2021

SCIENCE OUTLOOK

Academy of Sciences Malaysia

EXECUTIVE SUMMARY

SCIENCE OUTLOOK

Converging Towards Progressive Malaysia 2050

Executive Summary

Version 2

AKADEMI SAINS MALAYSIA

Let us work together to build a condusive STI landscape. In an ever more complex world, we need to make informed decisions based on evidence and data. With this, leaders will make the right decisions in any given scenario.

The Science Outlook 2015 and 2017 are an exemplary initiative on providing evidence-based analysis, insights and recommendations. This is pertinent in ensuring inclusive and integrated STI reforms in critical areas to boost growth and competitiveness for the nation.

YB Datuk Seri Panglima
Wilfred Madius Tangau
Minister of Science, Technology and Innovation

Science Outlook is a flagship study of ASM that aims to present insights supported by relevant data on Malaysia's STI landscape. These inputs from the Science Outlook 2017 report reflect the views of the scientific community and complement key national initiatives.

I hope this report would serve as a useful reference for national STI planning as well as effective monitoring and evaluation. The uptake and implementation of the proposed strategies calls for effective collaboration, coordination and commitment. I am confident that if all parties work together in the spirit of national interest, we can successfully mainstream STI in nation building and converge towards a Progressive Malaysia 2050.

Professor Datuk
Dr Asma Ismail FASc
President, Academy of Sciences Malaysia

Mainstreaming Science, Technology and Innovation (STI) at all levels and sectors is recognised as the key enabler to catalyse productivity, enhance competitiveness and promote inclusive growth. To realise Malaysia's aspiration of becoming among the top innovation-led nations in the world we have to increase STI proficiency and transform the way STI is coordinated and propelled in Malaysia.

The theme *'Converging towards Progressive Malaysia 2050'* is timely towards addressing this vision.

Professor Datuk
Dr Halimaton Hamdan FASc
Chairperson, Science Outlook 2017

Executive Summary

Converging towards Progressive Malaysia 2050

Over the past 50 years Malaysia has transcended from an economy that heavily relied on primary commodities to one which is now driven by high-tech manufacturing and Foreign Direct Investments (FDI). The economy now is geared towards global collaborations to tap on current knowledge and innovations. A sustainable and inclusive developed economy in the 21st century is driven by knowledge capital that fuels technological innovations that are the basis of high value-added enterprises. The various prosperity and development programmes introduced by the Government such as Economic Transformation Programme (ETP) and National Key Economic Areas (NKEA) are founded upon the utilisation of science, technology, and innovation (STI) as the engine of growth. In tandem, Malaysia's aspiration to become an advanced nation can only be realised if Malaysians are a progressive and innovative society.

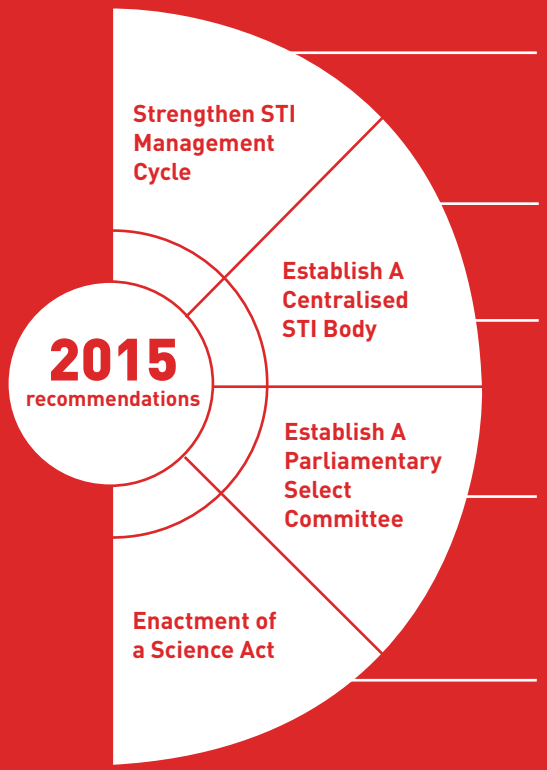
Although Malaysia's growth has been steady, the STI development however has not shown much satisfactory trajectory in comparison to developed nations. In 1986, the First National Science and Technology Policy was formulated and included as a distinctive strand within the Fifth Malaysia Plan (1986–1990). This was followed by other similar action plans, culminating with the NPSTI (2013-2020) – all with the goal of leveraging on STI for inclusive socio-economic transformation. Is Malaysia still playing catch-up?

It is vital to examine the outcomes of these policies, what have been the most significant hurdles to date, what new challenges that are expected to crop up during the transformation period into becoming an advanced economy, and what possible course correct interventions will needed. The Science Outlook 2017 continues to present an objective independent review of the outcome of these policies in building Malaysia's STI capabilities and capacity against international benchmarks. The analyses provided in the Science Outlook 2017 Report are supported with new data collated from the various STI stakeholders in the country, from ministries and agencies, to corporate entities, researchers and policy makers. It also examines if and how the recommendations in Science Outlook 2015 have been implemented, and whether these actions have made an impact on the STI landscape in Malaysia.

Although Malaysia has only begun to make serious public investment in building an STI ecosystem for high technology industry and knowledge-based economy in the past three decades, the Government is committed to implement strategic policies to build the country's R,D&C capacity and capabilities in both the public and private sectors. This is done through establishing a competent and efficient STI governance, strengthening stakeholder network to facilitate resources and expertise sharing through dependable platforms, and building R,D&C infrastructure for strategic national, regional and international STI collaborations. Malaysia has the potential of developing world-class scientific innovations to benefit the country and global denizens; we just need to ensure that we deploy our ideas, talent, and resources effectively and efficiently.

01
STI Governance

CURRENT PROGRESS (2015-2017)



A monitoring mechanism for STI landscape is not in place

The National Science Council (NSC) was formed in January, 2016

A dedicated centralised STI body to operationalise STI-related decisions is yet to be established

Parliamentary Select Committee on STI-related matters has not been established under recent Parliament restructuring

A Science Act is yet to be enacted

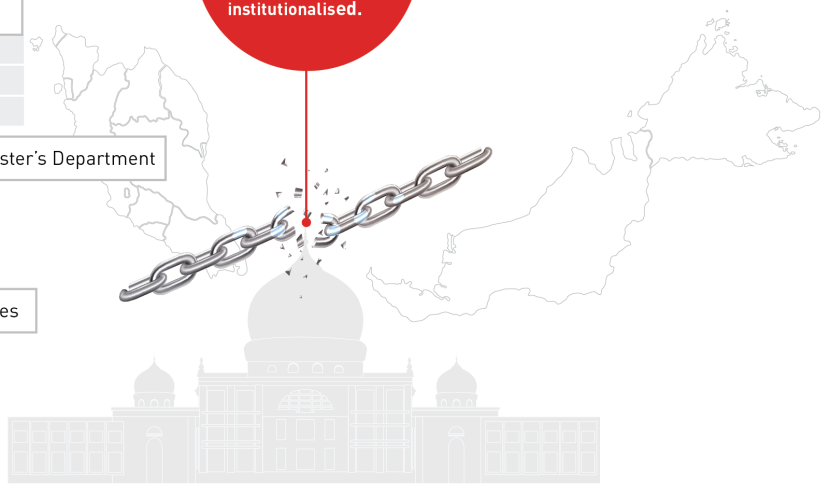
1 NATIONAL STI LANDSCAPE

268 Actors

Too many entities, resources spread too thin and weak follow through.

- **23** ministries
- **157** STI-related entities under respective ministries
- **27** STI-related councils
  - 1 international council
  - 10 councils chaired by Prime Minister
  - 16 national councils
- **16** STI-related entities under Prime Minister's Department
- **20** Public universities
- **6** Intermediaries
- **14** State governments & federal territories
- **5** Economic corridors
- **48** Active, STI-related national policies

Formal dedicated platform between Federal & State Government on STI-related matters is **not institutionalised.**



MEMBERS*

- 12 STI-related Ministries
- 2 State representatives
- 5 representatives from public sector
- 4 representatives from Industry/GLC
- 3 Academics

JOINT SECRETARIAT

- Secretary General of MOSTI
- Science Advisor to the PM

2 NATIONAL SCIENCE COUNCIL

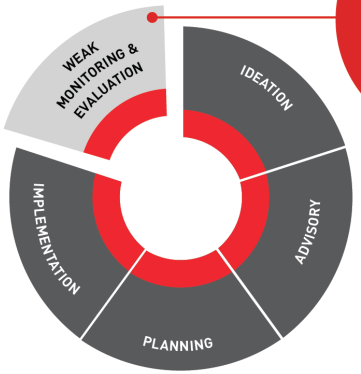
Apex STI advisory body in Malaysia

Chaired by Prime Minister

Has brought closer Ministers and key scientists to discuss STI-related matters.

* Membership as of 1st meeting in January 2016

3 STI MANAGEMENT CYCLE



Crosscutting monitoring and evaluation entity across ministries for STI- related matters is **not in place.**

01

Is the STI Ecosystem Well-Coordinated?

Malaysia is one of Asia's remarkable success stories. Its economic and social development since independence has been impressive. As in many developing countries, in Malaysia the process of modernization is generally understood as to unleash the productive power of science and technology into society and to fuel economic growth for well-being.

STI Governance, the first focus area of this study is especially important in understanding the complexity of actors and entities in the STI landscape. Well informed and independent STI governance plays the primary role in STI development of a country. The actors in the STI Governance like any Governance comprises of the Government and its machinery.

The accountability of the Government is supported by responsive participation from the private sector, academia and civil societies in charting the STI future of the country through mutual sharing of information and exchange of experiences. A strong and stable STI Governance will have the competency and capacity to chart a sustainable orientation through a robust STI ecosystem for the future generation. Good STI Governance overseeing the entirety of the STI ecosystem is paramount as it deals with the public's money for good science to create wealth for its people.

Malaysia's STI landscape unlike countries like the UK and Singapore is multifaceted characterised by the variety of institutions ranging from ministries, agencies, to government-linked corporations. As of December 2017, there are 48 active national STI-related policies in place; and for most the implementation and monitoring is not measured. The national STI landscape overarches 23 Federal Ministries.

There are 26 STI-related national Councils; 10 of these Councils are chaired by the Prime Minister, while the other 16 are chaired by respective Ministers. Six intermediaries are in place to develop and intensify industry-academia collaboration are carried out through. A lot of initiatives are also mirrored under the Prime Minister's Department or Central Agency. There are more than 160 STI-related agencies, foundations, institutes, statutory bodies and companies under respective ministries of which at least 16 are under the Prime Minister's Department.

The plethora of entities engages in every facet of STI policy making and, funding and implementation. Each organisation in the STI landscape is with its own objectives, strategic framework and policy instruments. The multiple stakeholders and support instruments have led to fragmentation of resources, overlapping competencies, and the risk of redundancy resulting in ineffective wealth creation and decision making. The fragmented landscape of the STI ecosystem at present causes inefficiency and dysfunction in the service delivery to support a strong innovation ecosystem.

One of the key components of any STI management cycle is monitoring and evaluation. At present Malaysia's STI management cycle is a fragmented wheel. STI cross-cuts but monitoring activities are only conducted by the ministries for its respective policies. The gaps in the cycle are also caused by components placed under the domain of different agencies. Therefore, alignment of national STI actors through a rationalisation exercise is proposed to be carried for better coordination, monitoring and evaluation and a leaner, empowering and efficient STI Governance.

The National Science Council (NSC) established with the purpose of streamlining the various STI-related councils and act as the apex STI advisory body in the country is chaired by the Prime Minister. It is a step forward for STI Governance in Malaysia as for the first time 12 Ministers from relevant Ministries come together to discuss STI matters. The representation at the NSC however should be more holistic, comprising key public and private sectors

players in order to have an all-inclusive view on implementation progress and issues, and to evaluate new development in the STI landscape. In order to remain sustainable the NSC ideally should be backed up by a legislative mandate and a dedicated and empowered secretariat. Such an entity is missing in our landscape.

At present in Malaysia, the NSC secretariat support comes largely from the Office of Science Advisor to the Prime Minister and the Policy and Strategic Planning Division of MOSTI which also has 14 other functions under its portfolio. A central council such as the NSC requires a more robust bureaucratic intelligentsia - perhaps an aptly named Science Planning Unit (SPU) - to effectively carry out all that has been outlined in its mandate.

A full-time role of the secretariat with often monitoring and evaluation of on-going programmes/projects and, deliberation on new proposals before presentations to the NSC will strengthen the apex body. For SPU to achieve its objectives, it must be granted a legitimate, legislative mandate that is supported with sustainable funding and strategic manpower. Roles and functions of relevant entities can be consolidated to function as a centralised SPU for coordination of planning, monitoring and evaluation of macro STIs as well as working as Secretariat of the NSC.

A National Science Agenda and a STI Masterplan (STIMP) will help in providing the direction for all the players in the ecosystem. At present, neither is in place. A specific national science agenda to serve as the consolidating guideline of the various STI-related policies and governance at present should be developed with an eye to harness STI to achieve Malaysia's aspirations beyond the year 2020. The agenda should nurture an STI ecosystem that supports technological innovations for knowledge-intensive productivity of a high-income nation.

The STIMP outlines the Government's development goals, strategies, parameters, and timeframe to implement the policy framework reflected in the national STI policy will serve as a crucial governance tool to harmonise, consolidate and focus all of the nation's STI-related initiatives and players in consonance with the national aspiration. The STIMP initiative is currently being undertaken by ASM and MOSTI.

Nearly all aspects of national and global development involve STI, underscoring the importance of a dedicated legal structure to facilitate STI governance. Legal instruments such as a Science Act are established to reinforce the Government's and stakeholders' commitment towards STI-related implementation and enforcement. A Science Act will also provide mandate and legislative clout for the NSC and other national STI actors.

A Parliamentary Select Committee (PSC) on STI, made up of a small number of parliamentary members that are appointed should be established. The establishment of PSC on STI is important to build political will and create legislative consensus towards promoting the STI agenda. It will become a formal platform in the parliament to discuss STI issues, supported with expert inputs. Thus, the establishment of the aforementioned committee is important to be included and mandated in the Science Act.

Effective delivery and coordination of STI governance should seamlessly cascade from Federal to State level and vice-versa. This however, requires concerted cooperation between the two. A formal structure with clearly delineated expectations, roles, and supporting network will benefit the development and implementation and coordination of STI Governance in each state.

The lack of effective STI governance in the nation in the last 15 years has caused the state of STI to become retrogressive. In addition, the lack of cross-cutting co-ordination of STI has failed to mainstream STI for socio-economic advancement. STI is usually associated with knowledge generation and technology development. However the direct impact of STI to economic growth has not been well translated in Malaysia.

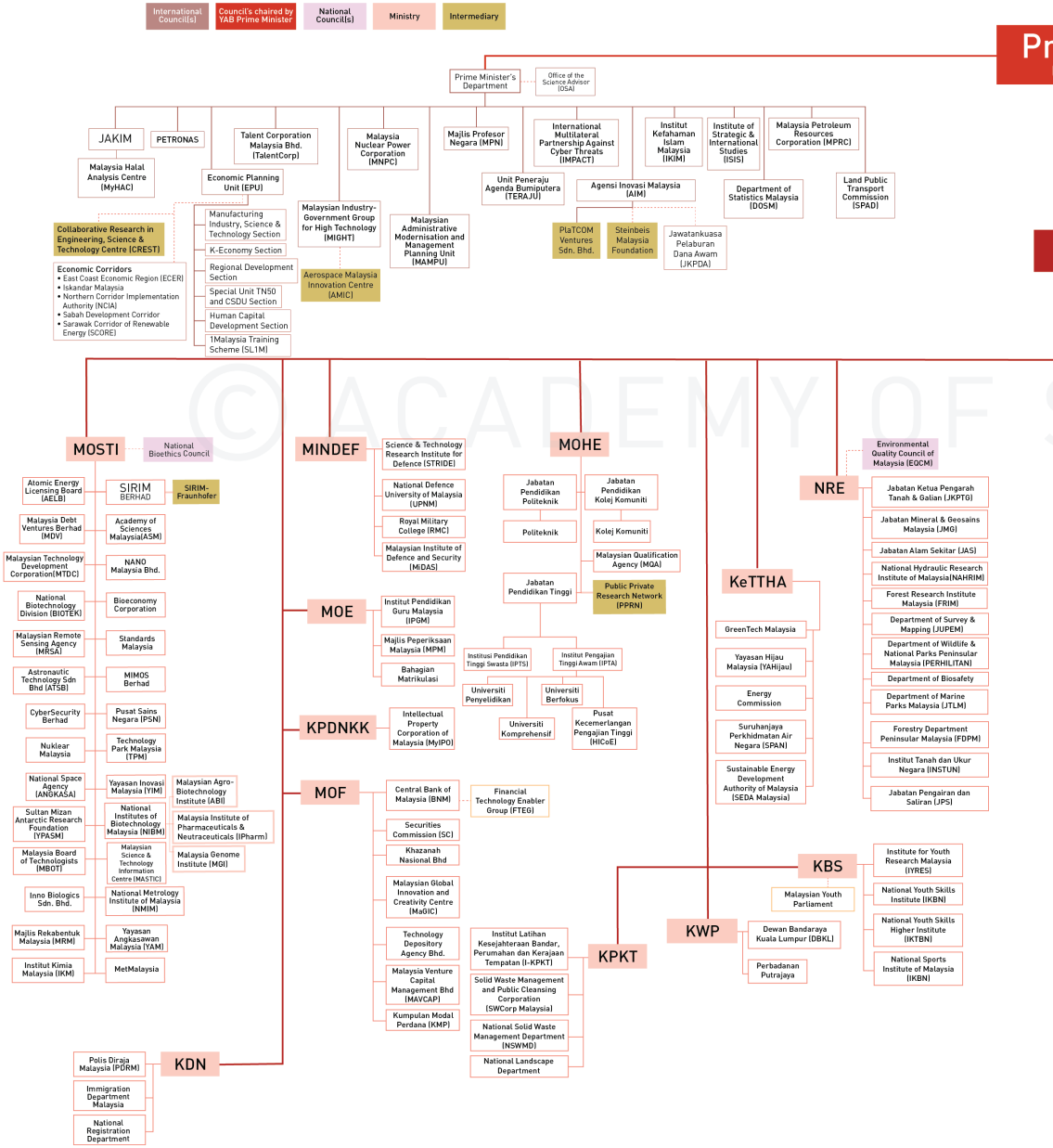
Way Forward

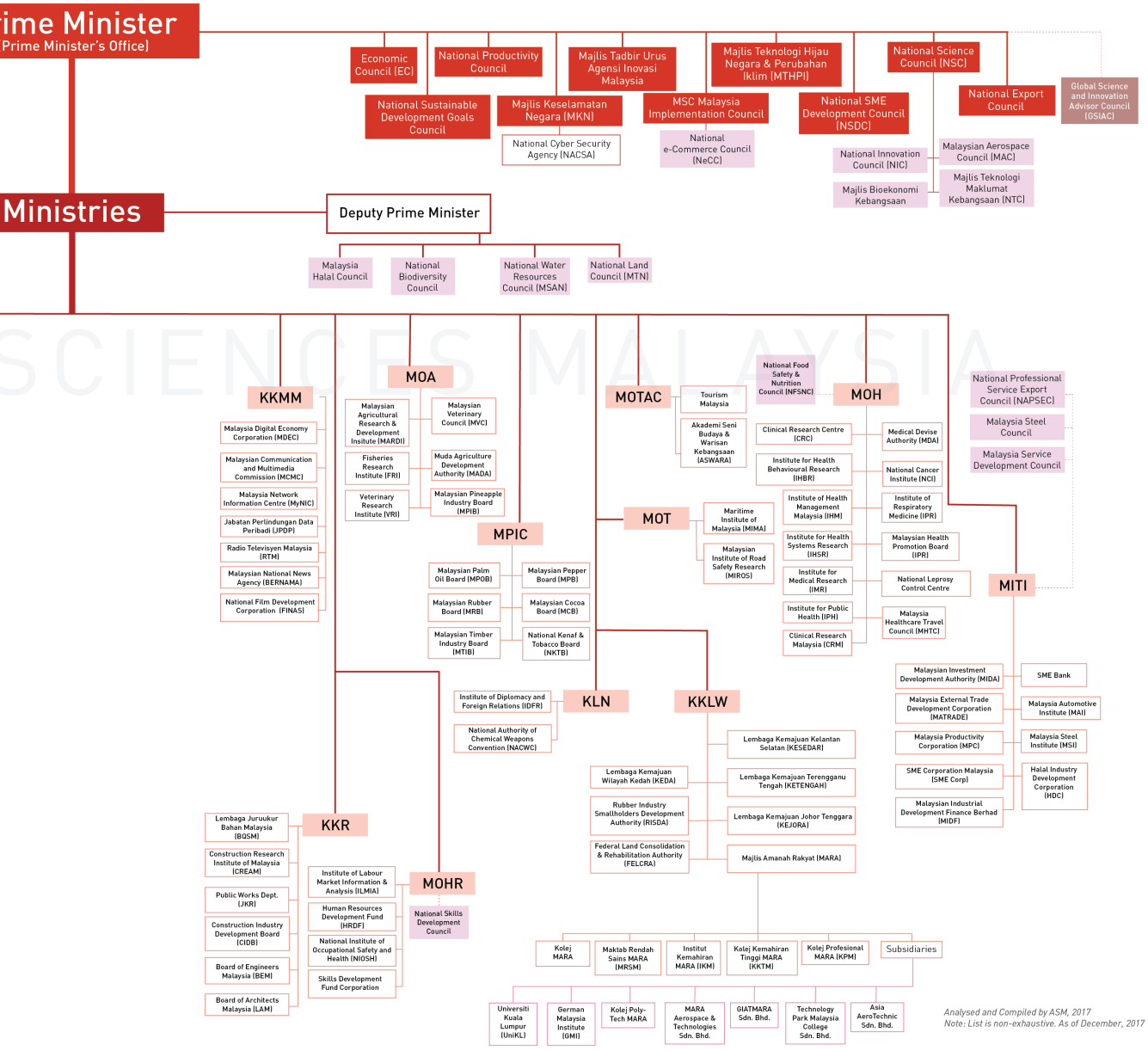
1. Strengthen Science Planning and Coordination through a Centralised Dedicated Body

Alignment of national STI actors through a rationalisation exercise is proposed to be carried out and a centralised STI body named as the Science Planning Unit (SPU) is proposed to be established under the purview of the Prime Minister's Department. SPU will be the enforcement arm of the NSC with a mandate that transcend all ministries to enable greater stakeholder participation and synchronised planning, coordination and monitoring of STI decisions.

2. Establish a Formal STI Platform between Federal and States Governments in West Malaysia as well as Sabah and Sarawak

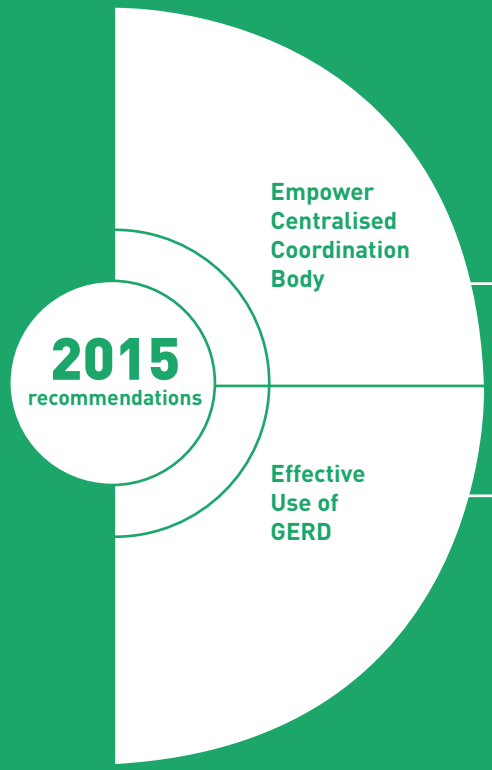
Effective delivery and coordination of STI governance at federal and state level require concerted cooperation between the two. A formal structure with clearly delineated expectations, roles, and supporting network will benefit the development and implementation of STI policies in each state.





Analysed and Compiled by ASM, 2017
Note; List is non-exhaustive. As of December, 2017

02
Research, Development & Commercialisation

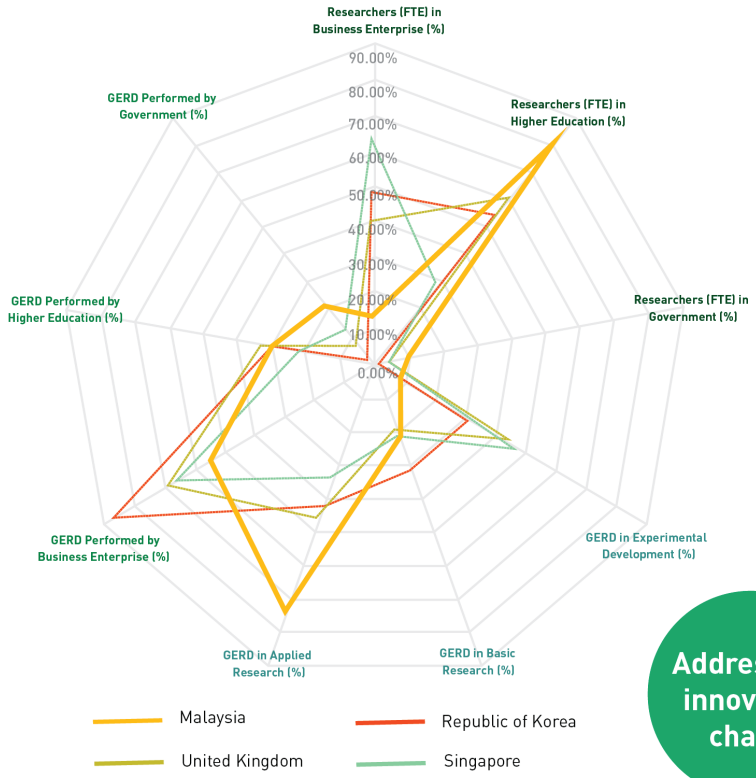


CURRENT PROGRESS (2015-2017)

The Research Management Agency proposal was approved by the Cabinet, however details of the current establishment has yet to be ironed out

A mechanism on improving the effectiveness of the Nation's GERD utilisation has yet to be developed

1 RESOURCE ALLOCATION AND DISTRIBUTION



2 TRANSLATION OF COMMERCIALISATION

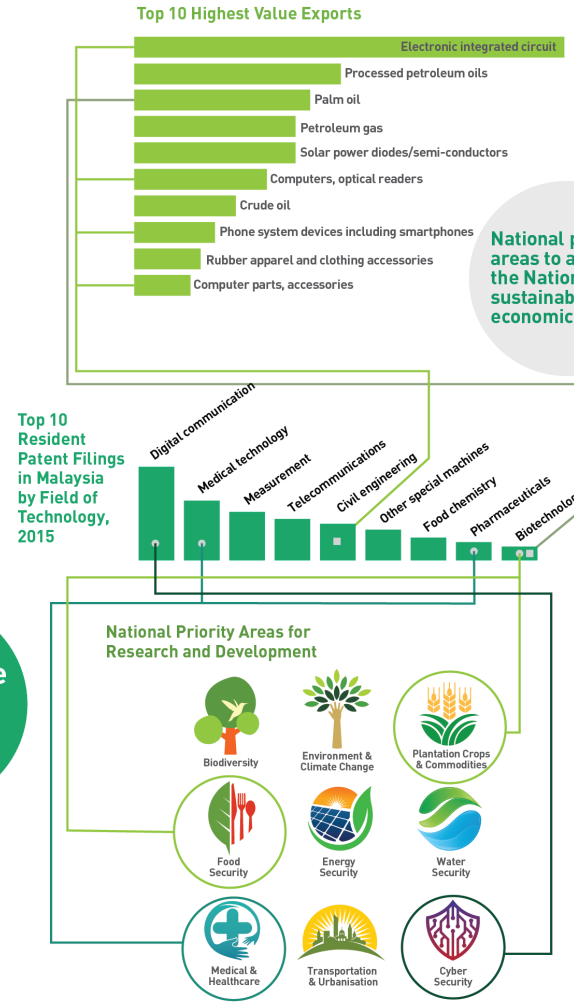
Malaysia : USD1.2 billion
Singapore: USD18.6 billion
Thailand: USD4.1 billion
Indonesia: USD1.6 billion
Philippines: USD0.6 billion

Our IP generates low income in comparison to ASIAN neighbours

More industry-led R&D initiatives needed

Address the innovation chasm

3 NATIONAL PRIORITY AREAS FOR R&D



02

How Impactful is RDC towards Socio-Economic Development?

A key element of a robust advanced economy of the 21st century is knowledge capital generated by scientific innovation. This is the underpinning of Malaysia's policies on STI and the Government's commitment to nurture the nation's research, development and commercialisation (R,D&C) ecosystem by synergising public and private stakeholders. A mature scientific innovation system does not happen overnight; intensive investment in research and development (R&D) in Malaysia only began little more than 20 years ago.

At present, R,D&C in Malaysia's public sector are led by public universities and public research institutions (PRIs). Business enterprises (BEs) – both local and foreign owned – also engage in R,D&C to make sure their products and services can command top dollar in the global market. Investment in R,D&C from both the public and private sector in 2015 amounted to RM15 billion (about USD3.54 billion), roughly 20 times higher than in 1996; the outcome of which are measured by the number of publications, patents filed and granted, as well as income generated from patents.

Malaysia's GERD has been on an upward trend over the years; the country's percentage of GERD/GDP is ranked 29th in the Global Innovation Index 2017 at 1.3%. To date, only 19 economies have achieved above the ideal ratio of 2% GERD/GDP. Although BEs are the largest contributing sector to Malaysia's GERD, it is still not comparable to the proportion of top innovative economies. At the moment, the biggest commitment for R,D&C in the private sector is from the multinational corporations (MNCs); very few small and medium enterprises (SMEs) engage in R,D&C.

Malaysia's percentage of GERD spent on basic research is similar to top innovative economies, but differs greatly in applied research and experimental development. Malaysia's high percentage of applied research and extreme low percentage of experimental development indicates the lack of potential for applied research to move to experimental development stage. As a result, only a handful of research can be developed into products and services for commercialisation. This could be caused by the lack of collaboration between university and industry.

The NPSTI (2013-2020) aims to increase the ratio of researchers per 10,000 workforce to at least 70 by 2020 to ensure Malaysia has sufficient R,D&C human resource. The number of researchers full-time equivalent (FTE) in the country has been growing steadily since 2008, reaching 69,864 in 2015. Malaysia is ranked 37th in the number of researchers (FTE) per million population in the Global Innovation Index 2017 report. However, the top 10 economies have 2.5 to 4 times more researchers (FTE) than that of Malaysia, indicating a need for Malaysia to increase the number of researchers to achieve greater R&D intensity.

The majority of Malaysia's researchers are found in universities, in contrast to the high performing economies whose researchers are mostly in BEs. This imbalance in the number of researchers versus funding allocated for their organisation may be another contributing factor to the inefficiency and ineffectiveness of GERD utilisation in Malaysia. Industry-led R,D&C is key to technological innovations that drive the nation's economic expansion. Malaysian industries are not innovating using R,D&C like the top economies, making the country vulnerable to technological seismic shifts that affect the global market.

With the notable exception of Republic of Korea, advanced economies tend to have a longer R,D&C history with entrenched ecosystem for experimental development and commercialisation. Therefore, they understand that investing money and time in experimental development is crucial in innovation-led growth. Lack of investment in experimental development and limited number of researchers in

BEs may halt the progression of applied research to commercialisation stage. The innovation ecosystem should be reshaped to encourage BEs to conduct more experimental development and facilitate migration of researchers from IHLs into industry. Gap funds can be introduced as a financial enabler to support researchers in the development of prototypes, hence reducing the risks involved in commercialising technology.

Knowledge-based economy is driven by intellectual assets that provide economic returns. Malaysia is ranked 34th globally in terms of total publication from 1996-2016 based on the SCImago Database; our published documents per researcher average is similar to Japan, but still not comparable to other top innovative economies. The number of patent applied and granted in Malaysia remains low. The reason for this observation should be investigated in order to increase the number of successful patent application.

Although the average expenditure per patent application for Malaysia is on par with Singapore, Singapore's income from the use of intellectual property (USD 18.6 billion) is much higher compared to Malaysia (USD 1.2 billion). This may be because industry-driven R,D&C have a bigger push on productivity with a focus on return on investment. The existing national R,D&C ecosystem must be transformed to explicitly highlight national research priorities and the country's research agenda, as well as strengthening industry-driven R,D&C to produce more patents which can be translated into novel products and services.

Malaysia is hampered by the lack of a right advisory body that can advise on STI development strategies as well as identify focus areas and opportunities for research, training, and knowledge transfer. As a result, Umbrella terms are commonly used as priority areas in Malaysia, leading to difficulty in producing focused and solution-oriented research. The complexity of R&D processes in Malaysia which involve multiple agencies under the scope of different ministries makes it urgent for the proposed Research Management Agency (RMA) in the 11th Malaysian Plan to do more than just administering funds disbursement, proposal evaluation, and monitoring the progress of public funded research. The proposed RMA should play a larger role which includes coordinating research priorities across ministries and agencies.

Aligning national research priorities to industry's needs has the potential to help Malaysian industries to be more competitive globally. It is crucial for Malaysia to conduct foresight studies involving industry players periodically to identify focus areas which can then be incorporated into upcoming Malaysia Plans to ensure all ministries and agencies share the same focus. The Malaysian public also need to be engaged when identifying issues that require STI interventions. The synergy between industry, academia, government and civil society is needed to materialise the national quadruple helix innovation system.

Innovation clusters have worked very well in developed economies such as the Netherlands. Since creating clusters from scratch is extremely challenging, identifying and catalysing existing clusters 'hidden' in their respective regions should be prioritised. To optimise resource allocation for the country's admittedly limited R,D&C financial and talent, mapping out the industrial clusters within the economic development corridors to identify R&D needs is needed to increase the efficiency of R,D&C resource utilisation. When institutions of higher learning are involved, this strategy can lead to intensification of industry-academia collaboration as well as encourage knowledge diffusion and specialisation. As large firms move up the value chain, SMEs will also benefit from providing their services to these large firms in the cluster.

In essence, all stakeholders must move towards increasing the country's GERD in the direction that will stimulate profitable output in terms of publications, patents filed, and intellectual property monetisation. Malaysian private sectors, particularly the SMEs, should take advantage of the incentives and infrastructure available to enhance their innovative capacity and technological adoption.

Boosting R,D&C in Malaysia must be a cooperative effort among all the players – both the public and private sectors – to align their vision and share resources for mutual advantage. The SPU proposed in Chapter 1 and the RMA that was mooted in the 11th Malaysian Plan can be central coordinators to enhance Malaysia's STI R,D&C and harmonise the roles of all the stakeholders. Leveraging on existing industrial and research hubs to galvanise niche clusters through university-government-industry synergy can help to fire up the regional economic corridors and generate sustainable growth for all states holistically.

Way Forward

1. Emphasis on Experimental Development

Increased funds for experimental development will encourage more collaboration between university and industry towards demand driven research which will consequently increase experimental development activities to produce more market ready products and/or services.

2. Expedite the Establishment of a Multifunctional Research Management Agency (RMA) and to Consider Establishing a Technology Commercialisation Agency (TCA)

It is important to expedite the establishment of a RMA to catalyse demand driven collaborative research with effective utilisation of funds and the TCA to complete the ready-to-market delivery cycle. Expediting the establishment of a RMA and TCA will assist in prioritisation of research and formation of symbiotic relationships with technology transfer offices and collaborative platforms.

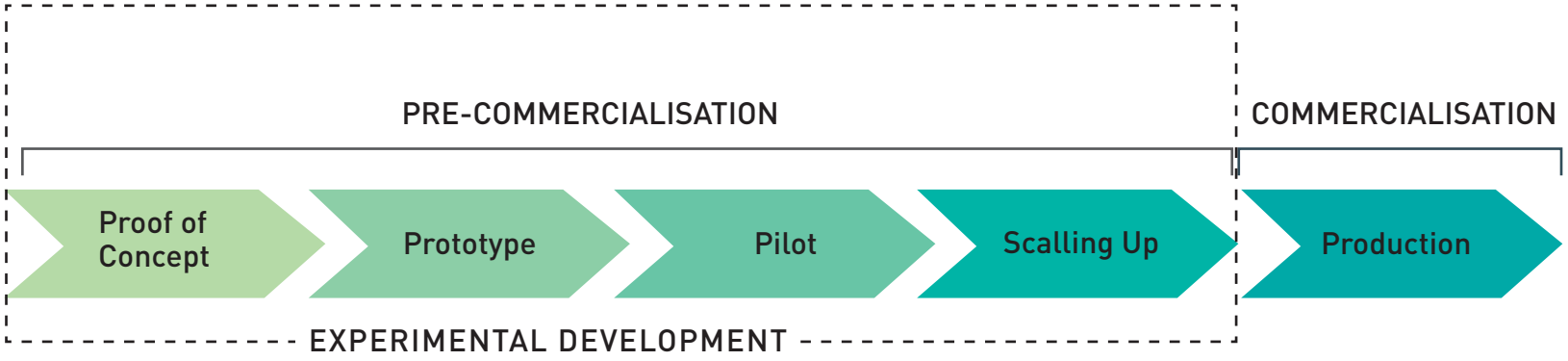
3. Re-identify National RDC Priority Areas

Re-identifying national RDC priority areas by aligning and streamlining to Malaysia's research and economic strengths and needs will result in optimisation of available resources.

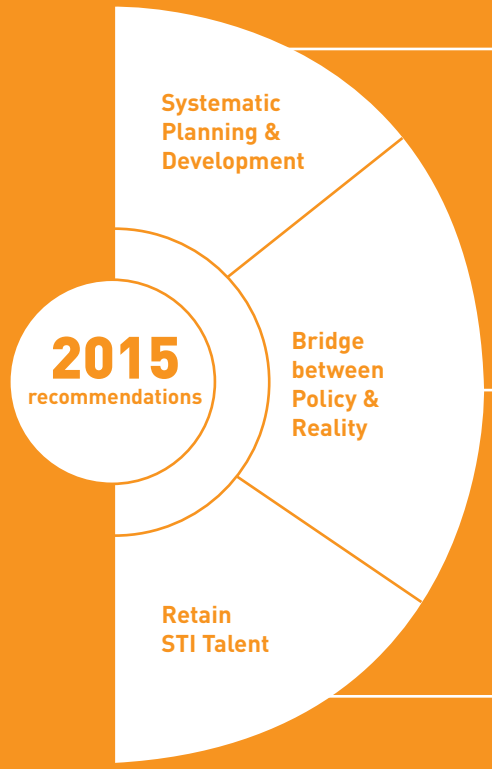
4. Development of Regional Innovation Clusters

Development of regional innovation clusters by enhancing collaboration between industry and knowledge institutions as the case in Malaysia's E&E sector must be considered.

What is Experimental Development?



03
STI TALENT



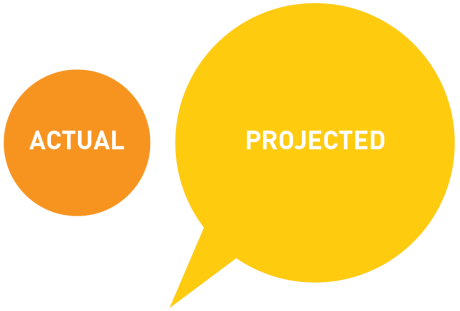
CURRENT PROGRESS (2015-2017)

This is being manifested in
- National STEM Action Plan (2018-2025)
- National STEM Movement

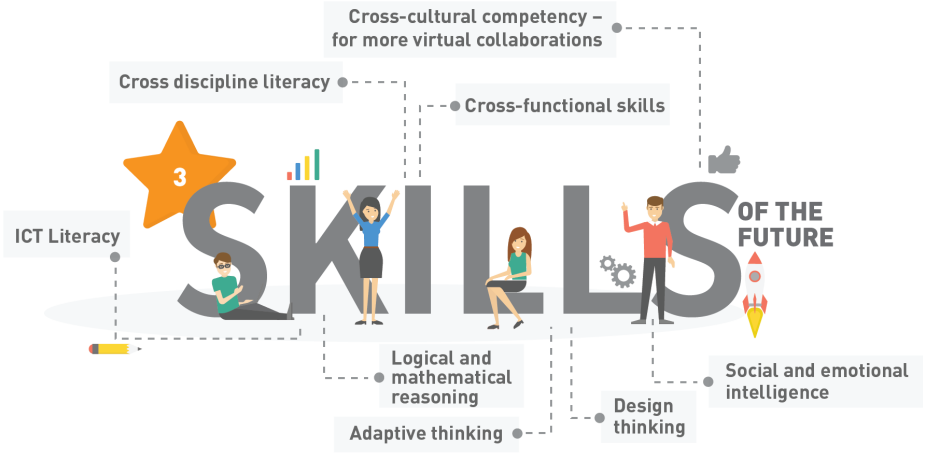
Various initiatives are being rolled out to bridge this gap through
- Visioning Malaysia's Future of Work: A Framework for Action led by Talentcorp
- Embracing Industry 4.0: A Malaysian Technology Strategic Outlook led by MiGHT
- Malaysia Productivity Blueprint 2017-2020 led by EPU
- TVET Malaysia Master Plan led by MOHR (on-going)
- The National Industry 4.0 Policy Framework led by MITI (on-going)
- Malaysian Higher Education 4.0 led by MOHE (on-going)

Incentivise talent through upskilling initiatives and recognition via
- Malaysian Board of Technologists (MBOT)
- Human resources Development Fund (HRDF)
- Penang Skills Development Centre (PSDC)
- National STEM Centre

1 Enrolment of Students in Science Stream – *Actual, and Forecast*

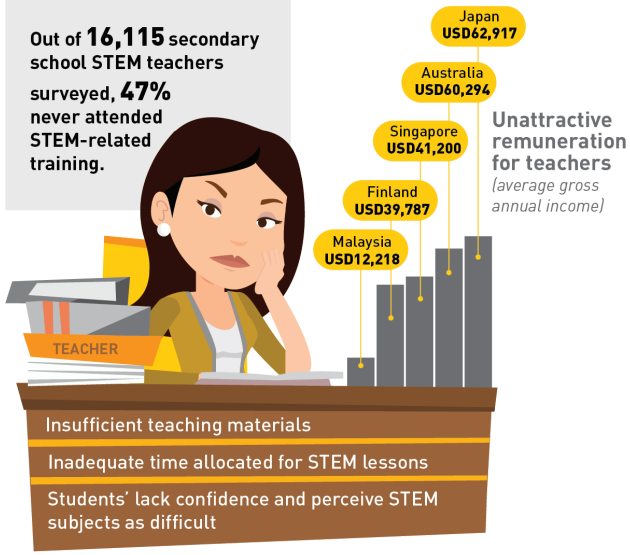


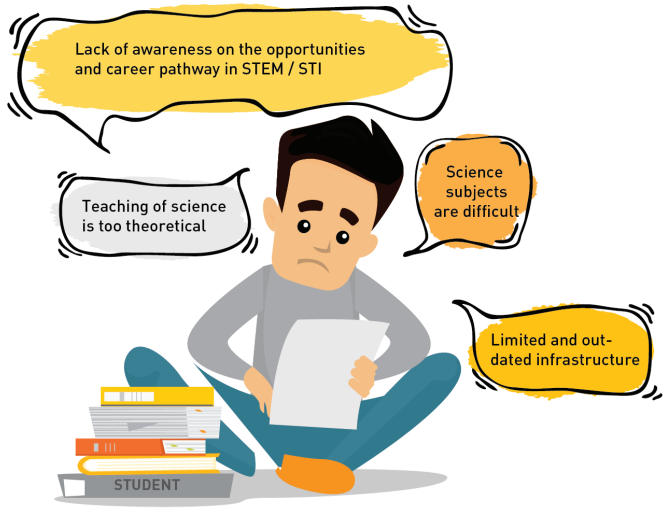
The desired target of 270,000 students ready to enter STEM courses at tertiary level by 2020 will not be achieved.



2 STEM CHALLENGES

Out of **16,115** secondary school STEM teachers surveyed, **47%** never attended STEM-related training.





03

STEM Talent Development: Is Aspiration and Action Well-Aligned?

Malaysia's drive to become a developed nation in a sustainable and equitable manner means increasing the dynamic capabilities of the nation's workforce. It is a holistic endeavour that targets all levels of the population, from children in pre-school all the way to secondary and tertiary education, as well as making sure that the current labour force is ready for the inevitable transformation of the job and socio-economic landscape. The Science and Technology Human Capital report was established to map out the route to ensure that the quality and quantity of Malaysia's labour force in STI to fulfil the country's development up to the year 2020 is sufficient.

There are approximately 5 million students enrolled each year in both primary and secondary schools across Malaysia. About 100,000 enrol in Science Streams at upper secondary level. To ensure these valuable assets remain in the pipeline for Malaysia's continuous supply labour force the Ministry of Education (MOE) has set up a number of initiatives to improve STEM education delivery including and beyond what is outlined in the Malaysia Education Blueprint 2013-2025. One of them is inclusion of higher order thinking skills (HOTS) in the syllabus beginning in 2014.

The first year where 20% of the questions are set based on HOTs was in 2016 which saw a dramatic decline in the performance of *Ujian Penilaian Sekolah Rendah* (UPSR) Science and Mathematics which continued into 2017. This may indicate that the students are not prepared for HOTS-style evaluation or there is a need to review how HOTS is delivered. Performance in Science and Mathematics in *Penilaian Tahap Tiga* (PT3) in 2014 to 2016 has been rather alarming; less than a quarter passed Mathematics and Science with a minimum of C. Only 23% of the PT3 students were eligible for Form Four Science stream in 2017, the pattern over the last five years showed less than 30% were eligibility annually. This is low and insufficient to fulfil the desire of reaching 60% Science or Technical based students in our education system as outlined in the 60:40 Science/Technical: Arts Policy. The Technical steam recorded around 22.5% enrolment in 2017.

In the 2016 *Sijil Pelajaran Malaysia* (SPM) level examination 80% passes with a minimum C grade were recorded for Physics and Biology, while slightly above 50% were recorded for Additional Mathematics and Chemistry. Students without a sound Additional Mathematics qualification may not gain entry into critical courses such as engineering. As the nation moves towards joining the next industrial revolution bandwagon, we may face a possible shortage of technological competent talent. As it is, the trend of lesser candidates taking subjects offered in the Science Stream for SPM is shrinking the talent pool entering institutions of higher learning (IHLs) for subsequent STEM training. Approximately 50% of SPM leavers pursue tertiary studies. Data from MOE and MOHE shows that only about 80,000 enrolled in STEM-related tertiary courses.

Lack of awareness of opportunities in STEM careers, parents not favouring science education, STEM subjects are too difficult, learning science is boring and too theoretical, and lack of encouragement to take up STEM subjects in school were among the reasons on low popularity of STEM subjects among students. Our survey on secondary school STEM teachers resulted in 48% responding that they had never attended STEM related training, reciprocating the boring teaching and learning complaint made by the students.

The advent of Fourth Industrial Revolution means that Malaysia's talent must be adaptable to change, have a high degree of facility for life-long learning, good interpersonal and collaborative skills, and is trained in multi-sectoral thinking. Preparation for technological disruption is possible through training and education; Reskilling and upskilling must be the norm for Malaysian talent to stay relevant to the job market.

Therefore, the Ministry of Higher Education (MOHE) included a new strategy to enhance student experience in the industry through degree apprenticeship. The 2U2I programme is being rolled out by selected universities whereby the student will spend 2 years in the university and 2 years in the industry to enable them to have real world experience with the theoretical knowledge they have obtained in the university. A similar module can be started at an earlier stage – during secondary schools to expose both teachers and students to the expectation of the industry. The establishment of the National STEM Learning Centre is expected to address the mundane teaching and learning of STEM subjects by producing more passionate teachers as well as engaging public to be encultured to science.

Upon enrolment and graduation, students and generally their parents need to be assured that STEM jobs are as rewarding as non-STEM jobs. Besides curriculum that involves hands-on-trainings, the Government should conduct STEM career path review with emphasis on remuneration and career development. This is because the Government is considered as the benchmark for employment wage and benefits, as well as positioning post with matching qualifications (i.e. not utilising under-educated labour force to save cost).

STEM talent is the core of high-skill, knowledge-intensive economy for global competitiveness. Like most economies, Malaysia's demographic will be moving towards an ageing population by 2030 which makes lack of STI talent in critical sectors more acute. While Malaysia ranks 16 out of 118 economies in Vocational & Technical Skills pillar of the Global Talent Competitiveness Index 2017, we rank 41 for the Global Knowledge Skills. The Global Innovation Index places Malaysia at 46 out of 137 economies in terms of technological readiness. The average ranks of our talent are a concern that the present STEM talent pipeline may be less competent to helm the country's aspiration towards the Fourth Industrial Revolution bandwagon.

From the pipeline, we may not be producing sufficient number of talent needed to sustain the country's growth in 2020 and beyond. However, STEM talent utilisation in Malaysia is not a straight forward matter of demand and supply, but rather a shortage of the right proficiencies and unmet compensation expectations. Rather than continue to produce over qualified and underutilised workers, the upskilling, training and education pathway in the country should be strategized to produce talent with the right mindset for life-long learning, and the flexibility to explore new niches. It is also vital to make sure that the talent powering the economy is appropriately compensated to match the nation's aspiration to be a developed country.

Way Forward

1. Attracting and Retaining STEM Talent through Improved Remuneration and Continuous Career Development

Engaging and attracting young people to first enrol in STEM-related degree programs and then to pursue careers in STEM remains a challenge. Therefore, revisiting of the entire education pathway to be in-line with current global demands, STEM pedagogy and curriculum is proposed. An improved remuneration scheme comparable to other nations and continuous career development is proposed to ensure sustainability and succession.

2. Prioritisation of Numerically and Technically Competent Talent Development

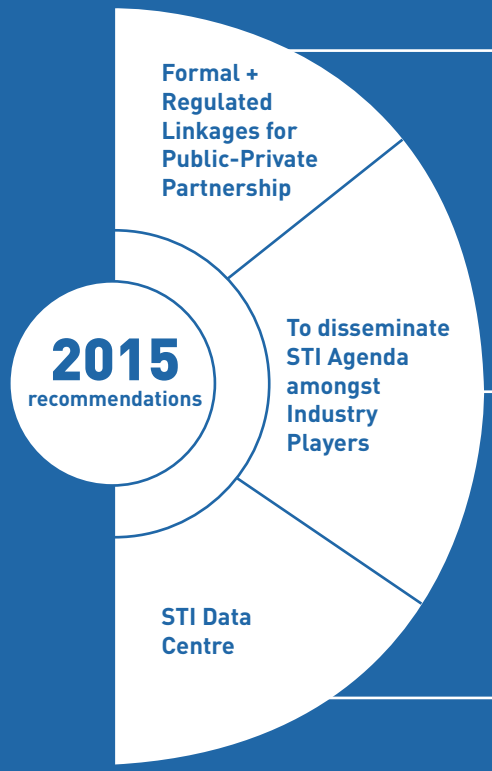
Numeracy skills are the foundation of most STEM courses at tertiary level and it is predicted to come in handy in most future jobs. Therefore numerically competent talent development must be prioritised to develop technical competency.

3. Development of Biennial National STEM Talent and Skill Gap Assessment

Development of a biennially nationwide STEM talent and skills gap assessment is proposed to gauge and identify the mismatch of our STEM talent - if there is either an oversupply or an under-demand of for especially critical jobs.

04
STI Energising Industries

CURRENT PROGRESS (2015-2017)



In 2017, the National Science Council has decided for the collaborative network model to be implemented to enable demand driven research and enhance innovation capacity

Selected industry captains have been appointed as members in the National Science Council and the National Innovation Council

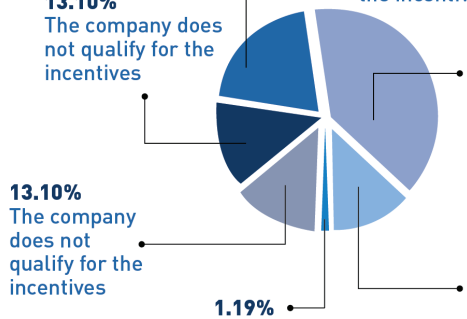
A centralised STI knowledge repository is not in place

1 MALAYSIA'S GLOBAL COMPETITIVENESS 2017-2018

Global Competitiveness Index Technological Readiness:	**35**/137
Global Innovation Index Knowledge Workers:	**93**/127
Global Entrepreneurship Index Product Innovation:	**130**/137
Bloomberg Overall Ranking:	**26**/80

2 ENERGISING THE INDUSTRIES THROUGH STI

Reasons for not taking advantage of Government R&D Incentives



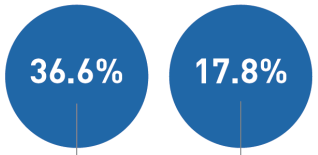
MOSTI, 2016

3 MALAYSIA'S INDUSTRY LANDSCPAE

98.5%
(907, 065)
of Business Establishments are SME

18.0%
High skilled workers in manufacturing sector

Performance of SMEs (2016)



Contribution to GDP

Exports

Many SMEs are merely **ADAPTERS & IMITATORS**
(EPU, 2017)

Only **6%** of Malaysian companies are **CREATORS,** whilst majority are **ADAPTERS**
(MPC, 2012)

42% of companies allocate less than 10% of their revenue for technology

3962
Industry Associations

42
Industry Parks

04

Are Malaysian Industries Poised to be Innovators?

Over the years industries in Malaysia have transitioned from resource-based to one that is knowledge intensive. Malaysia has charted its course towards becoming an innovation-led economy by recognising the need to develop indigenous science, technology and innovation (STI) capacity and capability for competitiveness and sustainability to better leverage on market opportunities and elevate along the global value chain.

On the global front, Malaysia enjoys a reasonably competitive position in the overall global competitiveness. However, when it comes to specific innovation indices, Malaysia fares quite moderately. Malaysia ranked 17th among 40 countries in the 2016 Global Manufacturing Competitiveness Index; in the product innovation pillar of the Global Entrepreneurship Index (GEI) 2018 Malaysia ranked 130 out of 137 countries - lowest among most ASEAN countries. GEI measures a country's ability to develop new products and integrate new technology. The 2017 Global Innovation Index ranking saw Malaysia suffering a massive drop in Knowledge Workers from 35th to 93rd spot. This raises concerns about the competency of the Malaysian workforce to engage in high-value innovation.

Given that 98.5% (DOSM, 2016) of Malaysian business establishments are small and medium enterprises (SMEs), there is a need to elevate the capacities of our industries, infrastructure, workforce competency as well as technology utilisation to be on par with global players. In 2016, SMEs only contributed 36.6% to the country's GDP. It is clear that Malaysia needs to invigorate the industry landscape by enhancing innovation capacity as SMEs have low appetite for investment towards R&D (MyKE III, 2017).

Innovation requires integration of knowledge and competences from a number of different fields: technology, market intelligence, product design, economics, etc. Our findings show that most of our SMEs are unable to create value from R&D output - most of the business establishments are technology imitators rather than true innovators. Our national ecosystems primarily support absorptive capability; but are not able to enhance our adaptive and innovative capabilities. Only 6% of Malaysian companies are creators (MyTIC, MPC, 2012). Foreign firms and countries benefit from our strong absorptive capability while Malaysian firms remain stuck at this level, unable to move up the innovation value chain.

Novelty of new products from both manufacturing and services sector are fairly less than 1% – being imitators, market saturation has unable our products to compete globally. The SME Corp's Survey of the first quarter of 2017 states that firms often release products and services to the market without developing foundational and driver conditions of the ecosystem, leading to high failure rates due low novelty of products and services.

Realising this, the Government continues to formulate policy measures intended to nurture and establish conducive environment for technology development to spur investment in technology for more innovative output. The current IMP3 (2006-2020) outlines the industry's strategies and policies for the country's sustained efforts towards realising Malaysia's objective to be a developed nation. The Government has also mapped out numerous initiatives to assist especially SMEs to strengthen their competitiveness.

The SME Masterplan (2012-2020) targets contribution of 41% of the nation's GDP and 25% of the nation's total export value by 2020, by the SMEs. It also targets to reduce employment share to 62% from 65% in 2016, by reducing reliance on cheap foreign labour and adopting technology that will help increase productivity. High Impact Programme (HIPs) aims to help SMEs develop innovations from prototype to commercialisation stages. The Innovation Certification for Enterprise Rating and Transformation (1-InnoCERT), a

programme facilitated by SME Corp awards certificates to innovative SMEs and facilitates fast-track access to funding or incentives (SME Corp., 2014) to encourage entrepreneurs to venture into high technology and innovation-driven industries.

Growth of industries is supported by strengthening the nation's ICT infrastructure such as the broadband strength and speed, and initiatives such as the Cloud First Strategy, the National Big Data Analytics Framework and Cyber Security Malaysia. The Digital Free Trade Zone (DFTZ) launched in 2017 is an initiative to capitalize on the confluence and exponential growth of the internet economy and cross-border e-Commerce activities. This setup facilitates seamless cross-border trade and enable local businesses especially SMEs to export their products globally with ease

The Malaysian Business Angel Network (MBAN) offer opportunities for project owners to book investments - MBAN's Accredited Angel Investors are eligible to enjoy a tax benefit amounting to RM 500,000 under the Angel Tax Incentive Programme. Securities Commission Malaysia has introduced six equity crowd funding (ECF) platforms in 2015 to provide alternative venue for capital-raising for SMEs and innovative new businesses (start-ups).

Strategic partnerships models to spur technology development, commercialisation and to accelerate the productivity growth of SMEs have been identified through innovation intermediaries such as SIRIM-Fraunhofer, Steinbeis Malaysia Foundation and PlaTCOM Ventures. The Public-Private Research Network (PPRN) was established to strengthen university-industry linkages to facilitate knowledge-transfer and catalyse R&D. However, these intermediaries are limited by nature of partnerships – they are not industry-led to foster demand-driven research and to effectively bridge the innovation chasm as well as to encourage open innovation. Hence establishing collaborative networks co-ordinated by industry-led trusted neutral entity for growth-potential key sectors should be the way forward.

Multiple actors and multiple industry-related knowledge dissemination channels with weak connections between them are diluting efforts of creating a successful innovation ecosystem. A centralised virtual knowledge repository to integrate, synergise and coordinate access to STI-related information must be considered. The virtual platform should be built upon intelligent systems encompassing research and market analytics frameworks and also capture information about teaching, training, facilities, business partnerships, and existing international engagement across scientific and non-scientific disciplines, and it should be accessible to all. This platform should also track and monitor STI-based BEs and SMEs to have targeted intervention.

A strong and robust STI-based industry would pave the path to enhanced productivity, job creation, innovation capacity and high-skilled talent pool. Therefore, Malaysia should strategically invest in selected niche STI based industries based on our current strengths and future projections to leapfrog from being immitators to innovators of technology.

Way Forward

1. Establish Industry-Led Collaborative Networks to Enhance Demand Driven Research and Private Sector Participation

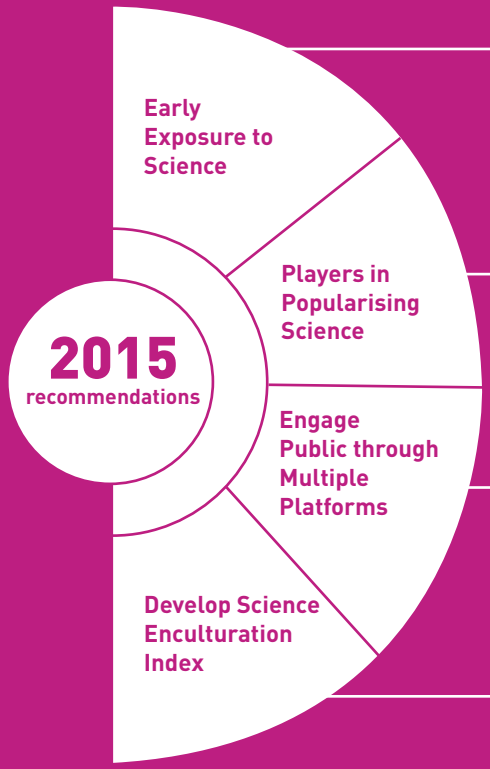
An initiative to stimulate the uptake of R&D and innovation among industries should be facilitated by industry-led ollaborative networks that shall guarantee the rise of knowledge clusters, leading to organically formed talent hubs (thus enhancing knowledge workers) and disruptive innovations.

2. Facilitate Dissemination and Monitoring of Industry Related Information through a Virtual Centralised Knowledge Repository and Data Centre

In order to enhance the development of STI-based SMEs and innovative start-ups, it is essential to provide sufficient industry related STI resources. Therefore a virtual centralised knowledge repository and data centre to make the full range of STI-based resources as well as market intelligence information known to all, is pertinent to energise the industries.

05
STI Enculturation

CURRENT PROGRESS (2015-2017)



The Malaysian Education Blueprint 2013-2025 addresses the need for early childhood education to STI

The National STEM Action Plan (2018-2025) being formulated by MOSTI, MOE and MOHE has incorporated STI enculturation strategies

Many public engagements on STEM are anchored by NGOs, industries and ministries, although weak coordination is observed

A dedicated STI Enculturation Index has yet to be developed, however, STEM Student Index is being formulated by MOE

1 STI ENCULTURATION SPACES ACROSS MALAYSIA

13
National & State Zoos

12
Science Centres

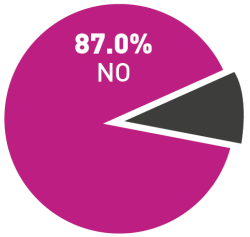
7
Museums with STI Exhibits

18
Permanent Wild Life Exhibits

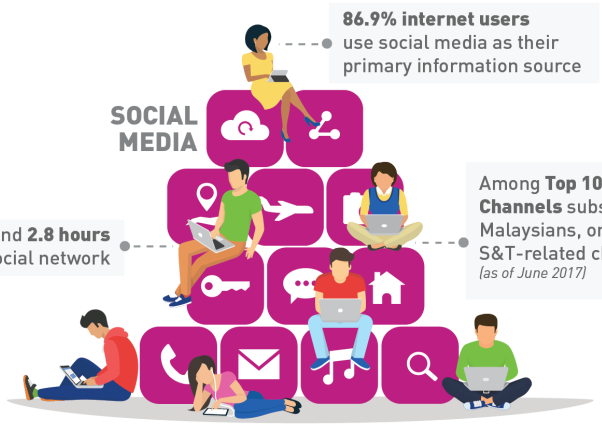
** List is non-exhaustive*

2 STI ENGAGEMENT

Industries involvement / promotion in STI-related outreach programmes / activities / events
(Industry Awareness and STI Perception, ASM 2017)



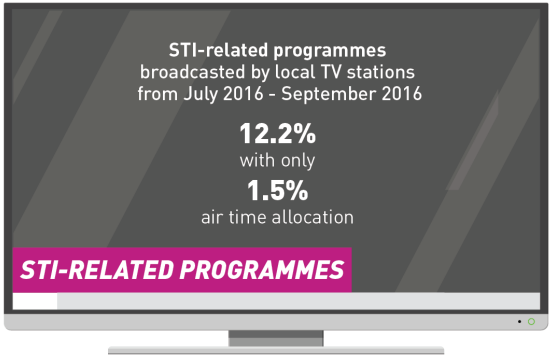
2 STI-RELATED INFORMATION SOURCES



86.9% internet users use social media as their primary information source

Malaysians spend **2.8 hours** a day on social network

Among **Top 100 Youtube Channels** subscribed by Malaysians, only 1 is an S&T-related channel
(as of June 2017)



05

Scientifically Encultured Society: Where Are We?

Culture is the collective manifestation of human intellectual achievement. Enculturation is the acquisition of one's own culture, including its values, behaviours, beliefs, understandings, social norms, customs, rituals, and languages.

STI enculturation is the process through which science culture become integrated in the mind and habits of the people, similar to how national and ethnic identity are internalised. STI culture includes scientific literacy, public understanding, acceptance and awareness of science and scientific methods, as well as the applications of science in day-to-day life engagements.

Various government institutions and universities conduct programmes to promote STI literacy and enculturation to the public. The Ministry of Health (MoH) for instance conducts various awareness programmes, ranging from promoting disease prevention to healthy living. MOSTI has a dedicated unit for STI related awareness programmes; with the latest being the NICE'17. Universities are also venues and promoters of disseminating scientific information to the public in their vicinity through activities such as faculty specific campaigns, public service programmes, scientific societies, film screenings, public forums, inaugural lectures, etc.

Informal science enculturation appears to have greater impact in nurturing a scientifically literate society; these out-of-school experiences are life-long, and enjoyment for it can be inculcated from young. Malaysians are fortunate that there are various designated environments that serve as STI enculturation spaces such as science centres, museums, zoos, nature preserves, botanical gardens, and aquariums offer a variety of permanent and temporary exhibitions to enrich STI immersion throughout the country. There are also new entertainment spaces or commercial theme parks that offer fun activities with STI elements incorporated such as Kidzania and Legoland. Continuous efforts to keep these spaces current, exciting, and attractive to new and recurrent visitors must be in place.

The Malaysian media – print, broadcast, and electronic – remain the most important means for most Malaysian adults to keep updated on science information. Study of publicly available broadcast over a three month period showed that Government television channels offer the most of in terms of STI content; private television channels had little to none. In Malaysia, newspapers have dedicated sections for science coverage apart from regular news with science content but have lesser content in comparison to Political and Sports coverage. YouTube channels that appeal to Malaysians are entertainment and comedy channels; similar to global YouTube viewing patterns and not a single STI-related YouTube channel made it to Malaysia's top favourites.

A virtual Science Media Centre for STI content resource can improve the quality of STI content across platforms in Malaysia. This centre will focus on communicating science concepts in layman encouraging translation and creation of STI content.

Civic scientific literacy in Malaysia is supported by STI grassroots movement and non-governmental organisations (NGOs) alongside professional associations; most of them utilise social media as a platform for STI activism. These grassroots movements debunk pseudoscience, give information on nutraceutical, and health products on the market, share relevant media content, invite knowledgeable speakers to give talks, and many more. Environmental NGOs in Malaysia such as the Persatuan Khazanah Ma' of Terengganu are instrumental in mainstreaming nature conservation and campaigning for wildlife preservation, important civil elements in STI enculturation.

Science education in the classroom is the most important formal method of science

enculturation; large amount of research and investment goes into strengthening science education in Malaysia from primary to tertiary level. However, the strongest agency of science literacy is through informal approaches that incites curiosity and encourages knowledge-seeking habits, supported by the availability and accessibility of designed environments (e.g. science centres, museums, zoos, galleries). Casual discussion with peers and family on STI matters, using information gleaned from attending public forums and expositions, as well as media and popular culture also promote habits of the mind for STI enculturation.

Benchmarking the Malaysian public's STI literacy against other countries, to assess scientific knowledge illustrated that science and mathematics literacy among young people in Malaysia are below the international average. STI enculturation survey showed that Malaysian adults generally scored below the international average; lower than the adults in most developed countries. Science culture is highly influenced by level of education, mass media coverage and cultural mentality. It is clear that more is needed to make science mainstream in Malaysia's culture.

It is evident that STI enculturation is a complex interplay of formal and informal learning, in and out of dedicated enrichment spaces as well as developing life-long habits of the mind to satisfy scientific curiosity. Even though Malaysians has yet to achieve the STI literacy of citizens in advanced countries; the good news is that there are plenty of avenues for Malaysians to enjoy STI enrichment, particularly for the benefit of the younger generation. Support for STI enculturation are not just from the Government and profit-driven private entities with STI agenda, but also by ordinary Malaysians who are determined to highlight the importance of science in our everyday lives. We can be optimistic that every effort is being expanded to make Malaysia a scientifically literate society for the 21st century.

Way Forward

1. Public-Private Partnership to Update and Upgrade STI Enculturation Spaces

Encourage Public-Private partnership to update and upgrade STI enculturation spaces to attract more visitors. STI places should also leverage on local scientists, scientific associations and social innovators such as content providers giving input on STI.

2. Virtual Science Media Centre to Strengthen STI Content in Various Media Platforms

A virtual resource centre that focuses on communicating science in laymen Bahasa Melayu and English and encouraging translation and creation of STI content needs to be in place.

3. Prioritise Development of STI-based Creative Content

The trend shows Malaysians are inclined towards entertainment-based programmes hence creative edutainment-based STI content must be considered. This will likely increase interest in STI.

06
Strategic International Alliance

CURRENT PROGRESS (2015-2017)

Increase in Institutional Level Agreements

Increased membership in international organisation

Increased perticipation in international high level meetings

1 TRANSLATING SCIENCE DIPLOMACY INTO ACTION

Malaysia's STI-related treaties

19.4% (187 out of 964)
BILATERAL

54.2% (58 out of 107)
MULTILATERAL

MOFA, 2017

- Agreements need to translate to benefits related to STI development for Malaysia
- Attract strategic partners
- Effective positioning of Malaysia's STI competencies & capability

2 MALAYSIA'S MEMBERSHIP IN STI-RELATED ORGANISATIONS*

**list is non-exhaustive*

3 IMPACT ON NATION'S STI CAPACITY

FUNDING

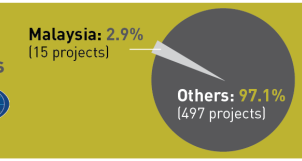
Access to **£735** million in research grants through the Newton Ungku Omar Fund

Secured £12.2 million as of April 2017

Newton Fund

British Council, 2017

Member countries STI-related projects funded from 2006-2016 APEC



KNOWLEDGE TRANSFER

Benefitted more than **32,000** participants from **143** countries **since 1980**

Project fpr Development of Low Carbon Society Scenarios for Asian Region

- **135** joint publications
- **100** workshops, seminars and symposiums were held

EXPERT ENGAGEMENT

Involvement and recognition of Malaysian researchers for the year 2016 in international organisations

785 members

152 in leadership positions

06

How Do STI International Alliances (Science Diplomacy) Stir Malaysia's Competitiveness?

Globalisation has transformed not just the economy of the world, but also how scientific resources, personnel, and research funding are no longer restricted by geographical borders in advancing scientific knowledge and finding solutions to global challenges. One of the ways to fully harness the potential of globalisation of STI is by understanding science diplomacy.

Science diplomacy is defined by the use of scientific collaboration among nations to address common problems and to build international cooperation. It is further segregated into three distinct types that differ according to the objective of the diplomacy required;

- **Science in Diplomacy**
- **Diplomacy for Science**
- **Science for diplomacy**

Malaysia's international alliances leverages on diplomacy and science through international agreements, membership in international STI-related organisations, joint research collaborations of IHLs and industries.

As of the end of 2016, the Malaysian Government has signed 964 bilateral agreements with countries all over the world of which 187 of them are directly STI-related, mostly to promote cooperation in scientific research and development. 112 of these were signed with Asian countries due to the geographical factor, trade partnership, as well as common diplomatic agenda.

Malaysia has also signed 107 multilateral agreements to safeguard its international interest. 58 of these are STI-related; such treaties present platforms where Malaysia can attract knowledge, talent and resources for STI advancement. Majority of STI-related multilateral agreements signed by Malaysia are efforts to monitor, regulate and standardise procedures where science is an important element for an agreement to achieve its objective.

By being part of the signatory members, Malaysia can retain its voice in the formulation of the monitoring, regulation and procedures as well as leverage on the advancement of technology of first world countries to boost our STI capacity and capability. These multilateral agreements are vital in promoting Malaysia's security, international law advancement as well as active participation in the international fora.

Malaysia also is a member of many international organisations. As a member of ASEAN and APEC, Malaysia has been holding significant posts in spearheading important missions such as the ASEAN Economic Community which was launched during Malaysia's chairmanship of ASEAN. Malaysia also leverages upon its membership in various international organisations to secure international funding for ambitious and impactful STI projects.

There are also many Malaysians having key roles in international organisations. This is an added advantage for Malaysia to lobby and secure important key ositions in international organisations to improve Malaysia's visibility in the global STI arena. This is especially important in fighting for Malaysia's stand in vital issues that could affect Malaysia's position and sovereignty.

The international networking of STI researchers and experts is unique; crossing national boundaries with partnership traditions that open many doors and support crucial frameworks for joint efforts to address a wide array of problems of broad interest. There has been substantial amount of strategic international agreements signed by Malaysian Research Universities (MRUs) from years 2012 to 2016 resulting in an increase of projects funded under these agreements. These MRUs performed well when compared to some other neighbouring countries except with Singapore. Most collaborations are done with the United States of America (USA), the United Kingdom (UK), Bangladesh and Nigeria. Malaysia both learn from developed nations and help developing

nations. In terms of publications, Malaysia is the top among ASEAN countries since 2010.

Strategic STI international alliances increases access to research funding and knowledge transfers. In 2016 approximately RM21.7 million worth of international research funds were pledged. Besides funds, strategic alliances also increase opportunities through expert engagements. At times, capacity building, technical assistance, knowledge transfer, sharing of facilities and resources adds to the success of important scientific discoveries.

Malaysia actively trades with economies around the globe. The number of trading nations bring along opportunities for further developing our STI capacity and capabilities especially in technology transfers. There are also opportunities to leverage onto the abundance of trade data and intelligence to predict trends and fore-sighting for emerging technologies.

Malaysia and its people need to continue to take the lead in strategising and positioning Malaysia's standing at global platforms. Hiring diplomats with technical know-hows will help ministries to make informed decisions on matters related to STI.

It is evident through this study that national policies plays large role in determining the direction of foreign policies initiatives. Therefore, it is important for Malaysia to strategise on its international alliance internally with important stakeholders to craft the right strategies in the Nation's best interest.

Way Forward

1. Leadership in Positioning Malaysia's Strategic STI International Alliances

To further strengthen the strategic STI international alliances, the various international platforms where Malaysia is a member must be fully utilized by our STI key opinion leaders to add to global competitiveness and increase the visibility of Malaysia's STI capacity and capabilities.

2. Enhance Roles of Science Attaché in Malaysian Embassies

The roles of Science Attaché in Malaysian embassies should be enhanced and expanded to include strategising, monitoring and evaluating STI-related issues pertinent to the nation's interest.

3. Strengthen Linkages Between Ministry of Foreign Affairs (MOFA) and Malaysian Scientific Community

The linkages between the Ministry of Foreign Affairs (MOFA) and Malaysian scientific community should be strengthen to include scientific evidences as an avenue for diplomatic decision makings.

4. Leverage Malaysia's Trade Platforms Globally to Facilitate Market Intelligence in STI-based Industries

Malaysia's should also leverage on its global trade platforms and trade missions for gathering STI-related intelligence to develop the right STI-related strategies for the Nation.

Conclusion

Malaysia's aspiration to be an advanced nation requires all sectors to have the capacity for developing knowledge capital to fuel Malaysia's drive to be an advanced economy. STI has underpinned the pillars of our economic growth for the last six decades since independence and should be seen as a catalyst to spur the new economy.

The Science Outlook 2015 outlined 18 recommendations to mainstream STI. 11 were taken up through 16 initiatives and programmes by the relevant stakeholders. The Fourth Industrial Revolution has made it more urgent for all stakeholders to collaborate in making sure that the country is capable of coping with potential socio-economic uncertainties brought about by STI upheavals to the global economy. Malaysia's progressive and innovative society must have the necessary STI robustness for the country to navigate the deep waters of knowledge-based economy for our sustained growth and inclusive development. Besides putting forth new ideas on how Malaysia's STI landscape can be further strengthened, the Science Outlook 2017 proposes that the remaining recommendations be revisited by these stakeholders.

But first some cross-cutting issues must be addressed. The multitude of actors in the national STI landscape has to be revisited. Too many actors and funding agencies become self-competing hence diluting available funding and resources. The weak link between the Federal and State Governments on the STI issues also must be bridged to cascade policies and decision for effective transformation of the nation towards joining the paradigm shift towards knowledge economy. Malaysia aspires to be an innovation-led nation. However, little emphasis is being put on experimental development. Hence we are going to see much less prototyping and product testing and even lesser commercialisation. The R&D done in Malaysia is also not industry-led as most of our researchers are concentrated in IHLs.

To ride on the knowledge economy, the country relies on knowledge-workers. However, there is a decline in interest of young people in enrolling in STEM-fields. The quality based on major national level examination is about average. Is STEM-field unattractive or is the pedagogy losing touch with the learning style of millennials? Our survey showed almost 47% STEM teachers from secondary school had not received any STEM-related training. The future jobs will be technology based. There are also critical STEM related jobs which may not be filled by national talent since the numbers are declining over the years. But then again, is our industry ready to hire STEM talent?

With 98.5% of our industry being the SMEs; most do not adopt technology and do not invest in R&D while only 6% are creators. The productivity of our SMEs is low; the contribution to the GDP is less than 40% and most SMEs do not have the capacity to hire knowledge workers. There is also no national data on the number of S&T based business enterprises in Malaysia. Overall global indices show competitiveness level is strong but innovation output is not realised through our industries.

Malaysians STI literacy and awareness is low although engagement is quite satisfactory based on visits to STI spaces. But the content of exhibits can be further updated to follow global trends to increase STI literacy of Malaysians. The STI content in media and the avenue for science communication can be further improved. Globally, Malaysia and some prominent Malaysians have stamped their mark in various international platforms. However, output through collaborations show that these avenues are not fully leveraged and internal strategizing between international divisions of various Ministries needs strengthening for better planning to capitalize on opportunities to form collaborations. Tying these loose ends should propel Malaysia's STI ecosystem and innovation to greater heights.

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