CHAPTER 14

Vigorously Advancing Science, Technology, and Innovation

The COVID-19 pandemic has made leaders, policy makers, and various stakeholders think carefully about what makes healthy and resilient communities. The government carried out calibrated policies to respond to the current health crisis while balancing fiscal priorities to address the existing challenges of poverty, social inequality, food insecurity and climate change, among others. On the Science, Technology, and Innovation (STI) front, setbacks were further aggravated by the unequal effects of the crisis on research and development, innovation (R&DI) across sectors largely dictated by the degree of openness and agility of the R&DI ecosystems to respond to the changes. The postponement of professional licensure examinations—particularly in the fields of Science, Technology, Engineering, Arts and Mathematics (STEAM)—created delays in hiring additional workforce to the sector. Despite these challenges, the reforms that were initiated before the pandemic served as a solid foundation for strengthened collaboration of STI actors.

On the upside, the crisis prompted the accelerated adoption of digital tools and techniques, which enabled government, businesses and schools to continue their operations. However, the "digital gap" remains. Thus, there is a need to accelerate infrastructure investments and improve digital connectivity to serve the unserved and the underserved in peripheral areas. There is also an urgent need to formulate innovative solutions and deploy the roll-out of existing technologies that will help reduce the negative effects of the pandemic.

ASSESSMENT

In general, the country's performance in achieving the desired outcomes for the STI sector slightly improved. The latest report shows that 13 out of 30 targets with available data have been surpassed, while 6 out of 30 targets with available data are expected to be achieved.

SCALE-UP TECHNOLOGY ADOPTION

Intellectual property products expenditure has been increasing. The intellectual property products expenditure as a percentage of Gross Domestic Product (GDP) stood at 0.8 percent in 2021, which is higher than the previous year's 0.7 percent. This indicates that the country is placing more investments in activities that increase the stock of knowledge or lead to the creation of new products, processes, services, among others.

There is an improvement in terms of creating new technologies but there is a lag in terms of improving existing ones. In 2021, there were 44 new patents granted, a number that is higher than the

target of 30 in the said year. On the other hand, there were 4 patents filed under the patent cooperation treaty (PCT) in 2021, which is higher than the target of 3 for 2021. In the same year, there were 815 new utility models (UMs) registered, which surpassed the target of 584 for 2021. Meanwhile, only 211 new industrial designs (IDs) have been registered in 2021, which is below the target of 494 for that year.

STI-related investments remained low despite some improvements. The country's percentile rank in the Global Innovation Index (GII) – Investment Index in 2021 was 23, slightly behind the target of 24 for the said year. In the same year, there were 81 new Technology Business Incubators (TBI) established which was below the target of 230 for the said year as resources were channeled towards pandemic response. On the upside, there were 126 innovation hubs instituted for the period 2017 to 2021, which exceeded the target of 108 for the same period. As targeted, investments in STI-based startups and spin-offs significantly increased. The Department of Science and Technology's (DOST) funding and investments for STI-based startups and spin-offs grew from PHP43.4 million in 2020 to PHP185.5 million in 2021.

ACCELERATE INNOVATION

The Philippine's GII ranking improved though still below target. The country progressed in terms of GII – Knowledge and Technology Outputs, placing itself on the top 18 percentile rank in 2021 and performing above the target of top 33 percent in the said year. On the other hand, the country recorded being on the top 38 in Overall GII and top 49 percentile ranks in GII – Creative Outputs, both below the set targets of top 35 and top 42 percentile ranks, respectively.

STEM enrollees and Balik Scientists were below set targets. On human capital, there were 194,499 graduates from Science, Technology, Engineering and Mathematics (STEM) fields in 2020, higher than the set target of 50,000 for 2020. However, the country underperformed in terms of STEM enrollees as there were only 1.3 million recorded in 2020, below the 1.7 million target for the same year. Amid travel and mobility restrictions, the government has engaged 33 Balik Scientists as of September 2021, which fell short of the 101 target for the said year.

The research and development (R&D) expenditure as a percentage of GDP also improved to 0.3 percent in 2018, above the target of 0.2 percent for the same year. In addition, the number of researchers per million population is 356 in 2018, which is higher than the target of 280 for the said year.[1]

Collaboration among STI actors improved. With its percentile ranking of top 47 in the 2021 GII – University and Industry, the country surpassed its target of top 49 percentile rank for the said year. Moreover, there were 100 multi-stakeholder partnerships among Higher Education Institutions (HEIs), government, and/or private sector firms developed through Regional Inclusive Innovation Centers (RIICs) in 2021, which was in line with the target for the year.

[1] Data is from DOST S&T Compendium, which is published every 3 years. The latest 2018 report was released in November 2021. The 2021 edition will likely be released in 2024.

IN FOCUS: JOSEPH BRYAN SANTOS, ASPIRING MECHANICAL ENGINEER, INNOVATOR, AND EXPORTER

Joseph Bryan Santos is a 23-year-old graduate of BS Mechanical Engineering working as a factory maintenance personnel in a private company. He dreams of becoming a licensed mechanical engineer, but the professional licensure exam was postponed due to pandemic-related restrictions implemented by the government.

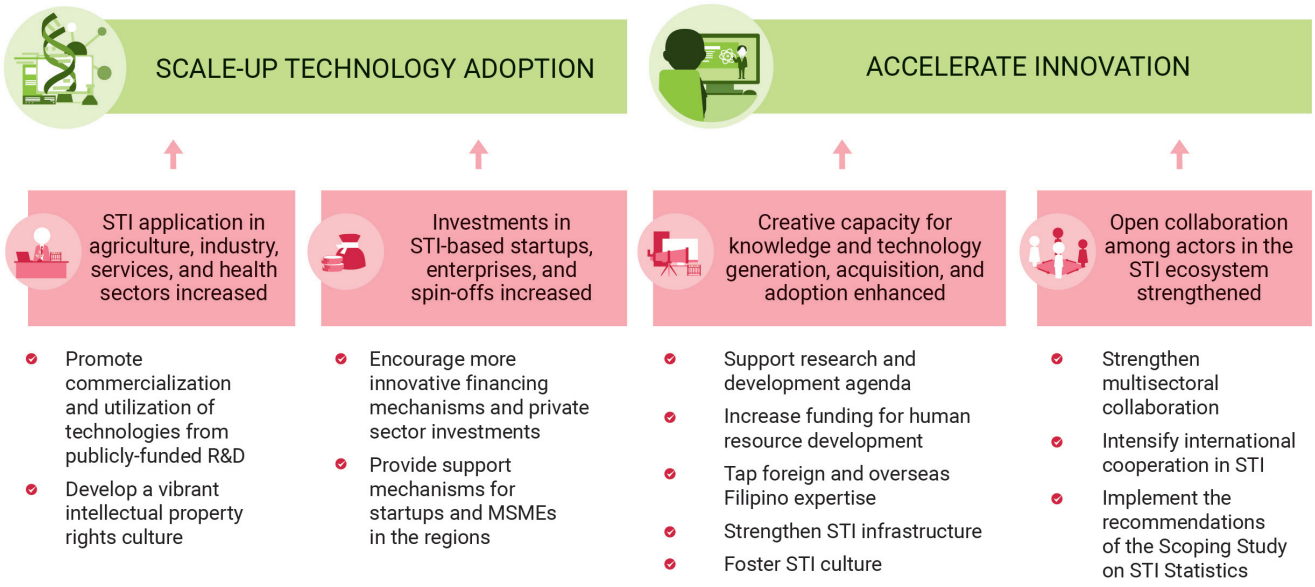
Since he was a young boy, Joseph has been innovating products that he thought would respond to emerging market demands. He hopes to sell his products domestically and overseas and secure patents for his original designs. Joseph also aspires to establish his own innovation company someday.However, he faces funding constraints. He has limited awareness of any government support that he may avail of to finance and develop new products. Joseph also has low trust in the country's intellectual property laws, which makes him fear the disclosure of his concepts and past inventions. Consequently, he plans to secure his patents overseas. Further, poor internet connectivity affects his ability to contact and collaborate with potential partners and limits his access to information. For now, Joseph continues to work part-time to support his family while also reviewing for the licensure examination.

STRATEGIC FRAMEWORK

Joseph's situation and aspirations reflect the lives of many similar individuals who need the enabling environment to increase their opportunities, reach their full potential, and contribute productively to the betterment of society. To help him, it is imperative that there should be a boost in investments inflows, improvement in the educational system, advancement in the ease of doing business, upgrade in good governance, and additions to infrastructure projects.

Specifically, the strategies for the STI sector address the following challenges and constraints that likely Joseph experiences: 1) limited access to finance for budding inventors and entrepreneurs; 2) delays or lags in achieving human capital outcomes and targets; 3) lack of support or low awareness of government interventions to help generate new research and creative outputs; 4) low trust as well as low awareness on the country's Intellectual Property (IP) laws; and 5) the digital divide.

Figure 14.1 Strategic Framework to Vigorously Advance Science, Technology, and Innovation



STRATEGIES

TO INCREASE STI APPLICATION IN AGRICULTURE, INDUSTRY, SERVICES, AND HEALTH SECTORS

Scale-up deployment of public-funded technologies that are ready for use or viable for commercialization to help cope with the pandemic. Given the demand for innovative solutions, existing public-funded technologies must be further utilized. In addition, the Shared Service Facilities (SSFs) and innovation hubs will be used for mass production of essential goods such as facemasks, medicines and patients monitoring systems. The identification of high-risk areas for COVID-19 with the aid of digital technologies will be further deployed for national and local government use. [*See Chapter 10 for further details]*

Continue expansion of the network of Innovation and Technology Support Offices (ITSOs) or patent libraries. Moreover, the Intellectual Property Office of the Philippines (IPOPHL) will establish more satellite offices in the regions to help increase intellectual property rights (IPR) applications throughout the country.

Intensify the IP awareness, education and information initiative campaign for MSMEs in the region. This will be done through basic orientation seminars, one-on-one consultations/IP clinics, patent drafting seminars, and capability building seminar/workshops, among others. Furthermore, the government will maximize the use of Information and Communications Technology (ICT) and online platforms in the conduct of IPR awareness campaigns.

Streamline processes for IPR applications/registrations. In addition, IPOPHL will strengthen its partnership with appropriate government agencies and units that are offering innovation support programs to ensure that many of the innovation outputs will have intellectual property protection and to reduce IPR application costs and turn-around-time. [*See Chapters 5 and 9]*

TO INCREASE INVESTMENTS IN STI-BASED STARTUPS, ENTERPRISES, AND SPIN-OFFS

Scale-up the implementation of the Philippine Startup Development Program. This is to provide a comprehensive support to startups and startup enablers from capacity building to helping them conduct their product launch, commercialization, and scaling-up of operations, among others.

Create a conducive environment for the proliferation of private ventures such as those in the space programs of the country. The existence of more private ventures will help R&DI activities to expand in unfamiliar areas, particularly in novel and emerging ones, where government expertise and/or resources are diminished.

Expand the innovation/business support mechanisms for existing and budding entrepreneurs. This will be done through the establishment of more innovation centers and business incubators (e.g., TBIs, innovation centers, Niche Centers in the Regions or NICERs) across the country, particularly where there is demand. Some services of these innovation support mechanisms will also be offered online to reach more intended beneficiaries. Further, the integration of these services is encouraged through the establishment of one-stop shops, or utilization of a fully-online, no-stop shop service delivery using the Central Business Portal. [*See Chapter 9*]

Support the expansion of the Regional Inclusive Innovation Centers (RIIC) and strengthen their linkages with other innovation support mechanisms. Moreover, the progress of the RIICs will be monitored and its linkage with existing TBIs, innovation centers and NICERs will be expanded to ensure accomplishment of industry targets. [*See Chapter 9*]

Operationalize the Filipinnovation e-community portal, which will serve as the repository of government and academic research and innovation outputs. Through the National Innovation Council (NIC), a one portal system will be deployed to regularly monitor various innovation projects and activities in the country, including sharing of success stories and best practices for public-funded STI outputs. Succeeding iterations of the portal will offer online services with interactive features that will allow the public to access services or file applications for scholarships or other services and programs online, including grants, and financial assistance.

Implement the Strategic Investment Priority Plan (SIPP) to encourage the establishment of highly-innovative industries. Incentives corresponding to the SIPP framework will be provided to highly-innovative industries that will generate positive spill-over effects to the economy. In particular, Tier 3 of the SIPP may avail of incentives under the Corporate Recovery and Tax Incentives for Enterprises (CREATE) law, consisting of R&D, generation of new knowledge and IP, commercialization of patents, industrial designs, copyrights, utility models, highly technical manufacturing, and others. *(See Chapter 9)*

Implement and monitor outputs of the Science for Change Program (S4CP). The program will be implemented and monitored throughout the country covering the 4 sub-program components, namely: (a) Niche Centers in the Regions for R&D (NICER) Program; (b) R&D Leadership (RDLead) Program; (c) Collaborative R&D to Leverage PH Economy (CRADLE) for RDIs and Industry Program; and (d) Business Innovation through S&T (BIST) for Industry Program. These programs are designed to be demand-driven, and responsive to the needs of the technology-users, businesses, and communities. The S4CP also encourages government-academe-industry collaboration that will lead to the generation of significant value added through improved processes and/or enhanced products.

Strengthen implementation of government interventions to facilitate digitalization and innovation of MSMEs. These programs include the Small Enterprise Technology Upgrading Program (SET-UP 4.0), OneExpert, OneLab, Shared Services Facilities (SSFs), and Technology Business Incubation—all designed to help MSMEs to improve their processes through automation and adoption of other appropriate technologies. [*See Chapter 9*]

TO ENHANCE CREATIVE CAPACITY FOR KNOWLEDGE AND TECHNOLOGY GENERATION, ACQUISITION, AND ADOPTION

Fast-track the formulation of the National Innovation Agenda and Strategy Document (NIASD). The NIASD will establish the country's vision and long-term goals for innovation, consistent with global and regional commitments and with AmBisyon Natin 2040 and the PDP. The said document will consist of strategies and action plans to improve innovation governance, such as identifying and addressing the internal processes of government agencies involved in the generation of R&D outputs, among others.

Conduct studies and collaborate on the use of hydrogen fuel for the power and transport sectors. The Department of Energy (DOE) and the DOST, in collaboration with relevant stakeholders, will study the potential application of hydrogen fuel for the power generation and transportation sectors. In addition, the government will pursue collaborations and partnerships to bring in or incentivize the use of renewable technologies under the CREATE law, particularly in carbon-intensive industries (e.g., energy, transportation, tourism, etc.) to reduce carbon footprint. [*See Chapters 9 and 20*]

Strengthen coordination with Research and Development Institutes (RDIs) and HEIs in implementing the Agri-Aqua Technology Business Incubation (ATBI) Program. The program serves as a convergence zone of the DOST-Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development's (DOST-PCAARRD) efforts and bridge support to realize the agribusiness potential of its many R&D outputs.

Support the implementation of the Artificial Intelligence (AI) Roadmap. Applications of advanced technologies, such as AI on electronics, communication, smart cities, transport, infrastructure, disaster risk reduction, agriculture, health, and data analytics, among others, will be supported. Continuous investments on national infrastructure, capacity building, research and data, and policies and stakeholders on AI will be prioritized to reduce economic costs and improve service delivery of both the public and private sector. [*See Chapters 9 and 10*]

Utilize space-based technologies in pandemic planning, monitoring, and operation. The use of satellite imagery, geographic information system, global positioning system, etc., will be utilized in risk mapping and forecasting, digital contract tracing, and vaccine deployment, among others. Consequently, data warehousing and data protection infrastructure must also be improved.

Continue the conduct of professional licensure examinations through alternative modes of delivery. For this purpose, the Professional Regulation Commission (PRC) and the Department of Information and Communications Technology (DICT) will endeavor to ensure the successful conduct of various professional licensure exams, taking off from best practices of other countries in offering digital modes while ensuring utmost security and minimizing risks (e.g., e-exams with remote proctoring). In addition, the government will encourage digitalization of review center operations and provision of online review platforms to serve the new graduates as well as potential examinees who were affected by the delays caused by the pandemic. [*See Chapter 10*]

Intensify promotion of the Accelerate the Science and Technology Human Resource Development Program (ASTHRDP) to encourage more scholars to pursue Master's and Doctoral programs in priority S&T areas, such as in agriculture, biological science, biotechnology, environmental science, fisheries and marine, health and pharmaceutical, ICT, materials science, among others. Furthermore, the government will employ and promote "citizen science"[2] as a strategy to encourage the public participation and collaboration in scientific research to increase scientific knowledge, intensify data generation, sharing of technologies, and nurture the public's interest in STI, among others.

Promote the online application and remote working arrangement for short-term engagements under the Balik Scientist Program to increase the participation of Balik Scientists despite the challenges brought by the pandemic. [*See Chapter 21 for further details]*

Promote ICT-literacy and build a wider base of data science, futures thinking, and other related expertise in the country. Data science subjects in the education curriculum and cross-disciplinary programs will be institutionalized. Furthermore, innovation skills will be integrated in the basic curriculum, including futures thinking, design thinking, and systems thinking to address the current generation's challenges (e.g., poverty, climate change, etc.). The training on DepEd personnel on how to manage and use AI, machine learning and analytics for creating predictive models to measure student readiness, achievement, literacy level, and work readiness under different Senior High School (SHS) tracks will be expanded. *[See Chapters 9 and 10]*

Enable technology transfer and attract productive investments in R&DI. Exchange programs for Filipino students will be carried out for better appreciation on how innovation is being done in other countries and address societal problems from a global perspective. Initiatives to relax foreign equity restrictions/regulations in critical sectors of the economy will also be pursued to attract productive investments in R&DI. *[See Chapters 9 and 15]*

TO STRENGTHEN OPEN COLLABORATION AMONG ACTORS IN THE STI ECOSYSTEM

Fully operationalize the NIC and ensure that its policies are cascaded to stakeholders, especially the Regional Research, Development and Innovation Committees (RRDICs) of the various Regional Development Councils (RDCs). The NIC will steer the whole-of-government efforts to address existing STI challenges. In turn, the RRDICs and RDCs will help ensure a whole-of-society involvement in addressing these challenges.

[2] Citizen science is a growing global movement fostering the participation of volunteers without formal scientific training in scientific research. Examples range from volunteer flood monitoring to participatory digital humanities to Do-it-Yourself biology research or participatory health research. Across these, citizen science is notable for enabling participation throughout various stages in research and innovation processes that are possible in virtually all scientific disciplines. As such, citizen science is an essential building block for advancing science, society, and policy. (Written input by the CSGP Citizen Science & Open Science Community of Practice to the UNESCO Recommendation on Open Science, Global Citizen Science perspectives on Open Science, 2020).

Employ a whole-of-government approach in building the Regional Inclusive Innovation Centers (RIIC) as the regional platform for collaborative programs to generate product, improve processes, or provide innovative services that are deemed important to achieve the goal of inclusive growth and development across regions.[3]

Continue the collaboration between the DOST and the Department of National Defense (DND) to generate new technologies on mechatronics and robotics to further mount the existing and future naval assets of the Philippine Navy**.**

Sustain the conduct of hackathons for different areas of applications. The government will continue to support the conduct of hackathons that intend to create new products and solutions to specific issues (e.g., health emergency applications, mobile apps, maritime applications, public transport solutions, education, and disaster response).

Pursue international cooperation particularly on areas that are deemed relevant to the needs of the country, which include vaccine development, climate change research, satellite technology application and AI adoption, among others.

Strengthen monitoring of STI outputs and outcomes. The Philippine Statistics Authority (PSA) Board Resolution No. 10 s. 2021 which endorsed the adoption of the Statistical Framework for the STI Sector will be aggressively implemented. The said framework systematizes the development of STI statistics in the country. It will undergo continuous process improvement in response to future and emerging developments.

[3] In relation to this, a single uniform, interoperable, and systematic record or directory of all available innovations, accelerators, and incubators nationwide will be created to allow various entrepreneurs, angel investors, innovators to have an open and collaborative partnership platform for communication. All RIICs and end-users are encouraged to have access to the information and can be updated by the users on a timely and relevant basis. This will also encourage more consultations among stakeholders and allow open and more inclusive innovation communities (e.g., grassroots, social enterprises, etc.) to flourish.

RESULTS MATRIX

Table 14.1 Results Matrix

INDICATOR	BASELINE (YEAR)	TARGETS			ACTUAL		
		2020	2021	2022	2019	2020	2021
Sector Outcome 1: Scale-up technology adoption							
Proportion of intellectual property products expenditures to GDP increased (%)	0.46 (2016)	Increasing	Increasing	Increasing	0.729%	0.728%	0.779%
Subsector Outcome 1.1: STI application in agriculture, industry, services, and health sectors increased							
Number of Filipino patents granted increased	30 (2016)	38	30	38	30	23	44
Number of Filipino utility models registered increased	552 (2016)	727	584	750	763	942	815
Number of Filipino industrial designs registered increased	508 (2016)	627	494	622	636	337	211
Number of Filipino patents filed increased	245 (2016)	348	353	394	336	411	452
Number of Filipino utility models filed increased	1,100 (2016)	1,862	1,380	1,848	1,861	1,221	1,536
Number of Filipino industrial designs filed increased	959 (2016)	910	675	873	828	583	619
Number of Filipino patents filed under Patent Cooperation Treaty (PCT) increased	2 (2018)	3	3	4	3	7	4
Subsector Outcome 1.2: Investments in STI-based startups, enterprises, and spin-offs increased							
Global Innovation Index (GII) – Investment Index percentile rank improved	17 (2016)	22	24	25	8	35	23
Number of TBI graduates increased (i.e., enterprises and spin-offs) (cumulative)	41 (2016)	Increasing	230	270	72	80	81
Number of innovation hubs increased (e.g., TBIs, innovation centers, niche centers, etc.)	23 (2016)	63	108	128	84	99	126
Sector Outcome 2: Accelerate Innovation							
Overall Global Innovation Index (GII) rank improved	Top 58% (2016)	Top 38%	Top 35%	Top 33%	N/A	Top 38%	Top 38%
GII – Knowledge and Technology Outputs percentile rank improved	66 (2016)	Top 33%	Top 33%	Top 33%	Top 24%	Top 19%	Top 18%

INDICATOR	BASELINE (YEAR)	TARGETS			ACTUAL		
		2020	2021	2022	2019	2020	2021
Subsector Outcome 2.1: Creative capacity for knowledge and technology generation, acquisition, and adoption enhanced							
R&D expenditure as a proportion of GDP increased (in percent, incremental)	0.16 (2015)	0.35	0.40	0.50	Awaiting Results of R&D Survey	Awaiting Results of R&D Survey	Awaiting Results of R&D Survey
Number of researchers per million population increased	200 (2015)	290	295	300	Yet to be provided	Yet to be provided	Yet to be provided
Number of STEM enrollees in HEIs increased	1.29 (AY 2015-2016)	1.7	1.59	2.03	1.13	1.3	Yet to be provided
Number of STEM graduates in HEIs increased	183,000 (AY 2015-2016)	50,000	113,000	318,000	Yet to be provided	194,499	Yet to be provided
Number of Balik Scientists engaged increased	25 (2016)	46	101	151	45	34	33
Subsector Outcome 2.2: Open collaboration among actors in the STI ecosystem strengthened							
GII University-Industry Collaboration percentile rank improved	52.5 (2016)	Top 49%	Top 49%	Top 49%	Top 20%	Top 79%	Top 47%
Number of collaborations between HEIs and industries increased	70 (2014)	120	130	150	Yet to be provided	214	Yet to be provided
Number of collaborations between HEIs and government increased (National Government Agencies [NGAs] and LGUs)	300 (2015)	450	480	500	Yet to be provided	301	Yet to be provided
Number of STI-related international cooperation of HEIs increased	40 (2015)	80	95	100	Yet to be provided	151	Yet to be provided

Note: 2020 targets were set prior to onset of the COVID-19 pandemic and retained in the midterm update. 2021, 2022, and end-of-plan targets were adjusted to take into consideration the effects of the COVID-19 pandemic.