian research and development in a coordinated way and some views at the sub-national level that 'decentralization' makes this a policy arena for sub-national initiatives; and
- entrenched distrust of each other among all the actors in the knowledge system (e.g. Rakhmani et al 2020)

These 'operating conditions' for research and development in Indonesia are well-understood. In the study underpinning this report, we did not ask participants extensively about research collaboration and dissemination, in part because previous work had canvassed this in some detail (e.g. Rakhmani, 2020; CCPHI, 2019). However, the issue came up spontaneously during the interviews and so we include those views below.

5.4 Partnership with Industry

One of the sectors most often named and encouraged to collaborate is the private sector, particularly industry. Stakeholders, especially those from the government sector, sometimes give the impression that there is huge potential for collaboration with the private sector, even while 'being sceptical about the willingness of the private sector to actively engage in collaborating, and especially, funding, research projects for public policy purposes' (e.g. CCPHI, 2019: 20)

That enthusiasm received a boost in 2020, when Minister Bambang Permadi Soemantri Brodjonegoro, Minister of Research and Technology/National Research and Innovation Agency was able to showcase successful university/government/industry collaboration in the response to the COVID-19 and the development of prototype vaccines for Indonesia.[77]

[77] See, for example https://en.antaranews.com/news/161208/minister-readies-rp3423-tln-funding-for-covid-19-vaccine-procurement

In our study, participants from the government sector were primarily interested in joining forces with the private sector and getting it involved in research activities in order to significantly boost research budgets – national expenditure on research and development – and also take advantage of what are perceived to be better research facilities in the private sector. Those participants expressed their hope for research funding that would made available under an '80/20 rule', meaning 80% of the funding is provided by the private sector and the remaining 20% is covered by the government.

The basis for this view seemed to be a clear understanding that Indonesia is currently dramatically underinvested in research by international standards, but that it can replicate the experience of countries like United States, Germany, South Korea and Japan where industry supplies more than 70% of the national investment in research and development. The problem with taking those top-tier competitiveness countries as benchmarks is that they all have strong industrial sectors. It is also worth noting that BERD (the business contribution to expenditure on research and development) generally relates to patents, rather than publications (Cimini et al, 2016:207). In general, national scientific and economic production follow similar patterns (Cimini et al, 2016:210)

Other mature knowledge economies, such as Singapore, the United Kingdom and Australia draw just over 50% of their research and development funding from industry, and Canada even less (Hewett, 2018).[78] In Australia, only a small number of companies make significant research and development investments, often local arms of multinationals or companies compete globally in export sectors such as mining. Academic studies of the county closest to Indonesia in knowledge economy status, Thailand, suggest that this kind of ratio takes a long time to achieve (Kohpaikoon, 2020; Rattanakhamfu, S, & Tangkitvanich, S 2018, Brimble and Doner, 2007; Schiller and Liefner, 2007).

Industry participants in this study viewed research collaboration very differently from government actors. They pointed to the fact that collaboration is already taking place, but not on a large scale. In their view, companies already have their own research and development (R&D) divisions, which they consider to be adequate for supporting their business operations. When collaboration is suggested, they are concerned by the significant difference in the objectives of each party. In general, industry aims to commercialize results of its research, so they will choose research paths that accommodate this goal. On the other hand, researchers at research institutions or universities conduct many projects that will not produce results with a high 'innovation readiness level (IRL) or 'technology readiness level' (TRL). Industry participants suggested that industry will not be interested in funding experiments whose end results are probably not products ready for mass production or commercialization:

> *It is because of industry's mindset. Industry prefers well-proven technologies, ready-to-use technologies, so they do not need to think about research whose success is not guaranteed. Frankly, this might be a bit difficult for us researchers, because various schemes demand research to orientate towards commercialization and downstream [hilirisasi]. So, it is a challenge for us to find a common perception with industry who has a different mindset. Industry takes a lot of ready to use technologies from abroad. All of those technologies are already well proven and integrated. They think everything is up in the air when it comes to research. There is no certainty there. On the other hand, various research schemes offered by the Ministry of Education and Culture do require partnerships with users. This is a slightly difficult requirement for us, because maybe it has not become the norm for companies in Indonesia to partner with universities for its research and development activities. - Interview 024*

> *Regardless of the amount of government funding, the most important step to do now is to stimulate funding from the private sector. Because the private sector plays a dominant role, anywhere in the world. And it will become a dominant force once research has generated proven products. As long as research has not yielded any products, the private sector will be hesitant about getting involved in research. Therefore, we need to give certain incentives to embolden the private sector to join the research projects. They are considered bold (a) when there are clear incentives for taking bold steps; or (b) when no clear incentives are offered. - Interview 08*

Industry participants agreed that they wanted collaboration that would bring benefits to them, meaning at least creating well-proven technologies or products that would be ready for the next stage—prototype development.

[78] https://www.afr.com/opinion/business-doesnt-spend-enough-on-rd-20180730-h13c45

Industry is usually more selective. When industry has chosen to fund something towards downstream (hilirisasi), that means the industrial sector thinks it is an excellent project. But with the government, that is not always the case. - Interview 06

While the research outcomes are simply ideas whose application or benefits to industry are still unclear, industry will keep staying away from such collaborations.

5.5 Encouraging collaboration between universities

As we saw in Section 2 of this report, universities in Indonesia are categorized into clusters: independent, leading, mid-level and *binaan* ('targeted' institutions in the lowest cluster, which are under the guidance of the Education and Culture Ministry). Those categories are based on the assessment and mapping of universities' performance in research field, though a ratings scheme previously administered by the (then) Ministry of Higher Education, Research and Technology. As well as generating a reputational result, these ratings also impact the proportion and the types of research funding received under the Information System for Research Management and Community Service scheme (*Simlitabmas*). The categorization was designed to encourage universities in the binaan cluster to show better performance, so they can get promoted to the mid-level cluster. In the same way, universities in the mid-level and leading clusters are pushed to work their way to the independent (top) category.

At the moment, the independent cluster is still dominated by universities located in Java. This situation reflects, but also entrenches, significant performance gaps between one university and another. As in other tiered systems, the incentives for collaboration thus become asymmetric – independent universities do not need weaker regional partners, but universities at in the middle or at the bottom of the clustering need access to better human capital and knowhow in order to transform themselves. In this kind of system, encouraging collaboration between universities seems critically important:

But for internal schemes, it is not possible for us to collaborate with our colleagues from other universities outside UNHAS [Universitas Hasanuddin], and the problem is related to the university budget. But there are schemes for national research, under community service. For example, I have an ongoing community service project, and for that project, my team members have to come from other universities. That is what the Ministry has. So, it is possible for research conducted under a collaboration model. For instance, a large company, let's say company A, places huge trust in me. It asks LPPM to conduct research about this. But since we do not have any resources for the particular disciplines, we can collaborate with researchers outside the university. In essence, some schemes under the internal funding expect collaboration with other disciplines at UNHAS. At national level, some research and community service projects require us to collaborate with other universities, outside our university. - Interview 013

The fundamental factors that set apart one university cluster from another include quality of researchers (their length of experience, types of research that they have conducted and the number and value of research grants that they have received) and the supporting infrastructure available within the institutions. Independent universities tend to attract a larger numbers of research grants as the researchers who work there are considered to be highly credible. Researchers from the mid-level and binaan clusters would benefit from joining larger-scale research projects to gain experience from working with their more experienced colleagues:

Yes, UNHAS is almost 50 years old, and it always positions itself as a Big Brother or a Big Sister. We even have an office called BKS Intim, an abbreviation for the Coordinating Board for Higher Education Institutions in Eastern Indonesia, and the Board is headquartered at UNHAS. Although the Board has been unable to run any physical operation for the last 10 years, we have activities almost every year that lean towards sharing with our counterparts in Eastern Indonesia. Our Rector always organizes some activities, or encourages us to share research, publications, etc. with Higher Education Institutions in Eastern Indonesia. – Interview 012.

5.6 Interpersonal collaboration

Contemporary, high-quality research usually requires collaboration – most often if it relies on empirical data. One of the issues that participants spoke about in this study was the difficult of forming and sustaining research relationships and collaborative networks. Paradoxically, for those who had the opportunity to study abroad, that seemed to be easier to do overseas than at home in Indonesia:

So, next, the main factor behind success is the ability to collaborate with others. This includes networking, collaboration, and cooperation skills. Based on my experience, it is far easier to cooperate with people abroad than with fellow Indonesians. Also, international cooperation is more exciting because it gives you opportunities to travel to other countries and refresh yourself and work with different systems. – Interview 019.

Those researchers tended to maintain strong ties to their (overseas) host institution. This is consistent with responses in earlier studies that point to the relative weakness of autonomous, professional academic networks and conferencing opportunities in Indonesia (Rakhmani et al, 2020).

5.7 Building consortia

Indonesian universities have experience with prior schemes for research funding that were intended to facilitate this cross-university cooperation.

And back to the matter discussed earlier, about taking advantage of university cooperation carried out using DRPM funds, our lecturers do have to go to our partner university or our partner higher education institution. They have to go there to run some tests at the laboratory, since we do not have any here. Those activities have indeed been incorporated into the cost estimates (RAB) of the research budget. – Interview 017

However, interviewees report that an underutilized measure to date has been the funded research consortium with members from universities in different clusters, either located in the same area or combining regional and Java-based independent or leading universities. A second opportunity is to actively encourage the shared use of facilities and infrastructure that support research activities.

In terms of cooperation, I think it should not be limited to the context of human resources. Actually, we can cooperate by utilizing facilities available at other places. For example, cooperating with an institution that has laboratories equipped with complete tools would be very helpful when we are conducting studies, or analysis. So, cooperation is not limited to the context of human resources only. – Interview 018

This would be efficient, because institutional funds set aside for infrastructure could be freed up for investment in other research costs. If facilities are located at, and staffed by, stronger institutions, it also has the potential to address some of the systemic inequalities in funding and staffing.

5.8 International Researchers

Research and development today is a globalized endeavour. Both government and research actors in Indonesia understands this. The Directorate General for Higher Education of the Education and Culture Ministry (Kemendikbud Dikti), for example, encourages international collaboration through one of its funding mechanisms, described by one participant this way:

Actually, Kemendikbud Dikti also provides funding, it is called International Research Grant, for which we have to collaborate with partners abroad, but the amount of the funding is small, so international partners are not interested. For them, it is not exciting to work with small funding. I do not really know; the amount is maybe around IDR 150 million per year. As a result, it might be hard for them to find partners. Those who manage to find international partners are usually alumni of universities abroad, and normally they do it by contacting universities where they studied before. – Interview 024.

If that is accurate, then the scheme is not fully strategic – because of its design and underinvestment, it functions as a researcher mobility (travel) scheme, rather than a way of attracting expertise from an overseas partner. There seems to be a missing link or a mismatch here, because many international research funding schemes reward the inclusion of international partners, particularly those who can bring funding contributions.

Breaking into networks

The ability to travel outside Indonesia is clearly important in building professional research networks by establishing personal relationships with influential collaborators. But researchers who do not have a pre-existing network of contacts tend to find it difficult to gain experience working with researchers or institutions abroad:

Now, building a network is not that easy. It is a little difficult, because personal relationships normally play an important role when you are trying to build connections with partners abroad. – Interview 024

Not surprisingly, participants put some emphasis on the need to build mentoring capacity in the system, in the first instance for research institutions which do not have an international network of contacts:

> *Mentoring should be offered through cooperation between an Indonesian university and a sister university, or a partner university, with whom the Indonesian university has signed a memorandum of understanding. It is better to collaborate with partners abroad, in order to minimize patron-client relationships. When seeking for international partners, Indonesian universities should choose universities abroad that have the same research priorities as theirs. – Interview 04.*

Awareness of the importance of networked collaboration appears to be low among both government research institutions and universities. Participants expressed the view that many institutions feel that they do not need to carry out any cooperation, or that it is not attractive unless local institutions to have strategic positions in cooperation schemes. For example, a major Indonesian or international research institution might be visiting an area that a local institution considers to be 'their' research location, but the visiting institution simply views it as an object or site of its own research. In reality, there are universities in that area that could be invited to take part and help with the research process. Their participation is likely to make the research process easier and the research product better, because local researchers have a better understanding of the context and complexity of the research area.

Internationally, top-tier universities now require their researchers to work in this way as a matter of ethical research practice, as we saw in Section 4 of this report.[79] Researchers' own universities will not give them ethics permission to conduct research in remote or indigenous communities in their own country or overseas unless the researchers can show a research design that genuinely involves local communities and local research collaborators.

Once this kind of peer-to-peer institutional and team collaboration has become standard practice in conducting research in Indonesia, local research institutions' research performance is likely to improve to the level of playing significant, not only supporting roles in the research process. This is a virtuous cycle, where everyone involved gains maximum results, there is less research bias and ignorance, the standard quality of the research outputs rises and the capacity of the researchers themselves increases following their experience of working with reputable and more experienced Indonesian and international institutions.

[79] See for example, Australian Code for the Responsible Conduct of Research (2018): https://www.nhmrc.gov.au/about-us/publications/australian-code-responsible-conduct-research-2018; and the UK Code of Practice for Research: https://ukrio.org/publications/code-of-practice-for-research/

6

RECOMMENDATIONS FOR IMPLEMENTING BETTER RESEARCH AND DEVELOPMENT IN INDONESIA

Many recommendations can be made on the basis of this report and the many other reports that preceded it (e.g. Aminullah, 2020; Hertz et al, 2020; Pellini et al, 2018; Rakhmani et al, 2020; Siregar, 2020). Some are obvious and have been made repeatedly in different forums (such as the call to lift the level of Indonesia's research and development spending to at least 1% of its GDP). Others are currently the subject of work being carried out on the implementing regulations for the Sisnas Iptek Law.

In this section, we have selected 9 key pathways where stakeholder views and international best practice suggest that change is critically important for Indonesia. We select these recommendations because:

a) implementing them in the short-term could significantly improve Indonesia's research competitiveness;
b) the change has not featured prominently in public discussion; or
c) the steps toward the change are not obvious.

All of these recommendations are set out as short-term, medium-term and longer-term intervals of 5 years.

6.1 Apply a precise definition of research and development

The legislative and regulatory framework in Indonesia does not use a consistent and precise definition of 'research and development'. One of issues identified in prior studies is that much of the 'research' produced in Indonesia at present is not actually research. As we saw in the Introduction to this report, best practice internationally is that legislation, funding schemes and research actors (universities, government agencies, business and non-government organizations) apply a strict, OECD definition of what work qualifies as research:

Basic, Applied and Experimental Development research qualifies for research funding and is assessed as part of performance measures for research institutions and researchers;

Work that uses existing research or information by summarizing or collating it to support policy development, or that helps to publish or communicate research is important, but it is distinguished clearly from the production of actual research.[80]

Short-term recommendation

- Adopt the OECD definition as the national, uniform, meaning of research and experimental development (R&D) in Indonesia

- Use the new, precise definition in the implementing and derivative regulations of existing laws and regulations, rather than attempt to revise those existing Indonesian laws and regulations to conform to this new definition

[80] Examples of this include work done by government research institutions to advise on policy, based on existing research; work at universities that lacks robust data and analysis, sometimes created primarily for fulfilling promotion criteria (KUM); and work by CSOs and PRIs that repackages existing information.

- Develop some advocacy activities around 'better research' that fits within this definition, so that research actors (universities, government research institutions, CSOs and PRIs) can be recognized when they produce research that has rigour and quality

Requires work by: RISTEK-BRIN; Bappenas; MoF; MoEC; Universities, Government Research Institutions and PRIs

Medium-term recommendation

- Apply the OECD definition of research and development as a condition of government funding for all research (basic, applied and experimental) -- at the institutional and the project level

- The implication of this is that actors that create research that meets this definition (government, university, CSO, PRI or industry) would be eligible to compete for government funding for research

- Actors performing work that simply uses existing research or information, or communicates this could be funded by government, but not from budget allocations for research and development.

- This is a significant system shift and so needs to be introduced in stages, starting with government research institutions.

Requires work by: RISTEK-BRIN; MoF; MoE; LPDP and other Research Funding Agencies

Longer-term recommendation

The OECD definition of research includes 'open science' – or 'open research'. Open science requires that publications, data, physical samples, and software are made publicly accessible. It also demands that research results are transparent and accessible, so it encourages practices such as publishing open research, open access for publications and open-notebook science.

- Recognize 'Open Science' as research that falls within the OECD definition

- Ensure that government funding and support schemes include Open Science as an eligible form of research

- Ensure recognition of, and funding support for, research published in open access journals

- Support work on the national research repository and public access to the repository

Requires work by: RISTEK-BRIN; MoF; MoE; LPDP and other Research Funding Agencies

6.2 Establish a national research mission

Indonesia lacks a vision and a pathway towards 'mission led' research. Internationally, mature knowledge economies have redefined their national research priorities as a series of 'grand challenges' to tackle the most complex issues that affect the future of society – issues such as: climate change, cyber-security, energy sustainability, environmental degradation, food security, public health emergencies, marine resource depletion, maritime security, income inequality, impact of technology and artificial intelligence, water governance.

Mature knowledge economies review and revise these missions regularly. Setting the mission requires a process that involves civil society, universities and industry and is not dominated by government. National missions in research guide, but do not dictate, research funding allocation and research by individuals and institutions. For that reason, in economies with 'mission-led' research, some categories of competitive research funding are specifically tied to mission areas (e.g. schemes seeking projects that identify 'grand challenges' that require interdisciplinary research and schemes that promote collaboration with industry). However, mature knowledge economies leave ample space for 'blue-sky' or curiosity-driven research that may be outside the defined 'missions' – because sometimes individual research is more creative and valuable than directed research.

At present, Indonesia has no national research missions. Instead, it has very broad focus areas that break down into 'sectoral support' for products and industries. The process by which these products or 'flagships' are identified is not optimal, because it is understood by participants as being tied to budget allocations. The result is a crowded basket of research activities in which there is no clear priority.

With changes to Indonesia's legal and regulatory framework, the current status of the National Research Council (DRN) is unclear. Without an inclusive lead body to set and regularly revise the national research mission, it risks becoming an irrelevant policy.

The current impact of the national research priorities is also difficult to see; there is no evidence that the current national research priorities are contributing to national competitive research and development capacity.

Short-term recommendation

- Reformulate the national research priorities into no more than 10 national research missions, at least one of which is the application of social science and humanities knowledge to pressing social issues
- Identify those 'missions' through horizon scanning and broad consultation
- Establish the national research missions separately from the government budget allocation process
- Indonesia can achieve a 'fast start' on its national research mission by looking closely at the national research priorities of both advanced knowledge economies and peer economies in ASEAN
- Establish a follow-on institution to replace the National Research Council (DRN) as a national advisory body that can help shape the new national research missions.
- That new body must meaningfully involve civil society, universities and industry and avoid overrepresentation from government and government research institutions. Ristek-BRIN could play a helpful convening role.

Requires work by: BAPPENAS; RISTEK-BRIN; Coordinating Minister for the Economy, MoI; National research institutes; Universities; Civil Society research organizations; international partners and donors

Medium-term recommendation

- Create a mandate for the new advisory body to review the national research mission on a cycle of 2-5 years
- Link the new national research mission meaningfully to competitive funding opportunities.
- In practical terms, this means that 'mission-led' research funding by government would be at least 40%, and up to 60%, of the government funding available for research.

Requires work by: BAPPENAS; RISTEK-BRIN; National research institutes; Universities; Civil Society research organizations; international partners and donors

Longer-term recommendation

- In setting and reviewing the national research mission, the new advisory body should look for opportunities to learn from and connect to, national research priority areas in mature knowledge economies.
- This is a way of (a) accelerating Indonesian entry into international research networks; and (b) opening up opportunities to access external funding where Indonesia's national research missions overlap with or intersect with 'grand challenges' or research missions being funded by other national governments, philanthropic bodies or industry.

Requires work by: BAPPENAS; RISTEK-BRIN; National research institutes; Universities; Civil Society research organizations; international partners and donors

6.3 Build Comprehensive Research governance

The *Sisnas Iptek* Law and the establishment of BRIN mark a new stage in the development of a national system of research governance for Indonesia. Two key elements need further investment: (a) peer review and (b) functional separation of role within research governance.

Research governance: functional separation

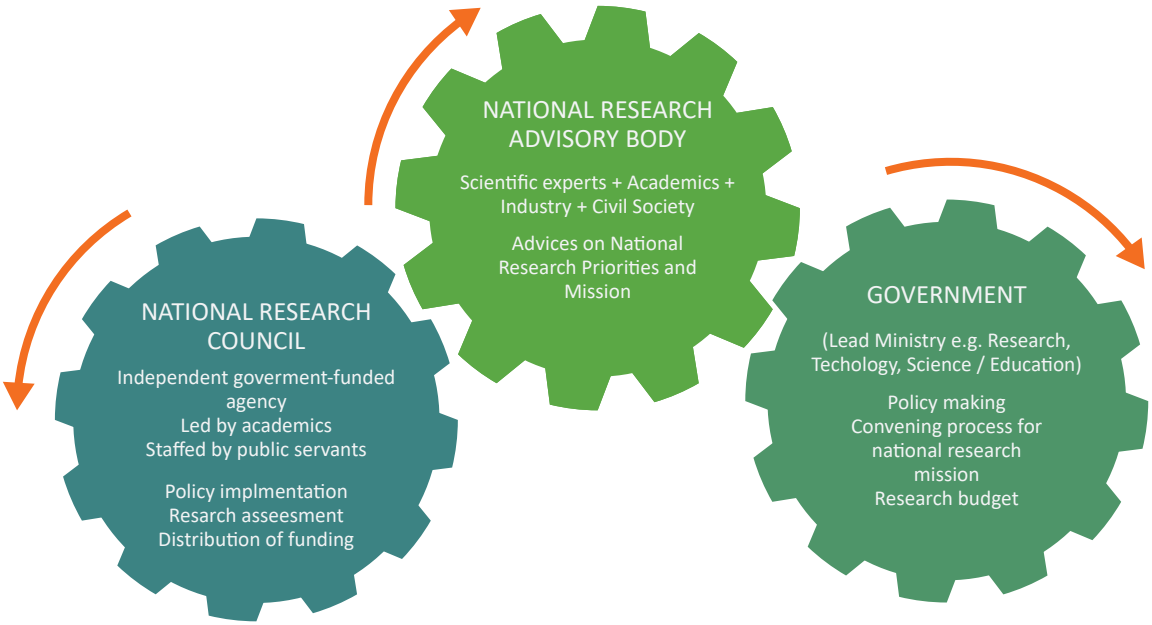
Internationally, the quality of an economy's research governance has an impact on the quantity and quality of research that it produces. Effective research governance separates the functions of setting policy and funding research from evaluating quality and significance of research and distributing funding on a competitive, peer-reviewed basis. Government has a key role in setting

policy and funding research in most mature knowledge economies. Evaluation of research and distribution of funding, on the other hand, are generally independent of government and free from political influence, as we saw in Section 2 of this report. These roles are based on peer-review – of institutions, of research projects and funding proposals, and of research publications.

For this reason, most national research funding bodies/ agencies are functionally independent of government and are accountable for their own performance. Most are advised by (or in some cases are linked to, or part of) National Research Institutes that have scholarly and disciplinary-specific expertise. Mature systems use both domestic and international peer-reviewers to deliver independent assessments of institutional and project-level research quality.

Internationally, the functional separation of roles in research governance often looks like this (Figure 6.1).

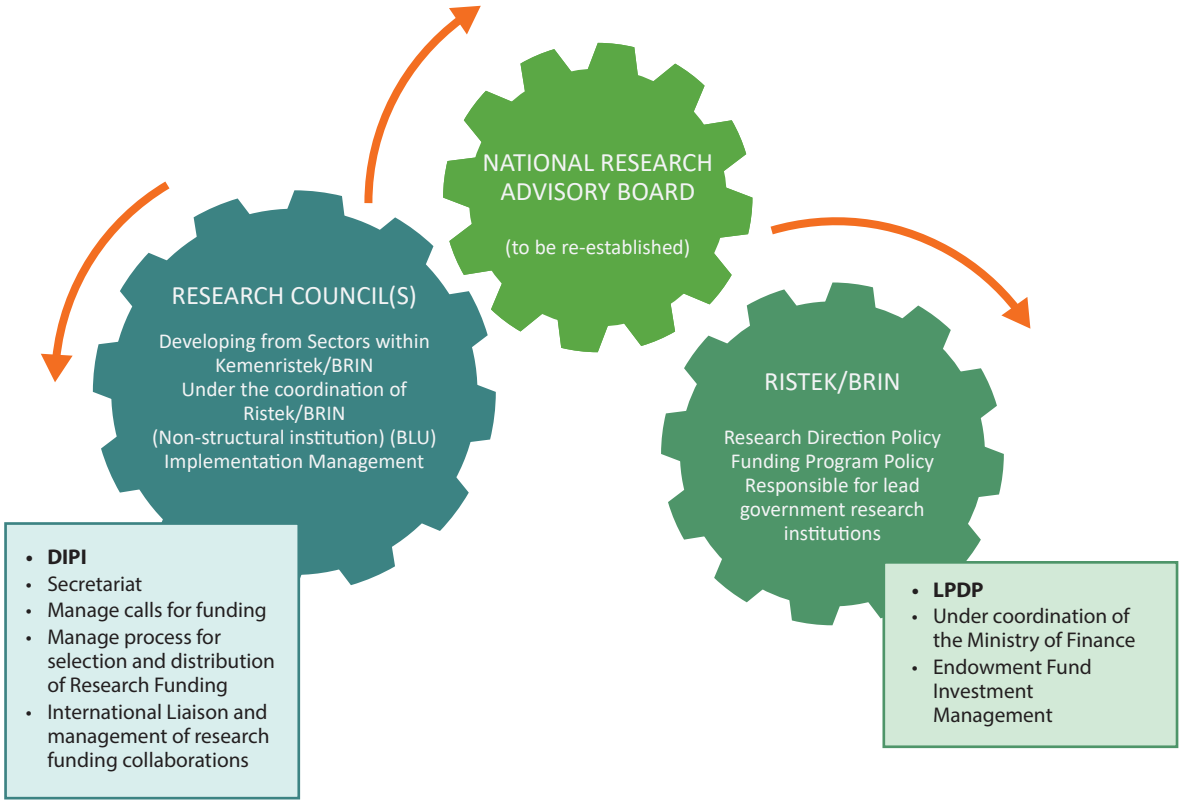
FIGURE 6.1 **MATURE RESEARCH SYSTEMS**



The establishment of BRIN is a welcome development in Indonesia, but it leaves open the question of which institutions should perform which functions -- and with what status, and when? To achieve an end-state of professional research governance that can operate separately from government, Indonesia will need an independent 'non-functional' ('public service') government agency (a BLU) that has the right scale and combination of research governance functions and capabilities.

The medium-term stages to establishing this would involve BRIN evolving into a separate entity (e.g. a Research Council with sectoral divisions) that has BLU status. BRIN would continue to supervise and coordinate the leading government research institutions. An independent research funding agency would have a conflict of interest if it was also responsible for providing funding to institutions that report to it, or for which it is administratively responsible. That design could look like Figure 6.2.

FIGURE 6.2 **MEDIUM-TERM STAGE TO ESTABLISH AN INDEPENDENT 'NON-FUNCTIONAL' GOVERNMENT AGENCY (BLU)**



An ideal long-term state would create a Research Council-type institution at scale, and absorb the functions assigned to DIPI (Indonesian Science Fund) in the diagram above. This matters because DIPI currently does not have a legal status that would enable it to be a funding distribution agency. [81]

Peer review

Systems of peer review require a research governance infrastructure, including systems for classifying research disciplines and sub-disciplines for researchers and projects, a pool (and database) of national and international expert reviewers and systems for managing the review process and checking its integrity.

Indonesia currently has a relatively small pool of National Research Reviewers (RPN). However, the implementation of peer review still requires considerable investment. Stakeholders suggest that the number of reviewers and the distribution of their expertise is still insufficient. A more serious issue is that government actors are involved in assessments of research funding and research output quality. It is also clear that the researcher time required to undertake high quality reviews is not recognized or rewarded by their research institutions: a culture of collective responsibility for lifting national research quality still needs to be developed (Siregar, 2020).

Borrowing expertise from international partners is a path that many developing knowledge economies have used effectively while building their own systems of research governance. Using international reviewers is also a way of building or strengthening international research networks (and potentially pathways to joint research or joint funding). DIPI maintains an International Reviewer Database, but this is also limited. A critically important step for Indonesia is to build a consolidated national database of qualified peer reviewer, but importantly, to also build the professional capacity to manage it effectively. LIPI has led with good practice in investing in its own researcher capacity building and in research infrastructure to date, and this could be extended.

Short-term recommendation

- Strengthen BRIN's capacity by establishing discipline-specific research advisory panels to advise BRIN on funding needs in specific research fields
- Undertake a study of how peer review in competitive funding of research projects has been implemented in 2-3 comparison systems (e.g. Thailand, Australia, Singapore)
- On that basis, build out or strengthen the system components (reviewer pool, database, discipline classifications, procedures, integrity checks) that are currently missing, to create an 'enhanced peer review' framework
- Double the number of eligible peer-reviewers in all disciplines
- Work with research institution employers to map ways of recognizing and rewarding the status of reviewers (beyond nominal payments)

Requires work by: RISTEK-BRIN, National Research Institutes, universities

Medium-term recommendation

- Apply the 'enhanced peer review' framework to all categories of government-funded research, at the project level
- Invest in a national program of research management professionalization within BRIN and within the government research institution and university that builds on developing good practice in Indonesia and pathway experience in 2-3 comparison systems (e.g. Thailand, Australia, Singapore)
- Undertake a 5-yearly review of BRIN and national research governance
- Develop a national code of research ethics that builds on international models

Requires work by: RISTEK-BRIN, National Research Institutes, universities

[81] DIPI is currently located organizationally under AIPI (Indonesian Academy of Sciences), which is in turn established under the State Secretariat, primarily with an advisory function, so neither DIPI (nor AIPI) have the functional independence that is desirable for a research governance agency in a mature knowledge economy.

Longer-term recommendation

- Undertake a 5-yearly review of BRIN and national research governance

- Establish an independent national research agency (as one or more research councils) that are responsible for decisions relating to the evaluation of research quality significance and the allocation of research funding on a competitive, peer-reviewed basis

- Divisions within that national research agency or the focus and mandate of those research councils could incorporate the current areas nominated for Deputies within BRIN (e.g. energy, transportation, health) and cluster these under STEM and social science and humanities umbrellas.

- Extend the 'enhanced peer review' framework to government funding for research at the institutional level.

Requires work by: RISTEK-BRIN, National Research Institutes, universities

6.4 Competitive funding for efficiency and excellence

Developing a knowledge economy requires a shift to the way that government funding is allocated for research and development. Internationally, most mature knowledge economies use competitive, merit-based models for allocating research funding at (a) the institutional level and (b) the project level.

Indonesia currently allocates research funding through two streams: (a) institutional funding, which is distributed directly to each research Institutions and (b) competitive research funding at the project level, mainly administered by the Ministry of Research and Technology (Kemenristek).

A key issue is that the Indonesia's institutional funding is generally not distributed on the basis of research performance; institutions propose their annual budgets, and these are reviewed and accepted by the Ministry of Finance. In this system, the incentive for institutions to use their infrastructure (mainly staff) to produce high quality research as efficiently as possible is very low. A second issue is that institutional funding is often re-distributed internally (sometimes on a competitive basis) to individual researchers or research teams. The result of this is that the research funding 'packets' are too small to support significant knowledge creation or discovery. Internationally, institutions such as universities do use some of their institutional funding to support projects that they select internally, but the basis for doing so is usually to build capacity for the researcher or the team to gain external funding. These schemes are for 'seed funding' -- not for the routine performance of research.

For research funding at the project level, the current implementation is not optimal for encouraging the best quality research. The quality of peer-review and the independence from government oversight and decision-making remain problematic issues.

Short-term recommendation

- Universally competitive project funding

- Establish a national principle of merit-based, competition for all government funding (from any source) at the project level.

- Mission-led research that is commissioned by government can be competitive. Where mission-led research is not selected and funded on a competitive basis this should be the exception to the rule.

- Make access to project level funding open to all government, university and civil society research organizations whose work meets the OECD definition of research and development

Requires work by: RISTEK-BRIN, National Research Institutes, universities, government research departments + Ministry of Finance

Medium-term recommendation

- Gradually competitive institutional funding

- Make institutional funding for government research institutions competitive

- Develop appropriate research performance measures for government research institutions

- Link research performance to the operational budgets of government research institutions

- Undertake a study of how research performance targets have been developed and implemented in 2-3 comparison systems (e.g. Thailand, Australia, Singapore)

Requires work by: RISTEK-BRIN, National Research Institutes, universities, government research departments + Ministry of Finance

Longer-term recommendation

- Review and strengthen performance measures of research for the university sector, particularly for those with independent status

- Gradually increase the significance of these (both rewards and reductions) for universities' operational budgets

Requires work by: RISTEK-BRIN, Ministry of Higher Education, Universities, Ministry of Finance

6.5 Research funding for infrastructure

An acute issue in Indonesia at present is that the permitted use of government research funds at project and institutional level are administered in an inflexible way. In particular, there seems to be inadequate provision for equipment (both large-scale, as research infrastructure, and small-scale, at the project level).

As we saw in Section 3 of this report, the international trend is towards radically simplifying research grant categories and simplifying the design of research grant budgets. The idea is to permit government research funding to be a flexible as possible.

Most mature knowledge economies:

- allow small equipment to be included in research project grant budgets (e.g. computers, cameras, recording equipment, computer software) where this is not provided by the researcher's home institution;

- create special grant categories through which institutions can apply for funds for large equipment (laboratory equipment, large-scale computers or access to computing time, large data base capacity). Those grants usually require the applicant to form a consortium or partnership with other institutions; the consortium is usually formed through a contract and the contract is evidence to the government that there will be protocols for sharing the research.

Short-term recommendation

- Allow inclusion of small equipment in research budgets at project level.

- Make employer institutions responsible for equipment audit and appropriate use.

Requires work by: Ministry of Finance

Medium-term recommendation

- Introduce a competitive scheme for institutional bids for large-scale research infrastructure (prioritizing multiple institutions that form consortia)

- Build the professional capacity of the national research agency/national research council to create and manage contractual arrangements for shared facilities

Requires work by: RISTEK-BRIN; Ministry of Finance; BPPT; LIPI: universities

Longer-term recommendation

- Increase the national budget allocation for large-scale research infrastructure to support international collaborations and attract more external research funding from domestic and international business and international research partners

Requires work by: RISTEK-BRIN; Ministry of Finance; BPPT; LIPI: universities

6.6 Attracting non-government and private sector contributions

Although the government is the 'first investor' in research and development in all knowledge economies, governments seek to encourage private sector funding contributions. That includes companies investing in their own research and development; research linkages between companies and research institutes, universities and government; and funding from international partners (philanthropic organizations, donors, international research partners). Almost all knowledge economies do this in two ways: (a) tax credits and (b) co-investment schemes. These are discussed in Section 3 (above).

Tax credits

Most mature and developing knowledge economies now use significant tax credits/tax deductions to encourage industry-based research and development (Appelt et al., 2019; OECD, 2017). This is a direct benefit to the company applying for the tax credit, which can select what research and development they want to undertake and self-report that expenditure. Because the government forgoes this tax income, this is actually government expenditure on research, which is delegated to industry. These schemes tend to be popular with industry, but they have drawbacks, such as:

- the quality of the research or innovation may be low (it may only result in a slight improvement to the company's own products, rather than a breakthrough innovation);
- the quality of the research that a company can perform is limited by its 'absorptive capacity' – the quality of and qualifications of its human resources;
- the company's research program may not involve other research actors (such as universities or government research institutions);
- the effect of the tax deductions needs to be monitored over time by government to check that that they are producing the desired results.

As we saw in Section 3 of this report, Indonesia has introduced a 'super-tax' deduction for research and development in 2020 and this is a necessary, but probably not sufficient, strategy to increase industry's contribution to Indonesia's GERD.

Co-investment by government

As we have seen in this report, some economies (generally those with highly developed industrial sectors and/or very high levels of foreign investment) have been successful in securing significant research and development spending by industry. That, however, does not guarantee that all research actors are collaborating and producing the highest quality research possible. As we saw in Section 3, a strategy used with some success in knowledge economies such as Japan and Australia is to invite more industry expenditure on research and development by co-investing government funds, but make this co-investment conditional upon there being a partnership between industry, university and/or government or non-government research actors. These 'linkage' or 'consortium' or 'collaboration' schemes are quite often linked to national research missions.

Managing external funds

Internationally, mature knowledge economies with efficient research governance are able to attract and manage external funds from industry, or from international partners. As a general rule, those funds are not mixed with (host) government funds; they are managed by the host government research council (or research agency) for a particular purpose (e.g. scholarships, research grants on a particular theme). An example of this is the National Science Foundation (NSF) in the United States, which acts as an agent when it manages research funds for other actors (domestic and international) and also manages the selection and distribution process. Part of the appeal of entrusting the NSF with these tasks is that it is independent and has demonstrably high levels of ethics, accountability and financial controls.

Indonesia's capacity to act as a manager of non-government and external research funds will increase once the building blocks of a research governance system (described above at 6.3 and 6.4) are in place.

Short-term recommendation

- Support and monitor the effect of Indonesia's new super-tax deduction policy

- Boost the 'absorptive capacity' of Indonesian industry by accelerating the production of PhD-qualified researchers, particularly in STEM disciplines

- This requires coordination across multiple actors and an increased investment in international scholarships

Requires work by: RISTEK-BRIN, National Research Institutes, universities, government research departments + Ministry of Finance + industry representatives

Medium-term recommendation

- Create a new research grant scheme that invites industry contributions (in cash or in kind) and rewards these with co-investment by government (usually a multiple of the industry funding).

- The condition for government co-investment is a research partnership with a university or a government research institution or non-government (CSO) research partner

Requires work by: RISTEK-BRIN, National Research Institutes, universities, government research departments + Ministry of Finance + industry representatives

Longer-term recommendation

- BRIN evolves into a functionally independent research council which has the professional capability to attract and manage non-government research funding (domestic and international)

Requires work by: RISTEK-BRIN, National Research Institutes, universities, government research departments + Ministry of Finance + industry representatives

6.7 Professionalize management of research funds

Quality of research – and the fulfilment of government policy goals regarding research – depends on the quality of research managers, as much as on the quality of research teams. Research management is a professional field - within government, universities, industry and civil society organizations. Research management costs are part of research grants costing

In Indonesia, research management is not yet professionalized: individual researcher /research teams carry out much of the work of finding and administering research grants.

Short-term recommendation

- Develop and pilot a scheme to professionalize management of research within government research institutions and universities

- Undertake a study of how research management has been professionalized in 2-3 comparison systems (e.g. Thailand, Australia, Singapore)

- Allocate some of the national research funding available for this purpose

- Require universities and government research institutions to demonstrate that some of their institutional funding is being invested in effective research management

- Reduce the compliance burden on individual researchers and research teams

Requires work by: RISTEK-BRIN, National Research Institutes, universities, government research departments + Ministry of Finance

Medium-term recommendation

- Develop a reward (dividend) scheme for institutions that are successful in attracting competitive research funds and require this to be re-invested in research management

Requires work by: RISTEK-BRIN, National Research Institutes, universities, government research departments + Ministry of Finance

Longer-term recommendation

- None

6.8 Accelerate Growth of Researcher Numbers and Quality

Indonesia's research capability is limited by the capacity of the researchers producing it.

Internationally, the entry-level qualification for most researchers in most fields (with some exceptions for practice-linked disciplines such as medicine and law) is a PhD. PhDs matter for subject matter expertise but also for research culture formation -- the standards, practices and ethics that create quality research and the ability to reproduce researcher human capital. Post-appointment, universities permit academic staff to change their roles over time (often in response to research funding). Individual performance is reviewed annually with goals and KPIs agreed.

Indonesia is coming from a low base, by researchers per million within ASEAN comparison economies and the percentage of university staff with PhDs. PhDs are not required for entry-level research positions and neither universities nor subsequent employers are incentivized to devote time and resources to systematic formation of researcher capability. Comparable economies have managed to grow their human capital faster than Indonesia.

Institutional inflexibility and legal structure for civil servants' limit researcher mobility. Level of effort for research is constrained by inflexible rules. Overseas-educated researchers cannot link their knowledge to systemic improvements. Career pathways are unclear and unsupported. Allocation of time for teaching and service is inflexible and reduces ability to conduct research.

Short-term recommendation

- Announce a national goal to move to PhD as the baseline qualification for entry-level researchers.
- Revise national targets for human capital development to accelerate PhD production in fields in the (new) national research mission that lack sufficient researchers (as for South Korea, Thailand).
- Targets need to include both STEM and non-STEM disciplines because of the predicted importance of interdisciplinary research for responding to mission-oriented research needs.
- Create a new category of 2-3 year funded fellowships for post-doctoral researchers that is portable – allowing them to work with the most productive senior mentors in their discipline
- For existing researchers, review the implementation of the tri dharma framework within universities in order to satisfy this requirement at the institutional level (overall workforce) rather than at the individual level.

Requires work by: RISTEK-BRIN, universities, Ministry of Finance, Ministry of Administrative and Bureaucratic Reform

Medium-term recommendation

- Require 50% new university appointments to hold PhDs or professional equivalents.
- Include PhD training within research funding schemes
- Consider a funding scheme for creating/strengthening domestic centres and networks for national PhD training (as in the UK) and/or making this an element of support for professors who are recognized as outstanding supervisors and mentors (as in Australia)
- Develop an agreed set of research training modules for national implementation that target early career researchers (meaning both PhD students and post-doctoral researches) (potentially with international support)
- Develop a national research ethics code that underscores academic freedom and responsibilities and develops processes for peer-review of research design

Requires work by: RISTEK-BRIN, universities, + Ministry of Finance

Longer-term recommendation

- Require all new university appointments to hold PhD qualifications
- Revise workload expectations and career pathways to permit postdoctoral researchers to have more dedicated research time earlier in their careers

- Ensure that competitive research funding schemes at the institutional level include specific allocations for early-career researches (meaning both PhD students and post-doctoral researchers)

Requires work by: RISTEK-BRIN, universities, Ministry of Finance, Ministry of Administrative and Bureaucratic Reform

6.9 Grow Research networks

A key part of knowledge creation is testing research ideas and results through debate. Indonesian knowledge ecosystem lacks institutions and spaces for research ideas to be debated and defended publicly and professionally.

Internationally, a significant proportion of researcher time is spent presenting research ideas and results publicly, through workshops, conferences, academic blogging, social media posts and community meetings, both domestically and internationally.

Indonesian researcher participation in domestic and international conferences by discipline is low for a middle-income country. This affects research output quality and international perception of Indonesian research quality.

Short-term recommendation

- Make government research funding conditional on a clear plan for disseminating research results, including holding academic conferences

Requires work by: RISTEK-BRIN + Ministry of Finance

Medium-term recommendation

- Ensure competitive grants allow budget items support for the creation of national academic networks and associations and conferences and for international conference attendance

Requires work by: RISTEK-BRIN + Ministry of Finance

Longer-term recommendation

- Use evidence of membership of international research networks and associations as a criterion for grant application evaluation

Requires work by: RISTEK-BRIN + Ministry of Finance

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APPENDIX A: METHODOLOGY

Research methodology for this report

This is research to support policy; it was commissioned by the Knowledge Sector Initiative (KSI) as part of an Australian-government funded collaboration with Indonesia's National Development Agency (BAPPENAS). It was carried out under the supervision of KSI and with inputs from participants who are both informants and ultimate users of the report. The primary research team belongs to a non-profit think tank Centre for Innovation Policy and Governance (CIPG)[82] and was selected by KSI as one of the policy research institutions (PRI) that it supports. The Australian National University (ANU) is partnered with KSI to help build research capacity of local policy research institutes (PRIs).

The focus of the work is a policy question that is politically contested and consequential – who should control resourcing and credentialling of research and researchers in Indonesia? The political history of research in Indonesia and the dominant role that has been played by government is well-documented and referenced in Sections 1and 2 of this report. CIPG sought to develop potential policy options that are consistent with or suggested by the project data. Thus, this report and its recommendations are inevitably the product of compromise and some predictive guessing about what will be palatable to and viable for those with a stake in the political question of how research will be regulated in Indonesia.

This report is based on applied research that used qualitative approaches to data collection. Applied research is deliberately designed to answer specific issues that need practical responses and solutions in the near future (Neumann, 2011), rather than to build, test or find links with specific theories.[83] The team chose qualitative approaches because the fokus kajian (research focus) of the study is Indonesia's research ecosystem and the actors that animate it. Qualitative research generally uses multiple data sources (Neumann, 2011) to help build a picture of complex phenomena, and in this study CIPG drew on two types of data.

Primary data in this study was collected between December 2019 and April 2020, by CIPG, using qualitative interviews with 43 Indonesian stakeholders. The participants in this study belong to organizations that create, regulate and/or use research in Indonesia: government policymakers, researchers, university academics, funding institutions, academic associations, think tanks and the private sector. A full list of the participants is included in Appendix B.

Participants were selected purposively, starting with a 'key actors' analysis of which organizations are most closely associated with, active in, or affected by, the five research themes of this study:

- The quality of research and innovation policy;
- Indonesia's research ecosystem: actors and structures;
- The role of research funding and its impact on research capacity;
- Research human capital – the creation, quality, motivations and behaviours of researchers;

[82] https://cipg.or.id/en/profile/

[83] Neumann (2011: 33-34) identifies four important qualities of applied research:
- The process of setting priority needs or priority problem;
- The process of identifying sources of information when making assessment;
- Explicit and urgent needs that might not cover the whole problem or long-term solution and
- The final solution might be one that is unexpected, or that is not so practical in terms of its implementation.

Research collaboration

CIPG then checked the 'key actors' for each research theme by location, size, sector (government/non-government/industry) to see if we could generate variation to capture, in a sample form, the range of actors and experience across the Indonesian archipelago. Within each organization our research design sought to sample at least two areas (one science, technology, engineering and mathematics (STEM)-focused and one humanities and social science (HASS)-focused) and to seek participants from the management or leadership tier and then in research institutions, also from the established researcher tier and early-career researcher tier. The intent was to try to capture the views of those closest to policy and resourcing decision making, and those tasked with designing and carrying our research, or new to the institutional environment.

For Part 4 of the study (human capital), interviews were focused on universities as the foundational locations in which Indonesia's research human capital is formed. Interviews were conducted with academic staff members and administrative staff within those universities' research and community institute (LPPM). The original research design also called for interviews with Deans and members of the university Executive, but this proved to be too complex to arrange during the early stages of COVID-19.

The selection of the target universities was based on their classification and location; the purposive sample included PTN BH (state universities with legal entity status) within Java (Universitas Indonesia; Universitas Gadjah Mada; Bandung Institute of Technology (ITB), I Institut Pertanian Bogor (IPB) and outside Java (Universitas Hasannudin); PTN BLU (state universities with public service body status) (Universitas Brawijaya); PTN Satker (state universities with working unit status) (Universitas Musamus); universities with religious affiliations (UIN Sunan Kalijaga Yogyakarta); and private universities (Universitas Ma Chung; i3L; Universitas Binus). The objective of choosing different levels of target universities was to gain an even distribution of information and to try to capture views from diverse positions within the system.

On average, we selected two interviewees from each university – an academic staff member and an LPPM employee or director. We interviewed academic staff members in order to explore their personal experience working as researchers. Their responses focussed on their individual experience of obstacles and expectations within the research ecosystem. The interviews with LPPM staff aimed to produce data on the research strategies of each university, particularly research funds management, human resources (HR) management, and challenges that the observe from an institutional standpoint.

COVID-19 effect

The original design included at least one regional comparative study, including individual and group discussions with research actors outside Jakarta, in order to provide regional perspectives. The COVID-19 pandemic in 2020 significantly affected the research for this study; in particular it meant that most interviews could not be conducted in person and the planned regional study could not be carried out. The result is that most participants in this study (38) came from Java (Jakarta and other major cities including Bogor, Depok, Bandung, Yogyakarta, and Malang). The remaining (5) participants came from cities outside Java (Makassar and Merauke).

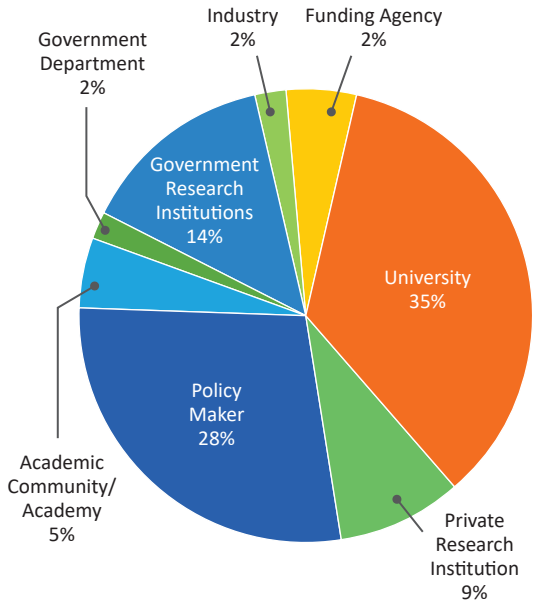
The need to respond to the pandemic in Indonesia limited the availability of some government and university respondents; this meant that the team had to modify the research design and seek interviews with the best available respondent.

We should also note that the study coincided with a period of government restructuring in Indonesia after the creation of the new Research and Innovation agency (BRIN) and that uncertainty about appointments at senior levels within this agency and in other Ministries affected the availability and willingness of some respondents to speak about policy issues.

The overall composition of the study participants can be found in the Figure 8.1.

FIGURE 8.1 **COMPOSITION OF STUDY PARTICIPANTS**

Participants = 43



Note:

The category of Higher Education Institutions includes all types of the higher education institutions both state-owned and private as mentioned within UU No. 12/2012: Universities, Institutes, Colleges, Academy, Community Colleges, and Polytechnics. The Private Research Institutions category refers to the R&D institutions that are non-state and not a higher education institution. This include industry's R&D units, private research group, think tanks, and also research-based NGOs and public research institutes. The Academic Community in this study refers to groups or networks of scientists and experts on particular areas/issues under one group/network umbrella. Indonesia Academy of Young Scientists (ALMI) and Indonesia Academy of Sciences (AIPI) belong to this category. The category Government R&D Institutions includes state-owned institutions, both ministerial or non-ministerial, that carry out Research, Development, Assessment and/or Application (Litbangjirap) activities. It also includes research and development agencies (Balitbang) under their respective Ministry, LIPI, and BPPT. The Research Funding Institutions category includes funding agencies, both state-owned and non-state, that distribute research funding to researchers and research institutions. Policy Maker category includes high-level decision makers in Ministries and Non-Ministerial Institutions within the Government.

Consent and confidentiality

The primary data was gathered through group interviews and individual interviews. Formal consent was sought from, and recorded for, all participants by CIPG. Regardless of whether participants agreed to be identified by name in this report, or other documents flowing from the study, we have decided to refer to participants by code, rather than by name. Every effort has been made to protect the confidentiality of our respondents; however, respondents also understand that they could be identified by their reported comments.

Group Interviews

Group interviews are a familiar and accepted form of gathering views to inform research in Indonesia, as they are elsewhere in the world (e.g. Creswell, 2014). For this study, CIPG used a group interview in December 2019 in Jakarta to launch the project and seek the opinions of high-ranking policymakers in Indonesia, who are critical to this study. This took the form of policy round-table discussion over 2.5 hours on 'Accelerating the Improvement of Indonesia's Research Competitiveness', and an invitation to help shape the study's research focus. CIPG identified and iterated the five themes chosen for this report in part from the views and opinions that were put in that first group interview. Two further group interviews were conducted during early 2020 and these focused-on research institutions and research funding. Each of these took place over 2 hours.

Individual Interviews

Individual, in-depth interviews were important to this study because they offered the opportunity to gain more insight into 'participants' thoughts, beliefs, knowledge, reasoning, motivation, and feelings' (Johnson, 2011). Those interviews were carried out in Indonesia in two phases: February – March 2020 and April – May 2020.

The first phase interviews focused on strategies for research and innovation policies (strategy), institutional structure within the research ecosystem (structure), and research funding (finance). Participants in these interviews were from universities, from policy departments within government Ministries, from research funding institutions, private research institutions, or from industry. Initially, these interviews took place at the participants' workplaces over 1-2 hours, but due to the COVID-19 pandemic, CIPG ceased conducting face to face interviews during this phase. We note with sadness that during the project, one of our interview respondents in Jakarta passed away due to COVID-19.

These were unstructured interviews that led with one or two key questions, such as:

- Have the strategies concerning research in Indonesia (the laws, the RPJMN, and national research master plan (RIRN)) been effective in supporting our country's research competitiveness? Do we need some kind of special 'grand strategy'?

- How do research institutions shape the research ecosystem in Indonesia? How can BRIN support the productivity of state research institutions?

- How do you understand research funding mechanisms and how research budgets are allocating to and by your research institution? What do you identify as issues or challenges with this?

In the second phase (April – May 2020), data collection focused more on topics concerning research human capital and research governance (including research networks and research dissemination).

All the interviews for this phase were conducted remotely by video conference applications, such as Zoom and Google Meet. Some of the key questions explored in this phase were as follows:

- Please describe the mechanism for recruiting and developing human resources in the research division research governance and procedures for monitoring and evaluating research activities, in your organization;

- How does your organization define "research," and conduct it?

- How do you regard the current performance of your research institution (from aspects of quantity, quality, and its relevance with end users)?

- What efforts that need to be made to foster research networks and, research collaboration that will effectively support the knowledge transfer process?

All the group and individual interviews were recorded, with the participants' consent, and transcribed. We used Dedoose as the qualitative data software to manage the data and record the coding for the transcripts prior to data analysis.

Documentation

The study used documentary sources of data including Indonesian laws and regulation, public policies, Presidential state-of-the-nation addresses, national development plans, institutional reports, news articles, and publications of research results related to the themes of this. It also drew on international data bases and self-reported qualitative and quantitative data from OECD and ASEAN economies that are also engaged in reforming and strengthening their national research and development capabilities. Throughout the report we use international comparisons of 'best practice' drawn from academic literature sourced by ANU researchers across multiple disciplines that analyzes mature knowledge economies (Australia, Japan, South Korea, the United Kingdom, the United States) and ASEAN economies that closest to Indonesia in their stage of research and innovation development (e.g. Thailand, Vietnam).

APPENDIX B: STUDY PARTICIPANTS

TABLE 9.1 **SCOPING WORKSHOP PARTICIPANTS**

NO	PARTICIPANTS	ORGANISATION	POSITION	GENDER	CATEGORY
1	Ainun Na'im	Ministry of Research and Technology/BRIN	Secretary General (*Sekretaris Jendral*)	M	Policy Maker
2	Alan Koropitan	Academy of Indonesia Young Scientists/ Akademi Ilmuwan Muda Indonesia (ALMI)	Head of Academy of Indonesia Young Scientists (ALMI)	M	Academic Community (*Komunitas Akademik*)
3	Bambang Prijambodo	Ministry of National Development Planning (Bappenas)	*Deputi Bidang Ekonomi, Kementerian PPN/Bappenas*	M	*Sekretaris Jenderal, Akademi Ilmu Pengetahuan* Indonesia
4	Chairil Abdini	Indonesian Academy of Sciences (AIPI)	Secretary General (*Sekretaris Jendral*)	M	Academic Community (*Komunitas Akademik*)
5	Dudi Hidayat	Indonesian Institute of Sciences (LIPI)	STI Policy Researcher, Center for Science and Technology Development Research (*Pelaksana Tugas Pusat Penelitian Kebijakan dan Manajemen Ilmu Pengetahuan, Teknologi dan Inovasi*)	M	Government Research Institution
6	Erry Ricardo Nurzal	Ministry of Research and Technology/BRIN	Head of Planning Bureau (*Kepala Biro Perencanaan*)	M	Policy maker
7	Iwan Untung	Ministry of Finance	Directorate of Budgeting Regulation Harmonization of the Ministry of Finance	M	Policy maker
8	Muji budd'ah	Ministry of Finance	Directorate of Budgeting Regulation Harmonization of the Ministry of Finance	M	Policy maker
9	Representative	Ministry of Finance	Badan Kebijakan Fiskal (BKF)	M	Policy maker
10	Representative	Ministry of Finance	Badan Kebijakan Fiskal (BKF)	M	Policy maker
11	Roro Vera Yuwantari Susilastuti	Ministry of Administrative and Bureaucratic Reform (KemenPANRB)	Head of Institutional Assessment III (*Kepala Bidang Asesmen Kelembagaan* III)	F	Policy maker
12	Subandi	Ministry of National Development Planning (Bappenas)	Deputy for Human Development and Development of the Community and Culture Bappenas	M	Policy maker
13	Yudho Baskoro Muriadi	Ministry of Research and Technology/BRIN	Deputy Director for Government R&D Institutions (*Kepala Subdirektorat Penjaminan Mutu dan Peniliaian Kinerja Lembaga Penelitian dan Pengembangan, Direktorat Lembaga Penelitian dan Pengembangan*)	M	Policy maker
14	Zanaria	Indonesian Endowment Fund for Education (LPDP)	*Kepala Divisi Seleksi Riset, Direktorat Fasilitasi Riset dan Rehabilitasi*	M	Funding Agency

TABLE 9.2 **INTERVIEW PARTICIPANTS**

INTERVIEW NO	ORGANISATION	POSITION	GENDER	CATEGORY
1	The Indonesian Science Fund (Dana Ilmu Pengetahuan Indonesia, DIPI)	Executive Director of DIPI	M	Funding Agency
2	Indonesia International Institute for Life-Sciences (i3L)	Head of Bioinformatics Department	M	University (Private)
3	SMERU Research Institute	Director of SMERU Research Institute	F	Private Research Institution
4	University of Indonesia (UI)	Head of Communication Research Center (*Pusat Kajian Komunikasi* UI)	F	University (PTN-BH)
5	Institut Pertanian Bogor (IPB)	Head of Research and Community Service Agency (*Lembaga Penelitian dan Pengabdian kepada Masyarakat*/ LPPM) IPB	M	University (PTN-BH)
6	Institut Pertanian Bogor (IPB)	Head of Veterinary Stem Cells Laboratory (PPSHB-IPB)	M	University (PTN-BH)
7	Ministry of National Development Planning (*Kementerian Perencanaan Pembangunan Nasional/ Bappenas*)	Director of Industry, Tourism and Creative Economy (*Direktur Industri, Pariwisata dan Ekonomi Kreatif) Bappenas*	M	Policy maker
8	PT Kalbe Farma Tbk	Director of R&D Pharma, PT Kalbe Farma Tbk	M	Industry
9	Center for Strategic and International Studies (CSIS)	Head of the Department of Economics (CSIS)	M	Private Research Institution
10	Gajah Mada University (UGM)	Department of Management and Public Policy (UGM)	M	University (PTN-BH)
11	Rikolto Indonesia	Planning, Learning, and Accountability Coordinator	F	Private Research Institution
12	Hasanuddin University	Faculty of Marine Science and Fisheries	M	University (PTN-BH)
13	Hasanuddin University	Head of Research and Community Service Agency (Lembaga Penelitian dan Pengabdian kepada Masyarakat/LPPM) Unhas	M	University (PTN-BH)
14	Perkumpulan PRAKARSA	Executive Director of the Perkumpulan PRAKARSA	M	Private Research Institution
15	The Indonesian Agency for Agricultural Research and Development (*Balitbangtan*)	Head of *Balitbangtan* 2010-2015	M	Government Research Institution
16	Gajah Mada University (UGM)	Head of Research and Community Service Agency (*Lembaga Penelitian dan Pengabdian kepada Masyarakat*/ LPPM) UGM	M	University (PTN-BH)
17	Universitas Musamus	Head of Research and Community Service Agency (*Lembaga Penelitian dan Pengabdian kepada Masyarakat*/ LPPM) Universitas Musamus)	M	University (PTN-Satker)
18	Universitas Musamus	Faculty of Agriculture Universitas Musamus	M	University (PTN-Satker)

INTERVIEW NO	ORGANISATION	POSITION	GENDER	CATEGORY
19	Ma Chung University	Head of Ma Chung Research Center for Photosynthetic Pigments (MRCPP)	M	University (Private)
20	Bandung Institute of Technology (ITB)	Head of Research and Community Service Agency (*Lembaga Penelitian dan Pengabdian kepada Masyarakat*/ LPPM) ITB	M	University (PTN-BH)
21	National Institute of Health Research and Development (Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan/ Balitbangkes)	*Ketua Komisi Etik Penelitian Kesehatan*	M	Government Research Institution
22	Brawijaya University	Head of Research and Community Service Agency (*Lembaga Penelitian dan Pengabdian kepada Masyarakat*/ LPPM) Brawijaya University	M	University (PTN-BLU)
23	Sunan Kalijaga State Islamic University (UIN Sunan Kalijaga)	Researcher and Head of Research and Community Service Agency (*Lembaga Penelitian dan Pengabdian kepada Masyarakat*/LPPM) UIN Sunan Kalijaga	M	University (PTN-RA)
24	Brawijaya University	*Dosen Fakultas Teknologi Pertanian Universitas Brawijaya*	F	University (PTN-BLU)
25	Unknown	Unknown	M	Policy maker

TABLE 9.3 **BREAKFAST MEETING – GROUP INTERVIEW PARTICIPANTS**

NO	PARTICIPANTS	ORGANISATION	POSITION	GENDER	CATEGORY
1	Laksana Tri Handoko	The Indonesian Institute of Sciences (Lembaga Ilmu Pengetahuan Indonesia/LIPI)	Head of LIPI	M	Government Research Institution
2	Rini Widyantini	Ministry of State Apparatus Utilization and Bureaucratic Reform (Kementerian Pemberdayaan Aparatur Negara dan Reformasi Birokrasi/KemenPAN-RB)	Deputy Minister for Institutional and Governance Affairs (Deputi Bidang Kelembagaan dan Tata Laksana KemenPAN-RB)	F	Policy maker
3	Dadan Moh. Nurjaman	Agency for the Assessment and Application of Technology (Badan Pengkajian dan Penerapan Teknologi/BPPT)	General Secretary of BPPT	M	Government Research Institution
4	Wahyu Widodo Pandoe	Agency for the Assessment and Application of Technology (Badan Pengkajian dan Penerapan Teknologi/BPPT)	Deputy of Industrial Technology Design and Manipulation (Deputi Bidang Teknologi Industri Rancang Bangun dan Rekayasa BPPT)	M	Government Research Institution

APPENDIX C: RESEARCH, DEVELOPMENT AND INNOVATION LAWS AND REGULATIONS IN INDONESIA

TABLE 10.4 **RESEARCH, DEVELOPMENT AND INNOVATION LAWS AND REGULATIONS IN INDONESIA**

PERATURAN PERUNDANG-UNDANGAN	
Undang-Undang (UU)	*UU No. 25 Tahun 2004 tentang Sistem Perencanaan Pembangunan Nasional*
	UU No. 17 Tahun 2007 tentang Rencana Pembangunan Jangka Panjang Nasional Tahun 2005-2025 (RPJPN 2005-2025)
	UU No 11 tahun 2019 tentang Sistem Nasional Ilmu Pengetahuan dan Teknologi
	UU No. 12 Tahun 2012 tentang Pendidikan Tinggi, universitas dapat direstrukturisasi menjadi Perguruan Tinggi Negeri Badan Hukum (PTN-BH)
	UU No. 3 Tahun 2014 tentang Perindustrian
	UU No. 13 Tahun 2016 tentang Paten
	UU No. 23 Tahun 2014 tentang Pemerintahan Daerah
	UU No. 20 Tahun 2003 tentang Sistem Pendidikan Nasional
Peraturan Pemerintah (PP)	*PP No. 39 Tahun 1995 tentang Penelitian dan Pengembangan Kesehatan*
	PP No. 41 Tahun 2006 tentang Perizinan Melakukan Kegiatan Penelitian dan Pengembangan Bagi Perguruan Tinggi Asing, Lembaga Penelitian dan Pengembangan Asing, Badan Usaha Asing dan Orang Asing
	PP No. 35 Tahun 2007 tentang Pengalokasian Sebagian Pendapatan Badan Usaha untuk Peningkatan Kemampuan Perekayasaan, Inovasi, dan Difusi Teknologi
	PP No 48 Tahun 2009 tentang Perizinan Pelaksanaan Kegiatan Penelitian, Pengembangan, dan Penerapan Ilmu Pengetahuan dan Teknologi yang Berisiko Tinggi dan Berbahaya
	PP No. 13 Tahun 2014 tentang Jenis dan Tarif Atas Jenis Penerimaan Negara Bukan Pajak yang Berlaku pada Kementerian Riset dan Teknologi
	PP No. 45 Tahun 2016 tentang Perubahan Kedua Atas Peraturan Pemerintah Nomor 45 Tahun 2014 Jenis dan Tarif Atas Jenis Penerimaan Negara Bukan Pajak yang Berlaku Pada Kementerian Hukum dan HAM (tax deduction untuk kegiatan penelitian dan pengembangan)
	PP No. 29 Tahun 2018 tentang Permberdayaan Industri
	PP No. 14 Tahun 2015 tentang Rencana Induk Pembangunan Industri Nasional (RIPIN) 2015 – 2035
	PP No. 79 Tahun 2014 tentang Rencana Umum Energi Nasional (RUEN) 2017-2050
	PP No. 45 Tahun 2019 Perubahan atas Peraturan Pemerintah Nomor 94 Tahun 2010 tentang Penghitungan Penghasilan Kena Pajak dan Pelunasan Pajak Penghasilan dalam Tahun Berjalan (triple-tax-deduction)
	PP No. 38 Tahun 2017 tentang Inovasi Daerah
	PP No. 26 Tahun 2015 tentang Bentuk dan Mekanisme Pendanaan Perguruan Tinggi Negeri Badan Hukum yang telah diubah dengan PP No. 8 Tahun 2020 tentang Perubahan atas PP No. 26 Tahun 2015 tentang Bentuk dan Mekanisme Pendanaan Perguruan Tinggi Negeri Badan Hukum
	PP No. 17 Tahun 2010 tentang Pengelolaan dan Penyelenggaraan Pendidikan
Peraturan Presiden (Perpres)	*Perpres No. 18 Tahun 2020 tentang Rencana Pembangunan Jangka Menengah Nasional Tahun 2020-2024 (RPJMN 2020-2024)*
	Perpres No. 38 Tahun 2015 tentang Kerja Sama Pemerintah dengan Badan Usaha dalam Penyediaan Infrastruktur
	Perpres No. 106 Tahun 2017 tentang Kawasan Sains dan Teknologi
	Perpres No. 16 Tahun 2018 tentang Pengadaan Barang dan Jasa Pemerintah
	Perpres No. 38 Tahun 2018 tentang Rencana Induk Riset Nasional Tahun 2017-20145
	Perpres No. 142 Tahun 2018 Rencana Induk Pengembangan Ekonomi Kreatif Nasional (RIEKN) Tahun 2018 – 2025
	Perpres Nomor 77 Tahun 2020. Tata Cara Pelaksanaan Paten oleh Pemerintah
	Perpres no. 5 tahun 2006 Tentang Kebijakan Energi Nasional (KEN)

PERATURAN PERUNDANG-UNDANGAN	
Peraturan Menteri	*Permenristekdikti No. 36 Tahun 2018 tentang Tata Cara Penyusunan PRN dan Mekanisme Pemantauan dan Evaluasi Pelaksanaan PRN*
	Permenristekdikti No. 1 Tahun 2018 tentang Tim-Koordinasi-Pengawasan-Sanksi Kegiatan Litang yang dilakukan Pihak Asing
	Permen Ristek No. 4 Tahun 2007 tentang Tata Cara Pelaporan Kekayaan Intelektual, Hasil Kegiatan Penelitian dan Pengembangan dan Hasil Pengelolaannya
	Permen Ristek No. 1 Tahun 2010 tentang Kriteria, Syarat, dan Tata Cara Pengenaan Tarif Sebesar USD 0,00 (Nol Dollar Amerika) atas Jenis Penerimaan Negara Bukan Pajak yang Berlaku pada Kementerian Riset dan Teknologi yang berasal dari Perizinan Penelitian dan Pengembangan bagi Perguruan Tinggi Asing dan Lembaga Penelitian dan Pengembangan Asing
	Permen Ristek No. 2 Tahun 2010 tentang Syarat dan Tata Cara Pengenaan Tarif atas Jenis Penerimaan Negara Bukan Pajak yang Berlaku pada Kementerian Riset dan Teknologi yang berasal dari Jasa Sewa Prasarana Pusat Penelitian Ilmu Pengetahuan dan Teknologi
	Peraturan Menteri PPA No. 31 Tahun 2010 tentang Pedoman Pengelolaan Penelitian Pengarusutamaan Gender, Pemberdayaan Perempuan dan Perlindungan Anak
	Permen Ristek No. 1 Tahun 2012 tentang Bantuan Teknis Penelitian dan Pengembangan Kepada Badan Usaha
	PMK No. 142 Tahun 2012 tentang Tarif Layanan Badan Layanan Umum Pusat Penelitian dan Pengembangan Teknologi Minyak dan Gas Bumi "Lemigas" Pada Kementerian Energi dan Sumber Daya Mineral
	Permen Kehutanan No. 92 Tahun 2014 tentang Tata Cara Pengenaan, Pemungutan dan Penyetoran Penerimaan Negara Bukan Pajak Bidang Penelitian dan Pengembangan Kehutanan
	Permen Ristekdikti No. 13 Tahun 2015 tentang Rencana Strategis Kementerian Riset, Teknologi, dan Pendidikan Tinggi Tahun 2015-2019
	Permen Ristekdikti No. 42 Tahun 2016 tentang Pengukuran Kesiapterapan Teknologi
	Permen Ristekdikti No. 14 Tahun 2017 tentang Negative List, Daftar Kegiatan dan Objek Perizinan Penelitian Asing yang Tidak Direkomendasikan
	Permenristekdikti No. 20 Tahun 2017 tentang Pemberian Tunjangan Profesi Dosen dan Tunjangan Kehormatan Profesor
	Permenristekdikti No. 9 Tahun 2018 tentang Akreditasi Jurnal Ilmiah
	Permenristekdikti No. 50 Tahun 2018 tentang Standar Nasional Perguruan Tinggi
	Permenristekdikti No. 12 Tahun 2019 tentang BOPTN
	Permenristekdikti No. 29 Tahun 2019 tentang Pengukuran dan Penetapan Tingkat Kesiapan Inovasi
	PMK No. 35 Tahun 2018 tentang Pemberian Fasilitas Pengurangan Pajak Penghasilan Badan
	PMK No. 72 Tahun 2015 tentang Imbalan yang Berasal dari PNBP Royalti kepada Inventor
	(PMK) No.106 Tahun 2016 tentang Standar Biaya Keluaran (SBK) Tahun Anggaran 2017
	PMK No. 69 Tahun 2018 tentang Standar Biaya Keluaran 2019
	Peraturan Menpan-RB No. 34 tahun 2018 tentang Jabatan Fungsional Peneliti
	Peraturan LIPI No. 14 tahun 2018 tentang Petunjuk Teknis Jabatan Fungsional Peneliti.
	Permenristekdikti No. 20 tahun 2017 tentang Pemberian Tunjangan Profesi Dosen dan Tunjangan Kehormatan Profesor.
	Permenristekdikti No. 69 tahun 2016 tentang Pedoman Pembentukan Komite Penilaian dan Tata Cara Pelaksanaan Penilaian Penelitian Menggunakan Standar Biaya Keluaran Tahun 2017
	Peraturan Menpan-RB No. 17 tahun 2013 yang kemudian diubang dengan Peraturan Menpan-RB No. 46 Tahun 2013 tentang Jabatan Fungsional Dosen Dan Angka Kreditnya
	Peraturan Badan Kepegawaian Negara (BKN) No. 9 tahun 2019 tentang Petunjuk Pelaksanaan Pembinaan Jabatan Fungsional Peneliti
	Permendikbud No. 33 Tahun 2012 Tentang Pengangkatan dan Pemberhentian Rektor/Ketua/Direktur pada Perguruan Tinggi yang diselenggarakan oleh Pemerintah

PERATURAN PERUNDANG-UNDANGAN	
Peraturan Lain	*Keputusan Menteri Keuangan No. 373 Tahun 2004 tentang Pembebasan Bea Masuk dan Cukai Atas Impor barang Untuk Keperluan Penelitian dan Pengembangan Ilmu Pengetahuan*
	Keputusan Menteri Ristekdikti No. 498 Tahun 2015 tentang Pembentukan Program Insentif Riset Sistem Inovasi Nasional Kementerian Riset dan Teknologi
	Peraturan Lembaga LKPP No. 7 Tahun 2020 tentang Perubahan Atas Peraturan Lembaga Kebijakan Pengadaan Barang/Jasa Pemerintah Nomor 11 Tahun 2018 Tentang Katalog Elektronik
	Peraturan Bersama Menteri Pendidikan dan Kebudayaan dan Kepala Badan Kepegawaian Negara Nomor 4/VIII/PB/20l4 dan Nomor 24 Tahun 2014 tentang Ketentuan Pelaksanaan Peraturan Menteri Pendayagunaan Aparatur Negara Dan Reformasi Birokrasi Nomor 17 Tahun 2013 Sebagaimana telah Diubah dengan Peraturan Menteri Pendayagunaan Aparatur Negara dan Reformasi Birokrasi Republik Indonesia Nomor 46 Tahun 2013 Tentang Jabatan Fungsional Dosen Dan Angka Kreditnya
	Peraturan Kepala LIPI No. 2 tahun 2014 tentang petunjuk teknis peneliti
	Keputusan Kepala BPPT No. 1/Kp/BPPT/I/2009 tentang petunjuk teknis perekayasa.

APPENDIX D: RESEARCHER PROFILES

Nur Huda is a Center for Innovation Policy Governance (CIPG)[84] researcher with an educational background in Sociology from the University of Indonesia. He works with both quantitative and qualitative approaches. His main interest is the distribution of power and capital within society, but he also has experience in network and organizational studies, community development, and behavioural economics. During his time in CIPG, Nur has mostly worked on research and consultation projects related to the knowledge and innovation ecosystem, research and funding governance, and also start-up and business incubation programs.

Irsan Pawennei is a Co-Founder & Advisor at CIPG. He graduated from ITB with a Bachelor of Engineering and holds a Master's degree in management of Science, Technology and Innovation from the University of Manchester. His interests are Innovation, Policy, and Technology. His experience includes working on Science, Technology and Innovation policy and engagement with Indonesian Ministries and local governments. He was co-author for the OECD Review of Innovation Policy 2013, particularly the Indonesia chapter.

Andhina Ratri is a researcher at CIPG who originally graduated with a Bachelor of Agriculture and then expanded her study in development and rural innovation at Wageningen University, Netherlands. She is interested in in sustainable development and gender studies. She is also passionate about education, which has taken her to many rural areas of Indonesia. Recently, she has worked on a series of research consultancies on the research ecosystem, industry innovation, and research funding.

Veronica L. Taylor is a Professor of Law and Regulation in the School of Regulation and Global Governance (RegNet) at the Australian National University: https://researchers.anu.edu.au/researchers/taylor-v

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