14 Vigorously Advancing Science, Technology, and Innovation

CHAPTER 14

VIGOROUSLY ADVANCING SCIENCE, TECHNOLOGY, AND INNOVATION

Advancing science, technology and innovation (STI) will significantly raise the productivity of Filipinos, create quality and better-paying jobs, aid the country to become globally competitive, and foster long-run inclusive development. To this end, ample and vigorous support will be required from the government and the private sector, along with the active cooperation of universities and academe in general. This should result in the establishment of an STI ecosystem that will be self-sustaining.

While some gains have been achieved in this direction, more reforms are required to link the STI sector to various economic development efforts. Meanwhile, there remains a great need for government and the private sector to invest in students to pursue advanced degrees in science, technology, engineering, and mathematics (STEM) towards building a dynamic STI ecosystem. This will have to be a long-term undertaking for the country to be in step with the developments under the Fourth Industrial Revolution (Industry 4.0).

Assessment

The country's performance in achieving the desired outcomes for the STI sector has remained modest. Latest available data indicate that only five (5) out of 10 targets with available data have been surpassed.[1] These are the numbers of Filipino utility models and industrial designs registered; innovation hubs; science, technology, engineering, and mathematics (STEM) enrollees in higher education institutions (HEIs); and STI-related international cooperation of HEIs. On the other hand, the targets that were not met are the number of Filipino patents granted, Global Innovation Index (GII) - Investment percentile rank, GII - Knowledge and Technology Outputs (KTO) percentile rank, and the number of *Balik* Scientists engaged.

Table 9.1 Accomplishments versus Targets in Advancing Science, Technology, and Innovation

INDICATOR	BASELINE[a]		ANNUAL PLAN TARGETS				ACTUAL
	YEAR	VALUE	2017	2018	2019	2020	2018
Sector Outcome 1: Technology adoption promoted and accelerated							
Subsector Outcome: STI utilization in agriculture, industry and services sectors increased							
Number of Filipino patents granted increased (incremental)	2016	31	33	34	36	38	29
Number of Filipino utility models registered increased (incremental)	2016	555	594	635	680	727	1,044
Number of Filipino industrial designs registered increased (incremental)	2016	516	542	569	597	627	962
Subsector Outcome: Investments in STI-based start-ups, enterprises, and spin-offs increased							
Global Innovation Index (GII) – Investment Index percentile rank improved	2016	17	18	19	20	22	6

[1] *Only 10 out of 26 indicators for Chapter 14 Results Matrices (RMs) have available data.*

INDICATOR	BASELINE[a]		ANNUAL PLAN TARGETS				ACTUAL
	YEAR	VALUE	2017	2018	2019	2020	2018
Number of technology business incubators (TBIs)graduates increased (i.e. enterprises and spin-offs)	2016	41	TBD	TBD	TBD	TBD	82
Number of innovation hubs increased (e.g. TBIs, innovation centers, niche centers, etc.) (incremental)	2016	23	33	43	53	63	45
Sector Outcome 2: Innovation Stimulated							
Subsector Outcome: Creative capacity for knowledge and technology generation, acquisition, and adoptions enhanced							
GII – Knowledge and Technology Outputs percentile rank improved	2016	66	Top 34%	Top 34%	Top 33%	Top 33%	Top 40% (60)
Research and development expenditure as a proportion of GDP increased (in percent, incremental)b	2015	0.14	0.20	0.25	0.30	0.35	
Number of researchers, scientists, and engineers (RSEs) per million population increased (cumulative)b	2015	190	275	280	285	290	
Number of STEM enrollees in higher education institutes (HEIs) increased (in million, incremental)c	AY 2015/ 2016	1.29	1	0.94	1.09	1.25	1.02 (AY 2017/ 2018)
Number of Balik Scientists engaged increased (incremental)	2016	26	39	41	44	46	28
Subsector Outcome: Open collaboration among actors in the STI ecosystem strengthened							
World Economic Forum (WEF) University-Industry Collaboration percentile rank improved	2016	52.5	Top 50%	Top 50%	Top 50%	Top 49%	N.A.
Number of STI-related international cooperation agreements of HEIs increased (incremental)	2015	40	50	60	70	80	78

Notes:

a/ Actual data as of December 2015, or latest available data. May not necessarily be year-end values.

b/ The PSA and DOST are requested to produce this data annually instead of every two (2) years. Data from 2016 to 2022 may be needed to better monitor the indicator.

c/ The implementation of K-12 has resulted in the decline of freshmen higher education enrollment in 2016 and is seen to continue in 2017. In anticipation of this, the 2017 target was lowered than the actual number of STEM enrollees in 2016. On the other hand, the first batch of the K-12 enrollees will start to increase in 2018.

Promoting and accelerating technology adoption

STI-related investments remained low. However, more innovation hubs were established and the number of technology business incubators (TBIs) graduates grew. The country's percentile ranking in the GII – Investment Index declined to six (6) in 2018 from 12 in 2017. This is primarily driven by the lower country score and ranking in the sub-indicator on protecting minority investors.[2] The country also continued to underinvest in research and development (R&D). Latest available data reveal that the Philippines' overall R&D expenditure[3] remained at 0.14 percent of gross domestic product (GDP) in 2015,[4] reflecting low public and private sector R&D expenditure relative to its ASEAN peers. This can also be gleaned from the WEF Readiness for the Future of Production Report 2018.[5]

[2] *The country score on sub-indicator "protecting minority investors" dropped from 41.7 in 2017 to 40.0 in 2018. This indicator measures the strength of minority shareholder protections against misuse of corporate assets by directors for their personal gain as well as shareholder rights, governance safeguards, and corporate transparency requirements that reduce the risk of abuse.*

[3] *As defined by the Organisation for Ecomomic Co-operation Development, gross domestic spending on R&D is defined as the total expenditure (current and capital) on R&D carried out by all resident companies, research institutes, university and government laboratories, etc., in a country.*

[4] *Latest available data based on the preliminary estimates of the DOST - Planning and Evaluation Service, as of January 2019.*

[5] *In terms of R&D expenditure as a percentage of GDP, the front runners are Korea (4.3%), Japan (3.6%), Israel (2.2%), China (2.1%), and Singapore (2.2%). Our neighbors Thailand (0.5%) and Vietnam (0.2%) also invest more in R&D compared to the Philippines.*

To improve public sector R&D investment, the government supported efforts to augment R&D activities in the country through the Niche Centers in the Regions for R&D (NICER)[6] and R&D Leadership (RDLead)[7] Programs. In addition, the government has also instituted 45 new innovation hubs throughout the country in 2018, exceeding the target of 43 for the year. These innovation hubs offer support structures to STI-based start-ups, enterprises, and spin-offs by providing facilities, services, and opportunities to collaborate with other tech start-ups. Moreover, there were 82 TBI graduates in 2018, higher than the 56 graduates in the previous year.

The country did well in improving existing technologies, but lagged in creating new ones. In 2018, there were 1,044 new utility models and 962 new industrial designs registered, exceeding well the targets of 635 and 569, respectively. Meanwhile, patents granted increased to 29, higher than the 19 patents recorded in 2017, but lower than the 34 patents targeted in 2018.

As support to the creation of relevant technologies in the country, the government strengthened the implementation of programs that assist individuals and enterprises in obtaining intellectual properties, among others, to help commercialize technologies (e.g., Technology for Innovation and Commercialization,[8] Mind to Market,[9] and Intellectual Property Hubs and Spokes[10]).

Stimulating Innovation

Collaboration among STI actors improved. The University – Industry Collaboration percentile rank of the country in the Global Innovation Index Report remained at the top 48 percent in 2018, higher than the target of top 50 percent. There were 78 STI-related international cooperation of HEIs as of November 2018, which is 30 percent higher than the year's target.

Philippine ranking in the GII – Knowledge and Technology Outputs (KTO) Index dropped and less "*balik* scientists" were engaged. The country's rank in the GII – KTO Index dropped to top 40 percent in 2018 from top 34 percent in 2017. This is due to the lower country scores and rankings in the two pillars – knowledge impact[11] and knowledge diffusion,[12] which were more specifically pulled down by the sub-indicators on labor productivity, computer software spending, and foreign direct investment (FDI) net outflows. As of November 2018, the government engaged 28 "*balik* scientists" which is 31.7 percent less than the 2018 target. However, the enhanced benefits and incentives under the *Balik* Scientist Act is expected to engage more "*balik* scientists" in the ensuing years.[13]

---

[6] *Capacitates regional HEIs through R&D funding that will improve regional research and S&T infrastructure, enabling HEIs to integrate regional development needs with R&D and local resources.*

[7] *Engages experts with strong leadership, management, and innovative policy-making proficiency to strengthen research capabilities of HEIs and RDIs.*

[8] *TECHNICOM provides development support to interested proponents with commercially-viable projects. Through financial and technical assistance, the program aims to fast track the transfer and commercialization of research results. Retrieved from http://tapi.dost.gov.ph/programs-and-services*

[9] *Mind-to-Market is a program of the Intellectual Property Office of the Philippines that assists universities in connecting with businesses for commercialization of their intellectual properties. Retrieved from https://www.ipophil.gov.ph/releases/archive-2016/486-ipophl-supports-hei-s-innovation-through-ip-protection.*

[10] *The Intellectual Property Hub and Spokes system will also be promoted to provide intellectual property infrastructure, enable linkages, and facilitate transactions among partners.*

[11] *Under the knowledge impact pillar, the country registered lower scores and rankings on the sub-indicators labor productivity and computer software spending as a proportion of GDP.*

[12] *Under the knowledge diffusion pillar, the country's score was pulled down by the sub-indicator FDI net outflows as a percentage of GDP.*

[13] *The Implementing Rules and Regulations of the Balik Scientist Act (RA11035) took effect in October 2018 and provides for enhanced benefits and incentives. While waiting for the IRR, many applicants backed out of the program in 2018 and opted to avail of the better perks in the succeeding years (e.g. accident/travel insurance with PHP3 million coverage, tax exempt daily allowance of USD200, PHP500,000 incentive to be given after the completion of the engagement, PHP40,000 monthly housing or accommodation allowance, PHP5,000 monthly transportation allowance, among others).*

Targeted STEM enrolment was met although lower than 2017 figures. For Academic Year 2017-2018, the number of STEM enrollees in HEIs reached 1.02 million. Though this is slightly lower than the 1.27 million STEM enrollees in 2017, it is higher than the target of 940,000 enrollees in 2018.[14] To encourage more students to pursue STI courses, the government implemented and intensified its various scholarship[15] programs, including the Department of Science and Technology's (DOST) Human Resource Development Program.[16]

Moving Forward

Incentives under the *Balik* Scientist Act are expected to help ease the shortage of experts on specialized areas and emerging potential sectors of the economy. The recent initiatives to mobilize linkages among players in the STI ecosystem are also expected to drive its strategic directions and cohesion. On the other hand, the number of registered utility models and industrial designs is likely to remain way above target as areas for expansion remain huge. The demand for TBIs is seen to continuously increase due to the growth of service-oriented microenterprises[17] heavily relying on the use of digital and online platforms, along with active government efforts to raise TBI program awareness. With the stronger concerted efforts to collect STI statistics and the constant need for the public sector to create greater positive externalities, R&D expenditure as a proportion of GDP will likely increase.

Despite these foreseen gains, the need to address the risks and challenges of the STI sector remains crucial for it to fully harness its potential for growth, inclusivity, and long-term sustainability. Hence, the implementation of the following strategies is recommended.

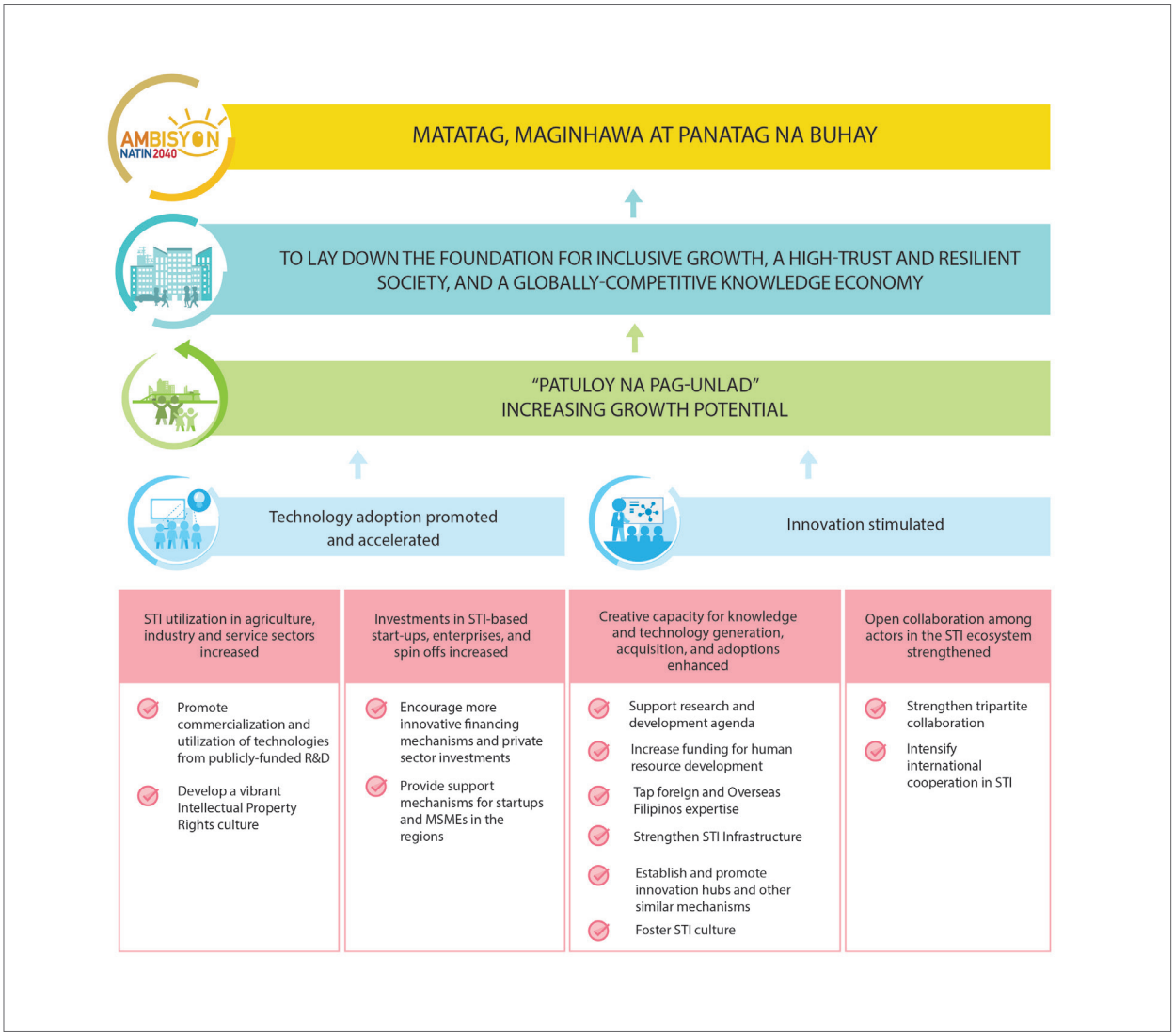
[14] *The implementation of K-12 has resulted in the decline of freshmen higher education enrollment in 2017 and 2018.*

[15] *Includes the Expanded Specialized Science Secondary Education Scholarship, Expanded Undergraduate S&T Scholarships for Inclusive Development, Expanded S&T Graduate (Masters/PhD) Scholarships, etc.*

[16] *The DOST Human Resource Development Program (HRDP) will cover scholarships and training opportunities in the priority fields identified by the DOST HRDP Committee. It will also include an incentive program for self-financed graduates of Doctorate and Master's degrees.*

[17] *Various areas of microenterprises in this regard include those in: (a) wholesale and retail trade; (b) food business; (c) online/web-based businesses; (d) graphic design; (e) professional services; (f) transportation; and (g) education services, etc.*

Figure 14.1 Strategic Framework to Leverage Science, Technology, and Innovation



To strengthen collaboration among actors in the STI ecosystem

Enhance collaboration among the players in the STI ecosystem. Congress has passed the "The Philippine Innovation Act"[18] and is now awaiting the signature of the President. The proposed law shall establish the Innovation Council that will adopt a "whole-of-government approach" (similar to that in Singapore and Malaysia), that will steer the direction of STI development in the country. This will also address the current fragmentation in the governance framework of the STI sector leading to the lack of coherence in the policies, plans, and programs. Moreover, the Collaborative R&D to Leverage Philippine Economy (CRADLE) Program should be intensified to further increase the collaboration between the government and academe.

[18] *The bill establishes the National Innovation Council which will develop the country's innovation goals, priorities, and long-term national strategy. Said Council will also formulate a National Innovation Agenda and Strategy Document that establishes the country's vision and long-term goals for innovation and provides a roadmap and the strategies for improving innovation governance through clear-cut delineation and complementation of innovation efforts across agencies, deepening and accelerating innovation efforts, and integrating and fostering public-private partnerships, among others.*

The formulation and implementation of the Inclusive Filipinnovation and Entrepreneurship Roadmap[19] which will push for the establishment of Regional Inclusive Innovation Centers, among others, should also be facilitated.

Boost efforts to produce relevant and up-to-date STI statistics. To determine the constraints in generating STI statistics and provide recommendations on how to address these constraints, a scoping study is being conducted. The results of the study will feed into the work of the Inter-Agency Committee on STI Statistics, the body that identifies and resolves issues and concerns being encountered by various government agencies in producing STI statistics.

To enhance capacity for knowledge and technology generation, acquisition, and adoption

Promote the enhanced benefits and incentives of the "*balik* scientists" under the *Balik* Scientist Act (Republic Act No. 11035). To help lessen the adverse impacts of the decrease in the number of science and technology (S&T) personnel in the country, the government should strongly promote the enhanced benefits and incentives of the "*balik* scientists" under the *Balik* Scientist Act, particularly in sectors and areas where expertise is lacking.

Additionally, the government will support the passage of the act amending RA 8439, otherwise known as the "Magna Carta for Scientists, Engineers, Researchers and Other Science and Technology Personnel in the Government." Said bill would: prohibit the government from imposing limits on the amount of additional honoraria from externally funded grants that may be received by S&T personnel; allow non-DOST personnel who are involved in S&T activities to also receive benefits under RA 8439; and authorize the extension of services of scientists who are due for compulsory retirement, among others.

Accelerate efforts to prepare/respond to the emerging Fourth Industrial Revolution (FIRe) landscape. According to the WEF Readiness for the Future of Production Report 2018, the Philippines is not yet prepared to manage the FIRe. This is particularly true in terms of production, where the country has exhibited low level of readiness as manifested in its weak performances in terms of technology and innovation, human capital, and institutional framework, among others.[20]

In response to the emerging FIRe landscape, the government should identify the priority frontier technologies[21] and formulate the roadmaps[22] on how to harness these technologies. The changing/updating of the STEM curriculum must be implemented[23] to respond to the needs of the FIRe (*refer to Chapter 10 Box Article 10.2 for complete details*).

---

[19] *This roadmap seeks to activate innovation and entrepreneurship as the main levers to reduce, if not completely eliminate, poverty in the country. The roadmap will institutionalize a policy framework and implement innovation-centered strategies and programs through strong government academe-industry collaboration, to address the challenges and take advantage of market opportunities arising from Industry 4.0 technologies, and serve as an engine for sustainable growth, job creation, and poverty reduction.*

[20] *As the study defined, "production" involves a broad spectrum of economic activity related to manufacturing products and goods. A full end-to-end appraisal of what it entails reveals the following sequence: Design-Source-Manufacture-Assemble-Distribute-Service-End of use-cycle. On the other hand, "readiness" is generally regarded as the ability to capitalize on future production opportunities, mitigate risks and challenges, and be resilient and agile in responding to unknown future shocks.*

[21] *There is no universally agreed definition for frontier technology. However, there is a recurring common feature across the different technological advances and that they all "have the potential to disrupt the status quo, alter the way people live and work, rearrange value pools, and lead to entirely new products and services. (Frontier Technologies for Sustainable Development in Asia and the Pacific. 2018. United Nations Economic and Social Commission for Asia and the Pacific). Some examples of frontier technologies are nanotechnology, artificial intelligence, internet-of-things, bioprinting, big data, blockchain, robotics, neurotechnology, synthetic biology and others.*

[22] *The DOST and the Department of Trade and Industry will lead the formulation of the roadmaps.*

[23] *The Commission on Higher Education will lead the updating of the curriculum.*

Furthermore, the government should support and pursue initiatives to remove restrictions on the practice of profession by foreign experts (e.g., engineers) listed in the Regular Foreign Investment Negative List *(refer to Chapter 9)*.

Increase STI-related human capital investments. Investing in people is essential in deepening and expanding STI efforts. Thus, the government should sustain its Young Innovators Program (YIP)[24] to complement the STI efforts in the educational system *(refer to Chapter 10 for more details)*. Moreover, the country should be able to create and maintain a critical mass of researchers, scientist, and engineers necessary to raise the quality of products and services in the market.

Advocate the passage of the "National Quality Infrastructure (NQI) Act." The government should support the enactment of the bill to develop an NQI system that will integrate and coordinate policies and programs involving standardization, accreditation, and metrology to meet local and international quality requirements for products and services of enterprises. This will promote a culture of quality, innovation, competitiveness, sustainable development, and compliance with international commitments, and also help address the lack of STI ecosystem in the country *(refer to Chapter 9 for complete details)*.

To increase STI utilization in agriculture, industry, and services sectors

Advance and monitor the commercialization and utilization of STI outputs. To increase the STI utilization in the agriculture, industry, and services sectors, the government must actively use the *Negosyo* Centers, entrepreneurial organizations, and state universities and colleges (SUCs) and HEIs offering business/ entrepreneurial courses as venues to introduce research outputs of the government and the academe that are ready for adoption.

R&D funding should be prioritized based on the commercial viability and marketability of the R&D outputs of HEIs and government agencies. To improve the academe's capabilities to commercialize technologies, the establishment of technology licensing offices (TLOs) in SUCs and research and development institutes (RDIs) should be continued. The Intellectual Property Office of the Philippines, in collaboration with the Commission on Higher Education, will undertake awareness programs/campaigns in SUCs on the importance of TLOs.

A good example of technology that will be commercialized and eventually be utilized is the Hybrid Electric Train (HET).[25] The HET is intended to address the heavy traffic congestion in many parts of the country. Moreover, the adoption and widespread commercialization of the HET technology will also provide opportunities for the local manufacturing industry (e.g., manufacturing of train parts).

[24] *The YIP provides financing to promising scientists and engineers and innovation-oriented researchers leading to quality research paper, publication, or product/invention. It will attract young and talented researchers to continuously invigorate the dynamism of the scientific environment.*

[25] *The HET is the first Philippine-made hybrid train powered by batteries and a generator which makes it environment-friendly. The train, developed by 10 Filipino engineers, has five (5) coaches with a maximum capacity of 880 passengers.*

Increase public awareness on R&D activities. The government should ensure that access to physical and digital S&T information and research data is available for all. It should also aggressively promote the research areas under the Harmonized National Research and Development Agenda 2017-2022 while ensuring the coherence and clarity of its developmental objectives.

The establishment of the Filipinnovation Portal[26] and the conduct of more STI exhibits and expositions could help increase the appreciation, acceptance, and participation of the general public in R&D and innovation.

To increase investments in STI-based start-ups, enterprises, and spin-offs

Create an enabling environment for STI investments. The government should support the passage of the draft bill institutionalizing the Science for Change Program (S4CP) which is intended to be a game changer for STI investments. The S4CP seeks to establish and expand STI programs along with the accelerated R&D thrusts under NICER and RDLead. It is also expected to ramp up industrial competitiveness through the CRADLE[27] and Business Innovation through S&T (BIST) Programs.[28] Another boost for STI investments will be the passage of the Innovative Start-up Act that will provide operational and monetary support to innovative and tech start-ups. The enactment of the Philippine Space Act is also expected to increase investments given the extensive application of space technologies on agribusiness, environmental conservation, national security, urban planning, transportation and communication, and disaster management.

[26] *The preparation of the Innovation Portal is being supported by the Global Innovation Policy Accelerator. The Global Policy Accelerator Program is funded through the United Kingdom government's Newton Fund and delivers executive development to national cohorts of senior policymakers from the main innovation institutions, while strengthening the implementation capabilities of their teams. (Source: https://www.nesta.org.uk/project/global-innovation-policy-accelerator/)*

[27] *Under the CRADLE Program, the private sector industry will identify the problem; and the HEI or RDI will undertake the research and development. CRADLE funding will only be given to HEIs or RDIs.*

[28] *The BIST aims to facilitate the acquisition of strategic and relevant technologies by Filipino companies for immediate incorporation in their R&D activities. This program will contribute to the technology development value chain as it provides the means for the industry to undertake R&D and acquire advanced technology for global competitiveness.*