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Contribution by Philippines

to the CSTD 2024-2025 priority theme on "Diversifying economies in a world of accelerated digitalization" and "Technology foresight and technology assessment for sustainable development"

PERMANENT MISSION OF THE REPUBLIC OF THE PHILIPPINES
TO THE UNITED NATIONS AND OTHER INTERNATIONAL
ORGANIZATIONS, GENEVA

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The Permanent Mission of the Republic of the Philippines to the United Nations Office and Other International Organizations in Geneva presents its compliments to the Secretariat of the Commission on Science and Technology for Development (CSTD) and has the honor to submit the Philippines' inputs on the priority themes for the CSTD Inter-Sessional Panel Meeting, which will be held on 21-22 October 2024.

The Permanent Mission of the Republic of the Philippines to the United Nations Office and Other International Organizations in Geneva avails itself of this opportunity to renew to the Secretariat of the Commission on Science and Technology for Development the assurances of its highest consideration.

Geneva, 04 July 2024

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PHILIPPINES' INPUTS

United Nations Commission on Science and Technology for Development (CSTD)

PRIORITY THEME 1: Diversifying economies in a world of accelerated digitalization

1. What are the specific challenges your economy is facing to develop or adapt frontier technologies and AI?

   The Philippines faces challenges on the following aspects:
   - Digital infrastructure – the country still needs to address concerns on different aspects of digital infrastructure such as limited access to high-speed, consistent, and reliable internet connectivity and limited access to high-performance computing, especially in rural areas
   - Skills and education on AI and workforce – there is still a lack of professional and experts on AI and other frontier technologies which the Department of Science and Technology is also eager to address with its programs and initiatives. There is a need for reskilling and upskilling the workforce, aligning the education system with the demands of the digital economy, and equipping the human resource with necessary training for AI-driven industries.
   - Policy support and regulatory framework – the policies and regulatory environment for AI and other frontier technologies are still evolving. The country needs clear regulations to address issues such as data privacy, ethical use of AI, and intellectual property rights.
   - Public awareness and understanding of AI – there could be more promotion about AI to be able to understand it and its applications more and maximize its benefits
   - Multistakeholder collaboration – the country would benefit with stronger collaborations among the government, academe, and industry for more innovative initiatives.
   - Cybersecurity, data security, and privacy concerns – alongside necessary policies, there is a need to build trust on data governance and ensuring protection of data in this age of AI and digitalization

   A concrete example of the challenges faced due to the rapid technological change is the country's experience in the handloom textile industry. The quick transition in the society requires material and human resource investment which challenges the small sectors to keep up. Artisan weavers are struggling to preserve their tradition while contending with the rise of counterfeit handloom products. Although the government is assisting in integrating digitalization into this industry, this initiative also faces challenges due to the low computer and technological literacy of the population, especially since many weavers fall into the old adult category. Their struggle in adapting digitalization yields to keeping the common method of orally passing their knowledge on to future generations compared to shifting with digitalization, which affects the development of more advanced documentation of techniques and artistic weave patterns for the preservation of tradition and culture.

   Moreover, the rise of counterfeit products affects not only the industry but also adulterates the culture. The solution of using an authentication mechanism through digitalization requires constant use of resources to keep pace with the technology in both material development and computer technology to keep the authentication working. These challenges in balancing sustainability with the benefits of frontier technology underscore the need for support of the country on its transition of adapting digitalization and frontier technology.

2. Can you provide successful examples of AI and other frontier technologies uptake in your country?

   The Philippines has taken advantage of the benefits of AI and other frontier technologies in the country including in different fields such as agriculture, environment, disaster risk reduction and management, health, manufacturing, finance, and smart and sustainable cities and communities.

   In general, the Philippines has adopted various digital solutions in the day-to-day activities. This includes digital payment platforms in various stores, malls, cafes, and shops. These use AI

algorithms to detect fraud and enhance security in transactions, enabling more Filipinos to participate in the digital economy

Agriculture

- Project SARAI (Smarter Approaches to Reinvigorate Agriculture as an Industry in the Philippines) - aims to craft crop advisories which are targeted for rice, corn, banana, coconut, coffee, cacao, sugarcane, soybean, and tomato. The crop advisories focus on integrating local weather data and drought forecast with farm management activities, specifically nutrient and water management, and proactive pest and disease monitoring. Project SARAI implements a near real-time monitoring of production areas using remotely-sensed images. Project SARAI is implemented by the University of the Philippines Los Baños (UPLB), together with 11 State Universities and Colleges (SUCs) and six National Government Agencies.
- Drought and Crop Assessment and Forecasting (DCAF) - DCAF detects, monitors and forecasts drought events and stress in a certain agricultural area. It generates maps that can be utilized to create a drought index tailored to the unique conditions in the Philippines. This drought index enables the prediction of drought occurrences up to six months in advance, assessment of crop yield, and site-specific mitigation of the severe impacts of drought.
- Water Advisory for Irrigation Scheduling System (WAISS) - WAISS is a tool for smarter water management by providing its end-users with practical information on irrigation scheduling and recommendations. It consists of two components: a field unit and software that processes the data from the field to generate an irrigation alert that will be sent to end-users via text message. It can send text messages to the user/farmer on the status of soil moisture and provides recommendations such as when to irrigate.
- Agricultural Robot - Tomasino Innovation Systems (AGROTIS) - AGROTIS is a system that can be installed to commercially available hand tractors to work autonomously or guided by GPS sensor when navigating to specified waypoints in the field while performing agricultural tasks. With this system, the farmer can monitor and operate the hand tractor from a remote base station. Emergency safety buttons and remote-control engine stop were included as part of safety features of the system. AGROTIS system also allows multiple hand tractors to be operated simultaneously in a coordinated manner.
- Automated Furrow Irrigation System (AFIS) - This technology incorporates irrigation flow models, irrigation management strategies, multi-sensors and control systems. AFIS technology involves real time irrigation that can determine the proper timing of irrigation vis a vis right amount of water to deliver into crops.
- Smarter Greenhouse - Smart management system for greenhouses that will automate the fertigation requirement in growing varieties of lettuce. The management system includes hardware and firmware component system to automate monitoring and control of temperature, pH, EC, water flow, air moisture, and temperature
- FertiGroe® nanofertilizers - An environment friendly technology for inorganic fertilizer application. It offers an average of 15-25% decrease in fertilizer use, and increased crop utilization efficiency for nutrient by 15-25%.
- ChicIoT: An IoT-Based Smart Poultry Building Environment and Growth and Health Status Monitoring and Modelling - This project lead by USeP in collaboration with Tetra Consulting Company (TCC) designed and developed ChicIoT: An IoT-based Environmental Monitoring and Disease Surveillance System with data analytics of a poultry building located in San Rosario, Bgy. Mahayahay Rosario, Agusan del Sur. The poultry building is owned by Agro-Industrial Development Corporation (AIDC) under the management of TCC. ChicIoT uses Wireless Sensor Networks to monitor environmental quality inside poultry facilities to allow identification of the early stage of disease in poultry farms and avoid its spread. The system will help in monitoring environmental conditions, such as temperature, humidity, dust concentration, light, in poultry facilities.
- Bamboost - a mobile marketing app with a primary goal of linking bamboo farmers, craft makers, and manufacturers to a wider market of buyers in the country and abroad and promotes the use of sustainable & eco-friendly bamboo products.

Culture and Livelihood

- The program entitled, “Digitalization of the Philippine Handloom Weaving Industry” of the DOST (through the DOST-Philippine Textile Research Institute), aims to protect and preserve the traditional handloom textile industry which expresses the art and culture across the country. The program aims to develop a centralized database of weavers with their products and

designed patterns. This database facilitates the identification and authentication of the handloom fabrics in the country. Moreover, digitized patterns and designs of the fabrics were preserved and stored which can be used for immortalization of the design as well as an effective knowledge transfer to the new generation. The collected data can be used in training algorithms and enhancing machine learning models, improving the identification of the origin of handloom woven textiles. The program also addresses the protection of the fabric against counterfeit products by developing functionalized textiles using advanced materials for authentication purposes. The fabrics contain layers of security markings which include a covert QR code that can only be scanned with the help of UV light. The QR code contains the information of the fabric and its weaver directed to the database developed. With the use of emerging technologies, cultural preservation and industry protection will be achieved and sustained.

Environment

- Synthetic Aperture Radar and Automatic Identification System or Innovative Terrestrial Monitoring and Maritime Surveillance (SARwAIS) Project - utilizes radar imagery and automatic identification system (AIS) data from the NovaSAR-1 satellite to strengthen the country's response to disasters and monitor vital natural resources. The Project distributes Synthetic Aperture Radar (SAR) and AIS data to concerned government agencies and academic institutions to augment their need for spaceborne data for various research and operational applications. These include terrestrial monitoring, disaster management, land cover classification and environmental and agricultural monitoring.

Disaster Risk Reduction and Management

- HazardHunterPH is a web application designed to increase hazard assessment accuracy, improve process efficiency and enhance the ease of doing business in relevant private and government institutions. The platform enables users to get multi-hazard assessment reports, which are needed by Local Government Units, banks and other government agencies for approval of building permits, bank loans and projects.
- GeoRisk Philippines - a government-led multi-agency initiative to serve as the central resource of information on natural hazards and risk assessment. It is both a (i) governance platform that spurs collaboration among different sectors, provides direction and guidance for decision makers in a transparent, systematic and efficient manner and (ii) an ICT and geospatial platform that promotes the use of technology to access data and analyses.
- PlanSmart Ready to Rebuild web application is an automated planning tool that aids disaster rehabilitation and recovery initiatives, most especially in the vulnerable areas. The application leverages on the existing GeoRiskPH Integrated Platform that can systematically generate a rehabilitation and recovery plan using calculation tools and producing consolidated results into a pro-forma planning document template. Through PlanSmart, the size of the population that can be affected by a disaster could be determined through accurate information including hazard assessments and reports. It gathers pre-disaster baseline data and post-disaster impact assessment. It could also help in identifying key stakeholders for rehabilitation and recovery such as local government units, electric cooperatives, water utilities, and NGOs that need to be organized and mobilized when a disaster hit. Lastly, PlanSmart provides a menu of funding sources for various projects, programs, and activities to ensure efficient financing of resilient recovery. (Links to videos about the application: bit.ly/PlanSmartIntroductionVideo; bit.ly/PlanSmartPHOverview)
- REDAS (Rapid Earthquake Damage Assessment System) is an impact assessment software tool that is able to estimate impacts (physical damage, fatalities and economic losses) due to various hazards such as earthquake, floods, severe wind, tsunami and lahars. It can also calculate impacts to agricultural damages caused by severe wind and flood hazards. It has module for hazards monitoring such as earthquake, tsunami and rain ideal for Operations Center and a special tool for earthquake intensity reporting by the public.
- PHIVOLCS-LAVA is the portal for public access of processed multi-parameter volcano monitoring data generated by DOST-PHIVOLCS through the years. It is based on the database structure conceptualized by the World Organization of Volcano Observatories – the WOVODat schema – and assembled using Php, Javascript and HTML with MySQL as the format for the back-end database (LAVA-DOME). PHIVOLCS-LAVA is intended to support local and international research, contingency planning, comparative analysis and other applications of volcanic unrest data. Data include:

a) Multi-parameter volcano monitoring data (volcano seismicity, plume/crater observations, ground deformation, lake/spring/fumarole physico-chemistry, gas flux, hydrometeorology)
b) Volcano monitoring network information
c) Philippine volcano information

- The DATOS Project builds on and integrates past and ongoing DOST-supported projects and related initiatives on disaster mitigation by providing a helpdesk pre-, during, and post-disaster events that would provide remote sensing and data science applications support to critical activities on disaster mitigation, analysis, and advice.

Health

- RxBox, a Telehealth System. The RxBox program aims to develop a locally-manufactured, medical-grade telemedicine device and demonstrate its usefulness in target Rural Health Units /Local Health Centers in GIDA (geographically isolated and disadvantaged areas) municipalities nationwide. With the telemedicine device capable of capturing medical signals through built-in medical sensors, the RxBox can reduce the overall cost of healthcare by enabling health workers to diagnose, monitor, and treat patients within the rural health facility. It includes blood pressure monitor, pulse oximeter, electrocardiogram, fetal heart monitor, maternal tocometer, and temperature sensor. Through the data being transmitted, specialists can assess the diagnosis even from afar. This was also beneficial during the COVID-19 outbreak where monitoring of patients' vital signs could be done remotely. (More information at rxbox.chits.ph/).

Smart and sustainable cities and communities

- The **V2X Initiatives for Road Safety (VIROS)** Project is pioneer in V2X Research in the Philippines. The proposed intelligent traffic controller also serves as valuable contribution towards modernizing traffic infrastructure in the country. The VIROS Project aims to design and develop an intelligent traffic controller unit with wireless communication capability. The intelligent traffic controller can gather and assess traffic conditions, undertake data-driven traffic control, and communicate these traffic conditions to road-users. For its pilot implementation, the application of the technology is intended to aid traffic management and improve overall road safety and driver decision making while traversing the roads. Using AI-based methods in computer vision, the intelligent traffic controller can analyze traffic statistics such as vehicle recognition and vehicle flow rate, assess traffic condition, and direct traffic. The traffic information is then communicated by these controllers wirelessly to vehicle drivers, pedestrians, and other road-users through Vehicle-to-Everything (V2X).
- The country also enjoys **Transportation Network Vehicle Service (TNVS)** platforms which are utilizing AI algorithms to optimize routes, predict demand, and improve the overall efficiency of their services.
- The DOST has developed with other national government agencies the **Smart and Sustainable Cities Program** utilizing data analytics for waste management, water resource management and optimization, traffic management, and improved services in transportation among others with focus on digital infrastructure, people/communities, and policies or institutions.
- **MapX** offers complete solutions for enhancing assessment and valuation to local executives and real property owners. It converts property lines into interactive maps using geospatial technology, which can aid the LGU's tax mapping services.
- The **PATURO: A Platform for Assessment and Tracking of Urbanization-Related Opportunities** project aims to create a smart index that measures the health of the city in terms of its population, land, transportation infrastructure and various economic activities.

Manufacturing

- For industries, the Philippines uses machine learning for faster processing of data in electronics. The electronics and semiconductor industry are currently integrating AI, Internet of Things, Additive Manufacturing in their attempt to transition to Industry 4.0.
- The Department of Science and Technology established an Advanced Manufacturing Center (AMCEN). It is a state-of-the-art prototyping laboratory aims to push the country's manufacturing sector's competitiveness to a higher level by increasing its technological readiness, business sophistication and innovative capacity. AMCEN, a facility that also serves as an innovation hub for advanced manufacturing, offers industrial design and development and rapid prototyping. The facility will also enable the country to develop sophisticated products

and technologies in the fields of aerospace, defense, health and medical services, biotechnology, automotive, and electronics and semi-conductors using rapid prorotyping (fast fabrication of a physical part, model or assembly using 3D computer aided design and 3D printing.

Finance

- In finance, the DOST shall leverage AI to help finance and banking such as the Central Bank of the Philippines for fraud detection, credit scoring, and customer service enhancement. DOST Programs continuously support science, technology, and innovations that promotes digital transformation and sustainability. Details are specified in the DOST Artificial Intelligence Programs and Technologies "AI for a Better Normal" E-Book https://www.dost.gov.ph/knowledgeresources/downloads/file/3002-dost-ai-program-technologies.html.

3. Has your country put in place inclusive policies for innovation and economic diversification specifically tailored to diffusion of digital technologies and AI?

   The Philippines has initiated several inclusive policies for innovation and economic diversification specifically tailored to diffusion of digital technologies and AI, including:

   - The **Philippine Development Plant 2023-2028** emphasizes enhancing innovation and technological adoption across sectors, including digital technologies and AI
   - **Digital Transformation Strategy** aims to harness digital technologies to improve governance, enhance public service delivery, and support economic growth. It includes initiatives to enhance digital infrastructure, promote e-governance, and support digital skills development.
   - The **Philippine Innovation Act (Republic Act No. 11293)** creates the National Innovation Council (NIC) to develop and implement innovation policies, including those related to digital technologies and AI. It promotes research and development (R&D) activities, offering tax breaks and incentives for companies investing in innovation and frontier technologies.
   - The Philippines is developing an **AI Roadmap** to guide the development and adoption of AI technologies across different sectors. This includes initiatives to promote AI research, education, and industry collaboration. The roadmap includes plans to create an AI research and development ecosystem, promote AI adoption across industries, and develop AI talent through education and training programs.
   - A program called "**Startup Research Grant Program**" was developed to fund research and development (R&D) activities and accelerate the commercialization of innovative products across sectors.

4. Do you have examples of policy instruments in place to favour the diffusion of frontier technologies in the economy and targeting specific sectors?

   Recognizing the importance of the diffusion and transfer of frontier technologies in shaping the country's economic development and competitiveness on the global stage, the Philippines has implemented various policies across various sectors. These policies include the following:

   - The **Technology Transfer Act of 2009 (Republic Act No. 10055**), which aims to promote and facilitate the transfer of technology from research institutions to industry. This Act provides a comprehensive framework for intellectual property protection, licensing agreements, and technology commercialization, all of which are essential for fostering innovation and increasing productivity in the economy.
   - The **Philippine Innovation Act (Republic Act No. 11293)** establishes the National Innovation Council to develop the country's innovation goals and strategy. This Act promotes a culture of strategic planning and collaboration among sectors to drive economic growth through innovation. One key provision of the Act is the establishment of an innovation fund to provide financial support for research and development projects. Additionally, the Act incentivizes companies to invest in research and innovation by offering tax credits and other benefits for qualifying projects.
   - The **Innovative Startup Act (Republic Act No. 11337)**, which emphasizes providing incentives to encourage the establishment and operationalization of innovative new businesses. The DOST, Department of Information and Communications Technology (DICT)

and Department of Trade and Industry are mandated to assess, monitor, develop and expand the **Philippine Startup Development Program**, which includes benefits and incentives for startups and startup enablers. The law also orders the Department of Education (DepEd), the Commission on Higher Education, and the Technical Education and Skills Development Authority (TESDA) to develop and integrate in their respective curricula entrepreneurial programs that shall foster an environment conducive to innovation and extend incentives to academic institutions that provide funds and/or grants for the research of their student and faculty.

- The **Intellectual Property Code (RA 8293)**, which aims to safeguard the interests of creators and innovators by providing legal mechanisms to prevent unauthorized use or exploitation of their works. This Code covers a wide range of intellectual property rights, including patents, trademarks, copyrights, and trade secrets. One key aspect of RA 8293 is the recognition and enforcement of copyrights, which protect original literary, artistic, and musical works from being reproduced, distributed, or displayed without the consent of the creator.
- The Department of Science and Technology (DOST) has also developed **the Industry 4.0 Roadmap** that outlines a strategic plan for transitioning Philippine industries towards Industry 4.0 by promoting technologies like automation, artificial intelligence (AI), and the Internet of Things (IoT).
- In the Philippines' **Green Jobs Act or Republic Act No. 10771**, the DOST, together with TESDA, is tasked to assist the country's Department of Labor and Employment (DOLE) in analyzing skills, training and re-training needs in relation to the use of green technology that has the potential to create new green occupations and greener jobs, especially in industries or sectors undergoing structural changes due to climate change and greening of the economy. It shall also provide a range of business development support to MSMEs. In April 2016, the Philippine Green Jobs Act (RA 10771) was passed into law to scale up promotion of sustainable growth and decent job creation, while building resilience against impacts of climate change by providing incentives to enterprises generating green jobs across all economic sectors.
- The Philippine Government has established innovation hubs and technology incubators, such as the **Technology Business Incubation (TBI) Program** of the DOST. The TBI involves an ecosystem where innovation is promoted and supported towards commercialization. It aims to help startup technology-based businesses by providing a range of resources, services and facilities needed during the development stage.
- DOST collaborates with universities and research institutions through its **Collaborative Research and Development to Leverage Philippine Economy (CRADLE) program**, which funds research projects with commercialization potential.
- The Philippine **Inclusive Innovation Industrial Strategy (i^3S)** aims at growing innovative and globally competitive manufacturing, agriculture, and services while strengthening their linkages into domestic and global value chains with innovation at the core of the country's strategic policies and programs. The strategy recognizes that innovation is crucial in addressing the challenges not only from globalization and rising regional economic integration but also from automation, robotics, artificial intelligence and other new technologies. The i^3S prioritizes the growth and development of 12 major industries covering automotive, electronics and electrical, aerospace parts, chemicals, iron and steel and tool and die, garments, textiles, and furniture, shipbuilding, tourism, IT-business process management particularly knowledge process outsourcing and E-commerce, agribusiness, construction, and infrastructure and logistics.
- The **Digital Cities 2025** aims to highlight the value of countryside development and the capability of key locations outside Metro Manila to become thriving business districts and viable investment hubs for Information Technology and Business Process Management (IT-BPM) services. These Digital Cities will hopefully motivate existing players to expand beyond the National Capital Region and encourage new ones to set up shop in the Philippines.
- Branded as "**Make it Happen in the Philippines**" (MIH), the campaign aims to generate foreign direct investments (FDIs) from 18 countries in Asia-Pacific, Europe, and America and will initially focus on key industries that have the most potential for foreign investment such as Automotive, Aerospace, Electronics, Information Technology-Business Process Management (IT-BPM), and Copper/Nickel. The campaign is part of the Philippine government's efforts to rebuild the economy during and post Covid-19 crisis.

The DOST has also supported and reviewed House Bill 1024, "An Act Establishing a Developmental, Standardization, and Incentivization Framework for the Establishment of Smart

Cities and Municipalities Nationwide, Appropriating Funds Therefor, and for other Purposes." The said bill is pending with the Committee on Local Government.

5. Has your country put in place mechanisms to strengthen industrial capabilities through partnerships among different stakeholders (e.g., university-industry, or private-public)?

   Yes, the Philippines has several initiatives, programs, and mechanisms that aim to create synergy and forge collaboration among different stakeholders involving the government, industry, academe, and even the civil society (e.g., communities). Some of which are as follows:

   - Pursuant to these policies, particularly the **Republic Act No. 10055 - Philippine Technology Transfer Act of 2009**, the DOST provides financial and technical assistance to research and development institutions (RDIs) and state universities and colleges (SUCs) in the implementation of programs/projects that would propel technology transfer and commercialization of developed technologies across different sectors such as agriculture, aquatic and natural resources (AANR), health, industry, energy, and emerging technologies.
   - There are **also state-of-the-art STI facilities and multifunctional hubs** for technology owners and generators, investors, and other key stakeholders such as the **DOST-PCAARRD Innovation and Technology Center (DPITC)** to facilitate/implement projects on capacity building, determining and assessing the commercial potential of technologies, protecting intellectual properties, and technology marketing. The DOST's **Metals and Engineering Innovation Centers (MEIC)** are initiated and developed by the government to capacitate State Universities and Colleges and their faculty researchers through the acquisition of industry-grade machinery and manpower development.
   - DOST has created the **Science for Change Program (S4CP)** to accelerate STI in the country in order to keep up with the developments in our time wherein technology and innovation are game changers. Through the Science for Change Program (S4CP), the DOST can significantly accelerate STI in the country and create a massive increase in investment on S&T Human Resource Development and R&D. S4CP focuses on Accelerated R&D Program for Capacity Building of R&D Institutions and Industrial Competitiveness which is composed of four (4) programs namely: (1) Niche Centers in the Regions for R&D (NICER) Program, (2) R&D Leadership (RDLead) Program, (3) Collaborative R&D to Leverage PH Economy (CRADLE) for RDIs and Industry Program, (4) Business Innovation through S&T (BIST) for Industry Program.
   - The **KIST Program (Knowledge, Innovation Science & Technology)** aims to develop special economic zones within university premises with a specific focus on science, technology, and innovation endeavors and promote technology commercialization and technology-based startups. The KIST program is an initiative by the Department of Science and Technology (DOST) in the Philippines. KIST parks aim to create a nurturing environment for startups and companies focused on science, technology, and innovation (STI). These parks provide them with various advantages through incentives.
   - The DOST has **Innovation, Science, and Technology for Accelerating Regional Technology-Based Development (iSTART)** that is a platform for the strategic alignment of the DOST in terms of technology transfer programs and projects, engagement of researchers, scientists, and engineers, and conduct of R&D enabling or improving the innovation ecosystem in support of rural development
   - Another mechanism to ramp up the MSMEs in the country is the **Small Enterprise Technology Upgrading Program (SETUP 4.0).** The program addresses pressing problems in the health and wellness sector, information and communications technology and electronics industries of the micro, small and medium enterprises by providing financing and other STI services. It provides technological and technical assistance to MSMEs to increase their productivity and competitiveness through Industry 4.0 STI interventions.
   - The **Community Empowerment thru Science and Technology Program (CEST)** helps in improving the socioeconomic condition of municipalities/communities considered as poorest of the poor by providing scientific and technological intervention packages. This could be through developing facilities and providing capacity building activities to communities and local governments such as in livelihood training programs.
   - The **Philippines' National AI Strategy** is committed to strengthening industrial capabilities through partnerships. The strategy emphasizes a "triple-helix" approach, fostering collaboration between government agencies, industries, and academic institutions. This creates a structured environment for AI research and development efforts. Furthermore, the strategy assigns

specific roles to different government agencies, also reflecting a whole-of-government approach.

- The DOST-PTRI has numerous collaborations and partnerships with various institutions, transferring its textile innovation to multiple communities around the country. Local Government Units (LGU) and stakeholders have collaborated with DOST-PTRI to establish hubs for processing raw materials such as bamboo and banana textile fibers, which provide new sources of textile material and facilitate the extraction of natural dyes and utilize the supply of local raw materials for the production of various textile products. Various Memoranda of Understanding and Agreements (MOUs and MOAs) have also been established with the private and public sectors, as well as with stakeholders, to strengthen the connections and address the needs of the textile industry in the Philippines. This initiative supported **Republic Act No. 9242, which mandates the use of Philippine Tropical Fabrics (PTF)** for the uniforms of public officials and employees, promoting local manufacturing, competitiveness, and employment.
- The aforementioned policies in Item 4 also promotes multistakeholder collaborations on STI.

6. How can international cooperation support the uptake of new technologies and the development of technological capabilities in your country and ensure that industrial policies will benefit all and do not worsen inequality?

   International cooperation opens up collaboration opportunities and benchmarking activities ensuring mutual benefits from all cooperating countries. International cooperation can support the uptake of new technologies and the development of technological capabilities in the country through the following ways:

   - Providing training and capacity-building programs that enhance the skills of local researchers, scientists, and technologists, there can also be collaborative initiatives on this with the communities and grassroots to further fuel community-led solutions and supporting local innovations;
   - Opening opportunity to access to and share cutting-edge technologies, laboratories, facilities, and innovations that may not be readily available domestically;
   - Collaborating on joint scholarship opportunities for Filipinos to pursue advanced degrees in science, technology, engineering, and mathematics (STEM) fields abroad;
   - Engaging in collaborative R&D projects with international partners that fosters innovation and technological advancement, this could be in different nature such as in bilateral, trilateral, or multilateral collaboration;
   - Creating a platform or forum for benchmarking, policy dialogue, and sharing of best practices;
   - Conducting assessments in the country as basis for STI interventions and policymaking, as well as monitoring and evaluation;
   - Supporting in formulating and refining of policy and regulatory frameworks that support the equitable distribution of technological benefits; and
   - Facilitating the adaptation and localization of technologies to fit the specific needs and contexts of the Philippines, among others.

7. What can the UN CSTD do to support an economic transformation that enhances your country productive capabilities and foster an inclusive digital transformation?

   - The CSTD can serve as a vital platform for the exchange of proposals, ideas, experiences, and intellectual thought aimed at developing impactful policies. Through the dialogues, it can also provide policy recommendations that can be tailored to the needs of the country. All of these could also lead to the creation of regulatory frameworks on emerging technologies and innovations that could support economic transformation.
   - The CSTD can continuously conduct technical studies and reports that would provide recommendations to the Member States, especially developing countries like the Philippines that would
   - Through the CSTD, the Member States can forge collaborations with each other, NGOs, and other stakeholders in the fields of science, technology, and innovation. The CSTD can foster collaboration that can lead to the adoption of impactful strategies that advance the Philippines toward a more innovative and sustainable future.

- By leveraging the expertise and resources available through the CSTD, the Member States including the Philippines can receive guidance on crafting comprehensive national strategies for science, technology, and innovation (STI) that are aligned with the country's development objectives. Furthermore, the CSTD can assist in identifying best practices and successful models, in promoting inclusive digital transformation, and encouraging innovation and entrepreneurship, among others, from countries that have successfully navigated similar transformations.
- Collaboration with the CSTD and other Member States can facilitate the transfer of knowledge as well as the propagation of state-of-the-art facilities, automated technologies, and digital industrialization that greatly improve productivity and efficiency of various industries. By drawing on the knowledge and experiences of other nations, the Philippines can effectively implement policies that drive progress and growth while avoiding common pitfalls.

PHILIPPINES' INPUTS

United Nations Commission on Science and Technology for Development (CSTD)

PRIORITY THEME 2: Technology foresight and technology assessment for sustainable development

1. Has your country conducted ForSTI, TA or both? If yes, what were the reasons for undertaking ForSTI and TA?

   Yes, the Philippines, through the Department of Science and Technology's National Academy of Science and Technology, crafted "PAGTANAW 2050" which means "to look ahead" in Filipino. PAGTANAW 2050 is the first inter- and trans-disciplinary Philippine foresight plan that anticipates the science, technology, and innovation (STI) inputs that will influence the development of the country in the next 30 years. The main goal of PAGTANAW 2050 is **to chart a strategic path by identifying the factors that will influence the development of the Philippines' scientific capital in the years leading up to 2050**, while focusing on the following: to guide in designing strategic plans that transcend political periods while aiming for inclusive growth, sustainability, and competitiveness in STI; to design and implement integrated yet time-specific strategies for a prosperous, inclusive, and agile Philippine future; and to harness the talent and tools in science and technology to innovate towards a prosperous, archipelagic, and maritime nation by 2050.

   In view of the objective to develop and institutionalize the country's Department of Science and Technology's Foresight Framework and Protocol, projects were undertaken to build the capacity of and establish a core team and technical working group in coordination with the Centre for Engaged Foresight and the Science, Technology, Research and Innovation for Development (STRIDE) Program under the United States Agency for International Development (USAID) Philippines. These projects enhanced the foresight capacity of DOST's attached agencies towards the full integration of futures thinking into planning and anticipatory development of programs and projects that are aligned with the SDGs.

   The Philippines also implements a holistic approach or package of assistance providing necessary technical, financial, and promotional support from concept/idea to commercialization of inventions, innovations, and technologies. This is usually done in the country's DOST-Technology Application and Promotions Institute (DOST-TAPI).

   In the R&D projects being proposed for funding of the Department of Science and Technology of the Philippines and its councils for research and development, especially for technology transfer programs, ForSTI and technology assessments (TA) are considered fundamental parts of the proposal evaluation process. During the proposal evaluation process, the councils look into the potential future impact of the technologies not only in the local but also in international setting. The Philippines, through the DOST, also recognizes that enhancing foresight within the councils is crucial for evaluating achievements, updating the Harmonized National R&D Agenda (HNRDA), and refining roadmaps, priority areas, and strategic S&T plans of each Council. For instance, the DOST-Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (DOST-PCAARRD) implements the Industry Strategic S&T plans (ISPs) that operationalize the DOST HNRDA. These medium-term plans, revised every 6 years, outline baseline and benchmark targets, strategies (R&D, policy research, technology transfer, capability building), resources, and partnerships necessary to achieve industry targets.

   By utilizing foresight methods, the development of vision and targets under the ISPs becomes more systematic and participatory. This approach facilitates the identification of future-oriented technologies and specific research that are anticipatory and strategic in addressing future opportunities and threats within specific sectors. Foresight enables the identification of human and institutional capacities required to address imminent S&T priorities in advance. Additionally, through the insights gained from future intelligence, DOST can proactively formulate policies to create an

environment conducive to technology development, acquisition, and transfer. The technology foresight project is also designed to support knowledge management activities.

ForSTI and TA are also incorporated in the Department's R&D agencies prioritization criteria. For example, in the DOST's Philippine Council for Health Research and Development, the set of criteria guides the Council in identifying which technologies will be given priority in terms of funding for the conduct of pre-commercialization activities. This allows the agency to plan and allocate its resources more effectively. The DOST-TAPI conducts TA to evaluate the potential impact, risks, and implications of adopting a particular technology. Specifically, it assists in the assessment of the investment readiness level (IRL) and technology readiness level (TRL) of the DOST-generated/assisted technologies to fast-track the transfer and commercialization.

The integration of ForSTI and TA in technology transfer activities is essential in developing a forward-looking and evidence-based approach to technology transfer, leading to better health outcomes and more effective use of resources. ForSTI and TA equip the nation and relevant agencies with the tools and knowledge to analyze future trends and proactively shape the direction of R&D in the Philippines.

2. If you have not conducted ForSTI or TA in the past, what were the reasons for this (lack of need or requests for it, lack of familiarity, lack of capacity, lack of funding etc.)? Would you be interested in pursuing either ForSTI or TA as a policy tool in the near future?

   The Philippines, through the Department of Science and Technology (DOST), has developed the aforementioned PAGTANAW 2050, the 30-year foresight and strategic plan based on inputs from policy forums, stakeholder discussions, and a comprehensive review of development plans, trends, needs, and gaps in Philippine STI. Nevertheless, the country would still continue to use and further develop its ForSTI and especially TA as policy tools. Capacity building activities would also be useful in the advancement of ForSTI and TA.

   Back in 1980, The first Philippine foresight document entitled "Probing our Futures: The Philippines 2000 A.D.' for the Philippines was published in 1980. Subtitled "Population, Resources, Environment and the Philippine Futures (PREPF), this foresight was organized by the Development Academy of the Philippines, the University of the Philippines School of Economics, and the University of the Philippines Population Institute. PREPF was based on the findings of a research program that probed into the future and considered alternative futures for Philippine society. It also analyzed trends that affected the use of natural resources, including minerals, forestry, and fisheries, and dealt with the critical issues of environmental pollution, energy, and adequacy of water resources. PREPF proposed priority policy actions towards the realization of a "marked improvement in the national quality of life" by the year 2000. Thus, PREPF covered the broad areas of socio-economic concerns that it deemed critical to the development agenda. ForSTI and TA were covered in broad strokes.

   Forecasting, which is different from foresight, was previously more popularly used in making strategic plans generally crafted at the start of a political leader's term which lasts only up to six years. Foresighting which includes backcasting and forecasting, is a collective intelligence where future pathways consider anticipated, risks and opportunities coupled with enablers such as Science, Technology, and Innovation, towards a "preferred future". The PAGTANAW 2050 is the DOST's current major ForSTI document.

3. What agency (or agencies), if any, is responsible for ForSTI and/or TA?

   ForSTI and TA initiatives in the Philippines may involve collaboration among multiple agencies and organizations to address diverse research and policy objectives. For ForSTI, several institutions including State Universities and Colleges (SUCs), the Commission on Higher Education (CHED), and the Development Academy of the Philippines (DAP) with its Center for Strategic Futures (CSF) are currently funded to help promote innovation and futures thinking as an effective tool plan for policymakers, post-graduate students, and younger generations.

The Philippine Senate has created the Committee on SDGs, Innovations, and Futures Thinking to supervise the country's progress toward its commitments to the SDGs by the year 2030.

With the crafting of the PAGTANAW 2050 document, the Department of Science and Technology in 2019, takes on the role of leading the ST&I Foresight in the country. PAGTANAW 2050 is a compendium of STI megatrends, global and national societal goals, transdisciplinary and interdisciplinary operational areas, and current and emerging technologies relevant to the nation's development. It is firmly grounded in the aspirations of the Filipino people within the context of natural and physical endowments, as well as shared Filipino values, skills, and other potentials. At present, PAGTANAW 2050 is the only Foresight document that has this coverage for a long-term ST&I-guided Philippine development encompassing several Presidential terms with periodic review for enhancement.

Another long-term vision for the Philippines is the AmBisyon Natin 2040, spearheaded by the National Economic and Development Authority. AmBisyon Natin 2040 embodies the collective aspirations of the Filipinos both as individuals and as a society. The core goal is to achieve a strongly-rooted, comfortable, and secure life by 2040.

Other important players include collaborations with the Philippine Futures Thinking Society (PhilFutures), U.S. Agency for International Development (USAID), Science, Technology, Research, and Innovation for Development (STRIDE) and the Center for Engaged Foresight (CEF), among others. Furthermore, government agencies like the National Economic and Development Authority (NEDA), National Innovation Council (NIC), and other higher education institutions collaborate to spread foresighting knowledge and practices nationwide.

On technology assessments (TAs), the DOST, through one of its service agencies, Technology Application and Promotions Institute (DOST-TAPI), has a primary responsibility to promote the commercialization of technologies and market the services of other operating units of the Department. Given this mandate, the Institute is responsible for conducting TAs for the DOST-generated and -funded technologies.

The DOST's planning councils also conducts TAs for the projects under their monitoring which depends on the sector or specific field in STI. An example is for health. The DOST-Philippine Council for Health Research and Development (DOST-PCHRD) often takes a lead role in initiatives involving health research and utilization. The Health Technology Assessment Council has been recently created to specifically handle health technology assessments. The Health Technology Assessment Division of the DOST supports the Council which serves as a body that assesses and recommends health technologies that may be funded or covered by the government.

4. Who was responsible for implementing the ForSTI and/or TA undertaken - national government, sub-national levels of government (state/province or other levels), industry, universities, research institutes or civil society?

A proposed STI foresight institute is tasked solely with the continuity and relevance of the initiatives detailed in PAGTANAW 2050. Such an STI foresight institute will, essentially, provide a steady base from which policymakers and government functionaries may build the needed support systems, infrastructure, and policies—as well as adjust the same when needed. The Department of Science and Technology which is mandated to lead the direct, lead, and coordinate the scientific, and technological efforts in the country will create a foresight body/institute for continuity of *foresighting* as a planning tool for science and technology development. It is now in the process of harmonizing PAGTANAW 2050 into its R&D plans and activities.

An Advisory Committee (within the National Academy of Science and Technology) to guide the STI foresight activities will be organized with representation from ranks of stakeholders, policymakers, and the communities that each foresight segment will affect, as well as functionaries of government from agencies that will be part of the planning and implementation of the initiatives proposed in this Foresight.

The specific STI stakeholders (e.g., local government units, schools, private sector establishments and organizations, government agencies, and government-owned and controlled corporations) can

contribute to the projects and initiatives of the institute. The STI foresight could provide a strong framework into which efforts by government at all levels, the private sector, industry, and communities can be integrated.

Other implementing agencies/institutions are listed in Item 3 of this document.

5. In which sectors and/or for what policy processes have ForSTI and TA been undertaken, or linked to? What SDGs have they related to?

The services sector, specifically education, has been actively undertaking the Futures Thinking initiatives of the Committee on SDGs, Innovations, and Futures Thinking. Included in these universities that committed to foresight tool plan are the University of Science and Technology of Southern Philippines, which recently conducted futures thinking training workshops; Visayas State University, which chose root crops as the commodity of focus for its Futures Thinking Initiatives; and Bukidnon State University, which held its BukSU's Futures Thinking Program Immersion. Other participating institutions are Sulu State College, and Mariano Marcos State University, which received funding to expand health programs, foster innovation, and strengthen future thinking; Sultan Kudarat State University, Philippine State College of Aeronautics, University of Southern Mindanao, the Polytechnic University of the Philippines, Northern Bukidnon State College, University of the Philippines, and Laguna State Polytechnic University.

Another long-term vision for the Philippines is the AmBisyon Natin 2040. It serves as a guide for the country's advancement from 2016-2040. AmBisyon Natin 2040 comprises the aspirations of Filipinos which are having a strongly-rooted, comfortable, and secure life. The following are the policies that have been linked to this vision: Build, Build, Build Program, Universal Health Care Law, K-12 Educational Reform, National Land Use Act, Ease of Doing Business Act, Government Digitalization Initiatives, Pantawid Pamilyang Pilipino Program (4Ps), Sustainable Livelihood Program, National Broadband Plan, and Energy Development Initiatives.

PAGTANAW 2050 emphasizes science, technology, and innovation as crucial to achieving the SDGs deemed to mitigate the rising of approaches and methods that have become non-supportive in our changing world. There is a section in PAGTANAW 2050 that deals specifically with the UN Sustainable Development Goals (SDG) 2015-2030. The section includes how the SDG goals could be used as achievement benchmarks by the government, non-government organizations, and academic institutions and how they are linked with the goals of PAGTANAW 2050.

At the core of PAGTANAW 2050 Foresight are 12 key operational areas, namely:

1) Blue Economy. (SDG 14: Life Below Water). The "blue economy" approach is imperative in the Philippines, an archipelagic country with territorial seas that are twice the size of its total land area. Scientific and technological innovations are expected to play a crucial role in the preparation and implementation of a comprehensive action plan for a National Coast and Ocean Strategy.
2) Governance. (SDG 8: Decent Work and Economic Growth). Having effective and well-governed institutions are essential to establishing an environment of high rates of investment and improved workforce performance in both the public and private sectors. Strategic technologies can be harnessed for both the government and private sectors to provide quality services, minimize human errors, reduce unreasonable bureaucratic procedures and unnecessary expense, and ultimately achieve administrative efficiency and timely response.
3) Business and Trade. (SDG 9: Industry, innovation and Infrastructure). While the Philippines has yet to establish a track record of translating scientific research into commercial products, the prospects can be improved dramatically by considering the business community's fundamental capacity as both beneficiary and enabler of innovation. In particular, we should provide a level playing field for our agriculture, industry and service sectors whose processes are especially friendly to innovation and research and development (R&D). However, this will not happen if the high cost of doing business—which includes the cost of energy—stemming from the poverty of public goods is allowed to persist.
4) Digital Technology/Information and Communications Technology. (SDG 9: Industry, innovation and Infrastructure). In this section, information and communications technology (ICT) is seen as a linchpin for achieving proficiency in STI in the Philippines. The full realization of the benefits

of ICT will necessitate a shift towards a robust and accessible Digital Ecosystem, in which Digitally Transformed entities interact with each other, mutually benefit each other, and promote the greater good. Technologies like blockchain, cognitive systems, robotics, and quantum computing including last-mile connectivity to serve users in rural and remote areas are required of this ecosystem.

5) Science Education and Talent Retention. (SDG 4: Quality Education; SDG 9: Industry, innovation and Infrastructure). The importance of the Science, Technology, Engineering, and Mathematics (STEM) system of education in producing competitive STEM talent in the Philippines is vital in enhancing, maintaining, and monitoring the knowledge infrastructure in STEM. We need to adopt new out-of-the-box pedagogies that emphasize learning by doing.
6) Food Security and Nutrition. (SDG 2: Zero Hunger). This operational area highlights the ability of agriculture to increase and diversify production towards the improved nutritional status of the population through new and science-based food system paradigms. In order to achieve desired nutritional outcomes, a sustainable food system should be characterized by green and inclusive growth, economic and social progress, and resilience to multiple risks.
7) Health Systems. (SDG 3: Good Health and Well-being). Foresighting the Philippines' health STI is anchored in achieving an efficiently working and properly funded Universal Health Care Program, which addresses needs that are real, palpable, and which immediately improve human lives. At the moment of writing this Foresight, the Philippines' response is focused towards managing the COVID-19 pandemic. Many of the health system technologies accelerated by the pandemic are quite useful for strengthening the healthcare delivery system.
8) Energy. (SDG 7: Affordable and Clean Energy). Since the Philippines is dependent on imported fossil fuel for its energy needs and the energy sector is among the major contributors to greenhouse gas emissions and climate change, it is essential for the country to transition to clean and affordable energy technologies to meet future needs. Priority should be given to solar, wind, and ocean waves energy systems, energy storage, smart grids and networks, biofuels, and energy from wastes.
9) Water. (SDG 6: Clean Water and Sanitation). Water resources, water uses, and regional water quality, demand and supply in the Philippines must be managed with regard to their use for domestic water supply, irrigation, flood control, power generation, and pollution control. Clean technologies will be adopted to improve the delivery of affordable clean water, minimize or prevent the production of wastewater effluents, and reduce the cost of water and wastewater treatment.
10) Environment and Climate Change. (SDG 13: Climate Action). The Philippines is a hazard-prone country and periodically suffers from extreme weather conditions, earthquakes, volcano eruptions, and other natural hazards. It is also one of the countries that are most vulnerable and at risk to climate change. Consistent with Goal 13 of the United Nations' Sustainable Development Goals, the Philippines must adopt global and local actions to combat climate change and manage its impacts by strengthening resilience and adaptive capacity to climate-related hazards and other natural hazards.
11) Shelter, Transportation, and Other Infrastructure. (SDG 11: Sustainable Cities and Communities). Secure shelter and good transport facilities are minimum basic needs that are fundamental to what Filipinos aspire for as "maginhawang buhay" (comfortable life) and "panatag na buhay" (secure life), as discussed in AmBisyon Natin 2040 and which still remains relevant within the extended 30-year timeframe of the Foresight. Considering the archipelagic setting and maritime nature of the country, the national aspiration to balance urban and rural development can only be achieved through the improvement of ports, roll-on-roll-off facilities, expressway and road networks, and public transport, coupled with a strategic combination of various water, land, and air transportation modes. Shelter is needed in different forms as residence, refuge, and building as a vital component in organizing smart communities in both urban and rural settings.
12) Space Exploration. (SDG 13: Climate Action; SDG 9: Industry, innovation and Infrastructure). Space-based technologies have important applications in communications, weather forecasting, disaster management, natural resources and land use management, and in monitoring the environment. Current upstream and downstream space initiatives and future plans on space technologies must continue to be enhanced.

6. What specific methods (tools) and methodologies have been used for ForSTI and/or TA?

In the development of PAGTANAW 2050, the following foresight methodologies have been applied:

- **Bibliometrics**

This is defined as the quantitative method of citation and content analysis for scholarly journals, books, and researchers. Through a thorough review of available bibliometric sources, megatrends, and other relevant information on Philippine STI and foresight methods were culled and used to gain a deeper understanding of the S&T innovations in the country.

- **SWOT and TOWS Analysis**

A SWOT analysis is a widely used technique for identifying an organization or project's strengths, weaknesses, opportunities, and threats. This is a planning tool that summarizes the internal strengths and weaknesses against external opportunities and threats. On the other hand, while TOWS analysis uses the same components as SWOT analysis but in the opposite order, this is one step further that is focused on reducing threats, taking advantage of opportunities, exploiting strengths, and removing weaknesses.

A SWOT and TOWS workshop was undertaken involving the problem tree analysis wherein the experts enumerated and discussed the causes (root), problems (trunk), and effects or consequences (branches) for the identified S&T areas. The SWOT paved the way for the internal and external analyses of the National Innovation System wherein internal analysis was done by enumerating the system's strengths and weaknesses. External analysis was made by reviewing political, economic, environmental, sociocultural, technological, and legal factors that could pose threats or provide opportunities. Through TOWS, experts managed to determine ways to use the strengths of the STI community to actualize opportunities and cope with threats. Similarly, they also came up with ways to use opportunities to minimize weaknesses and use threats to correct weaknesses.

- **Brainstorming**

A series of workshops and meetings (from January 2020 to March 2021) were conducted with experts and relevant stakeholders that considered future thinking/foresight methodology for Philippine STI and strategic, long-term, comprehensive policy and action plans for inclusive development, security, and governance.

The 2020 NAST PHL Annual Scientific Meeting (ASM) and the three 2020 Regional Scientific Meetings (RSM) were of particular importance to this Foresight in that they solicited and collated the perspectives of the broad scope of researchers and topic experts that comprise the science community.

- **Delphi Survey**

As defined by Cardiff University (2017), Delphi is a research survey technique used as a way of collecting data from respondents within their domain of expertise. It aims to deal with divergent opinions or controversial issues to achieve consensus concerning real-world knowledge on a certain topic.

For PAGTANAW 2050, a two-round Delphi survey was conducted to arrive at a consensus on the following:

1) Expected changes in aspirations outlined in AmBisyon Natin 2040 due to the COVID-19 pandemic;
2) Sociocultural, technological, economic, environmental, and political megatrends for consideration in the foresight;
3) Expected black swans or disruptions as Filipinos journey to 2050;
4) Additional areas for consideration in the foresight;
5) Perceived areas of current strength in Philippine STI;

6) Additional areas in the future that Philippine STI should be leading in;
7) Private and public institutional changes to enhance the role of STI in development and the lives of Filipinos;
8) Talent development and retention in STI;
9) Harnessing STI in asserting our sovereignty and identity as a maritime nation; and
10) Public investments and interventions in STI to reduce poverty or the conditions associated with poverty.

Respondents came from various academic institutions, civil society, government agencies, government-owned and controlled corporations, government think tanks, industry, international organizations, non-government organizations, professional organizations, and research and development (R&D) institutions.

- **Scenario Planning**

This is a foresight methodology used for exploring and anticipating future possibilities and their implications. It entails the creation of multiple scenarios to gain a dynamic grasp of the potential futures and link these to the decisions made in the present. In addition to the Delphi survey, the NAST PHL also conducted scenario planning exercises for major STI operational areas, which were then grouped into clusters based on their interrelatedness and interactions.

In the said workshop, participants came up with a futures triangle, wherein the pull factors of the future, push factors of the present, and weight of the past were scrutinized. Drivers of change and potential threats were also mapped in the process. Four scenarios were discussed: disowned futures, outlier futures, preferred futures, and integrated futures. After discussing these futures scenarios, the preferred and integrated futures scenarios were used to guide the causal layered analysis wherein experts crafted a hypothetical news headline and named underlying systems, worldviews, myths, and metaphors governing the clusters. The last step in the scenario planning was the backcasting. This was necessary as this required the experts to delineate steps that would help the country achieve the integrated futures scenario per cluster.

- **Technology Readiness Level**

For the some of the DOST Councils' technology transfer initiatives, common tools that we use for ForSTI and TA include our technology readiness level (TRL) metrics, prioritization criteria, technology roadmaps, and intellectual property valuation reports.

In the other foresight project of the DOST, the following are those used which have not yet been provided in the previous questions:

- **Shared History Presentation**, wherein participants will develop a "shared history map" of the key events, ideas, trends and influences from the past that shaped the present.

- **Rip Van Winkle + INSPECT++**, which is an exercise that allows participants to question the future and their assumptions about it. Participants will scan the external drivers that might influence or impact the future of an issue, topic, or concern through INSPECT++.

- **Emerging Issues Analysis**, wherein participants will identify and explore barely visible issues before they become a concern, trend, or problem.

- **Futures Triangle Maps**, which involves the three dimensions of the future pushes of the present, pulls of the future and weight of history. Participants will analyze the interaction of these three driving forces and develop their plausible futures.

- **Scanning the Forces of Change/ Megatrends Analysis**, wherein participants will identify and rank the highly impactful and highly uncertain drivers of change.

- **Causal Layered Analysis**, wherein participants will unpack, expand and deepen the range and richness of the preferred and integrated future scenarios that they imagined. This method will guide them in exploring and analyzing different levels of reality and visions of the future.

- **Backcasting**, which involves the identification of implementation strategies and next steps: specific policies, programs, projects and initiatives to achieve their preferred and integrated futures.

7. What challenges have you experienced in undertaking ForSTI and TA exercises? Does your country have any specific capacity needs to strengthen the conduct and use of ForSTI and TA?

   The challenges encountered in undertaking ForSTI and TA exercises in the country are as follows:
   - Access to quality information including literature and references with paywalls
   - Insufficient data or information on the technologies
   - Availability and interest in developing and retaining special talent to undertake ForSTI and TA, in relation to this, it is also a challenge to get the organizations interested in foresight. It is also important for them to build more trust and confidence in the organizations on foresight activities
   - Communication of ForSTI results in different types of audiences that needs to be considered; in relation to this, there is a challenge in translating outputs to practical actions in the organizations
   - With the increasing number of emerging technologies in health, current assessment methods may require updating
   - Getting people to think imaginatively
   - Managing clients'/customers' expectations
   - Linking scenarios with the planning process

   In terms of capacity needs, the following aspects may be considered
   - There is a limit in the scope and coverage of ForSTI and TA in the Philippines. ForSTI And TA are only limited to assessing the future impact, potential local and global market size, competitive advantage, technology readiness level, and commercialization roadmap of the technology.
   - There could be more capacity building efforts on foresight to be able to know the market trends.
   - There is a need for standardized method for technology assessment.
   - Another key area of focus on is enhancing the capacity of stakeholders to fully integrate foresight into strategic planning and decision-making processes through institutionalization, continued capacity building, stakeholders engagement, among others.

8. Have you conducted combined ForSTI and TA in a single exercise at any time? What were the benefits and challenges of combining ForSTI and TA? Do you see this as a useful and feasible approach?

   In PAGATANAW 2050, only ForSTI has been conducted with tangential reference to TA. Aside from attempting to gather the S&T tools, the exercise also tried its best to match the tools to address key operational areas. It also awakened national consciousness to devote prime importance to the Philippines being an archipelagic and maritime nation. ForSTI and TA combined will certainly refine and update PAGTANAW 2050.

   During the COVID-19 pandemic, the DOST, through its Health Council, DOST-PCHRD combined ForSTI and TA efforts to help identify critical areas for research and innovation, leading to the rapid development and deployment of diagnostics, treatments, and public health strategies. Combining ForSTI and TA was a useful and feasible approach, especially for organizations like DOST-PCHRD. The integrated approach provides a comprehensive framework for anticipating future challenges and opportunities while ensuring that current technological solutions are effective and impactful.

9. Are you involved in any international cooperation or partnerships for ForSTI and TA? Which ones and what are their benefits?

   The Philippines is a member of the ASEAN Foresight Alliance (AFA) which submitted very recently to the ASEAN Committee on Science, Technology and Innovation (COSTI) its First Report on Foresight for the ASEAN Science, Technology and Innovation Ecosystem for the committee's consideration and appropriate action. This is a project of the Malaysian Academy of Science and Technology (MAST) wherein the Philippines and several ASEAN members actively participated.

We are keen to learn from the ForSTI and TA experiences of other countries that have sustained their interest in these areas.

The Philippines is also a member of the UNESCO Global Futures Literacy Network and Asia Pacific Futures Network. The Global Futures Literacy Network is a diverse community of futures researchers, practitioners, and supporters, ranging from the 20 UNESCO Chairs in Futures Studies and Futures Literacy, to the High-Level Committee on Programs (HLCP) Foresight Network. Spanning across the globe in academic and government institutions, as well as businesses and NGOs, the network shares design practices, resources, ongoing work and progress updates in order to advance Futures Literacy. The Asia Pacific Futures Network, on the other hand, aims to provide a platform for all those who host, facilitate, and apply Futures Thinking and Strategic Foresight and help to promote the community of practitioners.

The Philippines, through DOST, has also conducted training on foresight and developed a Foresight Resource Manual in collaboration with the Centre for Engaged Foresight and the Science, Technology, Research and Innovation for Development (STRIDE) Program under the United States Agency for International Development (USAID) Philippines, as previously mentioned in this document.

10. What role(s) can international cooperation, and the CSTD, play in promoting ForSTI and TA?

In general, cooperation with other international organizations, institutions, and countries like the Member States in the Commission on Science and Technology for Development (CSTD) regarding ForSTI and TA offers a strategic opportunity to enhance capabilities and effectiveness of promoting excellence in foresight initiatives in science, technology, and innovation and technology assessments. The benefits of this endeavor extend beyond knowledge acquisition, this includes fostering collaboration, stimulating creativity, and providing valuable insights into different approaches, innovative techniques, and best practices, especially in those countries with similar socio-economic contexts.

International cooperation may promote and ignite dialogue on standardization and harmonization of ForSTI and TA approaches, guidelines and indicators for assessing the impacts of emerging technologies, resource mobilization to fund TA initiatives in developing countries and regions, global networking and collaboration to promote joint research projects, and monitoring and evaluation of the TA initiatives at the global level.

Active engagements with international partners can establish valuable networks and provide global perspectives on foresight and technology assessment methods and applications. Collaboration abroad provides unique opportunities for cultural exchange and through interactions with experts and practitioners from different cultural backgrounds can offer a deeper appreciation of the contextual factors influencing their STI foresight methods, practices, and outcomes. This cross-cultural exchange can enrich one's understanding of another's values and priorities, enhancing the ability to develop inclusive strategies relevant to emerging trends and challenges within the country as well as in the global landscape. These can establish platforms for sharing data, research findings, and technological developments across countries.

The Commission on Science and Technology for Development (CSTD) currently serves as a platform for dialogue on meaningful and pressing issues in STI which results are essential to ForSTI. The findings in technical studies can also be used in further developing the TA mechanisms in countries. The CSTD, like in international cooperation with those outside the Commission, plays a vital role in promoting the sharing of best practices, methodologies, and lessons learned in ForSTI and TA which may enhance local capabilities. Network and discussions can lead to collaborative research and development which opens to more access to advanced technologies, research facilities, and funding opportunities

Moreover, the CSTD has extensive experience and a broad range of expertise in various fields that can significantly enhance the quality and effectiveness of promoting STI foresight. The Commission can also provide global perspectives and access to extensive data and research resources which can be critical for informed decision-making. It may also facilitate collaboration and access to international resource funding and development partners. Joint initiatives under this platform may

also lead to the conduct of training and capacity-building initiatives to strengthen our own institution and human resources.

The CSTD may also further provide technical assistance and training to build local capacities in ForSTI and TA among its Member States.

11. What have been some important ForSTI and TA examples undertaken in your country, especially related to national policy (prioritization, design etc.)?

In the recently published **Philippine Development Plan (PDP) 2023-2028**, PAGTANAW 2050 was mentioned in Chapter 8: Advance Research & Development, Technology, and Innovation. It was included under the list of desired outcomes of having a basic R&D and knowledge creation strengthened. A special box was dedicated for its description that presented its goal, the twelve (12) key operational areas, and the importance of the STI Foresight.

AmBisyon Natin 2040, a long-term visioning initiative led by NEDA represents the collective vision of Filipinos for the country by the year 2040. This initiative incorporates foresight elements to promote sustainable and inclusive development. NEDA utilizes AmBisyon Natin 2040 as a guiding framework for the Philippine Development Plan (PDP) and other national policies, integrating foresight insights into long-term planning.

To date, there are **twelve (12) Regional Development Council Resolutions** that were issued in support of PAGTANAW 2050. It was already presented to the RDC of the National Capital Region (NCR) and just waiting for the resolution. On the other hand, an appointment with regions 7, 9, Caraga Region, and Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) is to be set to meet with the RRDIC in their regions.

The DOST's NAST PHL met with the Department of Trade and Industry (DTI) to align the **Philippines' Industrial Policy and Strategic Investment Priorities Plan (SIPP)** with PAGTANAW 2050. The PAGTANAW 2050 document was mentioned in DTI's Memorandum Order No. 61 s.2022 Approving the 2022 Strategic Investment Priority Plan.

DOST and NAST PHL met with UP System to discuss the possibility of having **UP Maritime and Oceanographic (UPMO) Studies** concerning the vision of PAGTANAW 2050 of making the Philippines a prosperous, archipelagic, and maritime nation. The premier state university plans to collaborate with other state universities and colleges, foreign universities with similar programs, and various maritime industry stakeholders to craft curricula and roadmaps for research and innovation. These will be aimed at developing the Blue Economy and the Archipelagic Nation by 2050 in alignment with PAGTANAW 2050, the Department of Science and Technology foresight and strategic planning project.

The DOST Secretary released a memorandum for a Department-wide use of the 12 Key Operational Areas (KOAs) of the PAGTANAW 2050 as topics or subject matter of modules and requests for suggestions on the 12 KOAs.

The explanatory note of **House Bill No. 9791 or the Circular Economy Act** mentions the PAGTANAW 2050 document to promote the transition to a circular economy. This bill is still pending approval from the Committee on Economic Affairs of the Philippine House of Representatives.

The Center for International Relations and Strategic Studies identified **Senate Bill No. 2450 or House Bill No. 9662 entitled Blue Economy Act** to be significant in advancing sustainable development and is one of the key operational areas of the PAGTANAW 2050 framework presented by the National Academy of Science and Technology, Philippines.

ForSTI and TA have been advanced in the health sector through the Health Research Priorities and the **National Unified Health Research Agenda (NUHRA)**, which outlines the health research priorities of the Philippines. Both were also incorporated in the **Balik Scientist Program** that encourages Filipino scientists working abroad to return to the Philippines and contribute their expertise to local research initiatives.

Recognizing the importance of researcher skills, the DOST also launched **SPRINT (Short Term Program for Researchers on Innovation and Technopreneurship)**, a capacity-building program designed to equip researchers for success in the innovation ecosystem.

12. Based on your experiences, how have ForSTI and TA improved STI decision making and the prioritization, design and implementation of STI policies?

    For the country's PAGTANAW 2050, it is too early to determine how its recommendations on science, technology, and innovation are influencing the present decisions to prepare for the future.

    In general, ForSTI and TA improved STI decision making and the prioritization, design, and implementation of STI policies in the following aspects:

    - Developing the National Unified Health Research Agenda (NUHRA) based on foresight exercises and stakeholder consultations ensure alignment with national health goals and emerging needs.
    - Encouraging the development and commercialization of locally-produced health technologies and innovations, which can address specific health challenges in the Philippines.
    - In TA, facilitating technology transfer that promotes the transfer of innovative health technologies from research institutions to the market, ensuring that research findings lead to tangible health benefits
    - Development of a prioritization criteria that serves as a guide in identifying technologies, especially in health, that will be given priority in terms of pre-commercialization funding support
    - ForSTI exercises continuously improve the country's capacity to do long-term visioning, identify crucial research areas, guide policy development, enhance capacity, and promote inclusive dialogue, which has improved the overall strategic planning process.
    - Policymaking has become more data-driven, with R&D outputs providing valuable insights and recommendations. Foresight exercises have also successfully identified future challenges and opportunities, leading to better prioritization of STI areas for sustainable development. This has further influenced the Harmonized National R&D Agenda (HNRDA) by highlighting key priority areas for investment on projects with the highest potential impacts.
    - Technology assessment is also crucial as it identifies technologies with the greatest commercialization potential, while also pinpointing those that require further R&D support. By identifying gaps in existing technologies, these assessments provide valuable insights for improving R&D evaluation and management processes. This information has directly led to the development of new policies and guidelines, further strengthening the Philippines' overall R&D ecosystem.
    - Foresight serves as a valuable planning and policy tool, providing a structured approach to envisioning future scenarios and understanding their implications, which are essential for crafting strategic plans and shaping policies. As a means of fostering consensus, foresight leverages participatory processes that transcend disciplinary boundaries, sectors, and borders, aligning our collective efforts toward making the Philippines a thriving maritime nation. Furthermore, foresight as a skill empowers the country to challenge its assumptions about the future and view situations from diverse perspectives. While achieving a completely accurate prediction of the future remains challenging, people can rely on the systematic process of envisioning potential future scenarios, including both threats and opportunities. In navigating the ever-evolving development landscape, it is crucial to anticipate changes, particularly in terms of challenges and opportunities, to ensure that the innovations being pursued not only address current issues but also position the countries for future success.