Navigating The Regulatory Landscape: Guiding the Development and Use of Emerging Technologies in The Philippines

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Abstract— This study delves into the examination of regulatory structures and government entities, particularly the Department of Trade and Industry (DTI), the Department of Science and Technology (DOST), and the Department of Information and Communications Technology (DICT), responsible for overseeing the governance of emerging technologies in the country. The research seeks to pinpoint the regulatory frameworks guiding the development of emerging technologies, user and developer protection, and the facilitation of industry innovation. It employs a comprehensive analysis encompassing legal statutes, governmental bodies, initiatives, industry interactions, and collaborations, with a particular focus on the DTI's comprehensive innovation and Industry 4.0 strategies, the DOST's diverse support initiatives for startups and innovators, and the DICT's efforts in technology adoption and regulation.

The findings highlight the significance of legal acts like the Data Privacy Act of 2012 and the Cybersecurity Prevention Act of 2012 in safeguarding users. Additionally, the research underscores the DOST's supportive programs for startups and innovators, such as the IPRAP, TECHNiCOM, and GALING initiatives. The DTI's partnership with Siemens, the Industry 4.0 pilot factory, and the SMART program plays a crucial role in integrating advanced technologies into manufacturing processes. Furthermore, the DICT's Tech Trend Programs and Emerging Technologies Workshops, conducted in collaboration with Huawei, aim to promote awareness and the adoption of emerging technologies. International collaborations, such as the Memorandum of Understanding with the US-ASEAN Business Council and the DICT's participation in the International Telecommunications Union Council, underscore the Philippines' dedication to global innovation and the development of technologies, including emerging ones.

The research emphasizes various legal frameworks, focusing on the regulation of emerging technology usage, the protection of users and innovators, and the support of innovation by harnessing the potential of emerging technologies. It also highlights the efforts of national agencies and their sub-agencies in ensuring the implementation of these legal frameworks and the execution of various programs aimed at advancing the innovation of emerging technologies. These initiatives serve to support developers and industries while upholding the security and safety of users. Overall, this underlines the nation's unwavering commitment to technological advancement through the utilization and regulation of emerging technologies for various purposes.

***Index Terms*— Emerging Technologies, Artificial Intelligence, Internet of Things, Innovative Technologies, Startup.**

1. Introduction

In an era marked by rapid technological progress, emerging technologies, referred to as new and innovative technologies that are being developed or have recently been introduced into the market (Mitchell, n.d.), have catalyzed profound changes and transformations across industries and societies. These advancements have significantly reshaped the way individuals lead their lives, conduct their work, and manage their daily routines.

A recent study conducted by Google (Canto, 2021) and published in the Business World news website has projected that digital transformation has the potential to unlock $101.3 billion in economic value for the Philippines by 2030. To realize this economic boon, the country's National ICT Ecosystem Framework will serve as the guiding path toward nurturing its digital economy, playing a pivotal role in bolstering the nation's overall economic landscape. Google's study highlights four rapid-growth engines in emerging technology that will play a pivotal role: the future of connectivity (encompassing 5G and the Internet of Things), applied artificial intelligence (AI), distributed infrastructure (cloud computing), and automation.

These transformative technologies are poised to be the catalysts for progressive innovation and economic expansion.

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Acknowledging their potential, the Philippines has designated information and communications technology (ICT) as a key sector in its digital transformation initiative. This initiative aims to integrate and harness a spectrum of technologies, from artificial intelligence to the Internet of Things and other cutting-edge innovations, to fully leverage their advantages. As these emerging technologies continue to evolve, their successful integration and use hinge on the presence of an effective regulatory framework that fosters innovation while safeguarding the public interest. This critical interplay between innovation and regulation underscores the need for a comprehensive understanding of the regulatory landscape governing these technologies within the Philippine context.

The primary objective of this research paper is to conduct a comprehensive examination and analysis of the legal frameworks governing emerging technologies in the Philippines. This includes an exploration of the laws, programs, and regulatory bodies responsible for the development and use of emerging technologies.

Through this research endeavor, our aim is to derive valuable insights and recommendations that will enable the Philippines to strike a delicate balance between regulating and utilizing these technologies. This equilibrium necessitates addressing ethical, legal, and social implications effectively. Ultimately, our goal is to provide a comprehensive understanding of the intricate relationship between technology and regulation, underpinned by a commitment to fostering innovation and ensuring the equitable distribution of the benefits of these advancements among the Filipino population.

2. Methodology

In this study, the researchers employed a qualitative research methodology to acquire data concerning the Regulatory Landscape governing the development and use of Emerging Technologies within the Philippines. The data for this study was sourced from various online repositories, encompassing news articles, official government website content, pertinent scholarly publications, and official documents pertaining to the legislative framework of the Philippines. Notably, the data collection was limited to the period spanning from 2017 to 2023, ensuring the provision of the most up-to-date insights into the regulatory framework influencing the development and adoption of Emerging Technologies in the Philippines.

The data amassed by the researchers underwent thorough qualitative analysis aimed at exploring discernible trends and valuable insights, all of which were pertinent to addressing the central research question of the study. This inquiry delved into an examination of the laws, initiatives, and regulatory entities that hold responsibility for the oversight of emerging technologies.

Throughout the research, a deductive reasoning approach was applied, commencing with the formulation of research objectives. Subsequently, data gathering transpired, followed by a comprehensive analysis of the data. Ultimately, the researchers synthesized their findings to arrive at informed conclusions, effectively culminating the study.

3. Results and Discussions

A. Legal Frameworks Supporting and Guiding the Use and Development of Emerging Technologies

1) Electronics Commerce Act of 2000

Republic Act No. 8792, more commonly known as the Electronic Commerce Act, was enacted on June 14, 2000. This legislation was designed with the overarching objective of facilitating both domestic and international transactions, agreements, contracts, exchanges, and information storage through the utilization of electronic, optical, and analogous mediums, modalities, instruments, and technologies. Its primary aim is to establish the authenticity and reliability of electronic data messages and electronic documents related to these activities. Additionally, it endeavors to encourage the widespread use of electronic transactions across both government and the general public, as documented on the Official Gazette website of the Philippines.

This law assumes a pivotal role in promoting and regulating the integration of technology within the nation's commerce landscape. According to a report featured on the Philippine News Agency's website on June 14, 2020, Ramon Lopez, the Secretary of the Department of Trade and Industry (DTI), articulated the necessity of revisiting this legislation to ensure its continued relevance in the present and future contexts. He underscored the imperative need to account for significant advancements in technology, the pervasive utilization of the internet, and the burgeoning e-commerce sector. The same report highlighted findings from the 2019 Google Temasek study, which predicted substantial growth in the Philippine e-commerce industry, with estimates projecting a leap from USD 2.5 billion in 2019 to a staggering USD 12 billion by 2025.

As evidenced by these reports, the Electronic Commerce Act of 2000 plays a pivotal role in the regulation and advancement of emerging technologies, including artificial intelligence and machine learning. Its primary objective is to invigorate and enhance e-commerce within the country. As elaborated on the TechWire Asia website by Raj in 2022, emerging technologies have significantly empowered companies to gain deeper insights into customer behavior and preferences. These technologies have also enabled a more personalized and engaging customer experience, prompting a growing number of companies to rely heavily on various emerging technologies to enhance their performance and meet evolving customer expectations. To harness the full potential of e-commerce, this law provides the necessary provisions for regulating technologies and underscores the importance of technology adoption to bolster both e-commerce and the broader national economy.

2) Intellectual Property Code of the Philippines

Republic Act No. 8293, also known as the Intellectual Property Code of the Philippines, was enacted on June 6, 1997, with the primary objective of safeguarding the exclusive rights of individuals such as scientists, inventors, artists, and other talented individuals to their intellectual property and creative works. This protection extends to instances where such intellectual property benefits the public and is essential for specified durations, as outlined in the Act. The overarching goal of the Act is to encourage the dissemination of knowledge and information, ultimately fostering national development, progress, and the welfare of society.

This legislation plays a pivotal role in assisting both Filipino inventors and foreign innovators operating within the country in securing their technological advancements and innovations. It achieves this by providing avenues for obtaining patents, copyrights, or trademarks to protect their intellectual property rights. Additionally, the law serves to regulate emerging technologies, including artificial intelligence (AI) and machine learning, ensuring that the rights of developers and creators are respected and upheld during the innovation and creation process.

3) Philippine Technology Transfer Act of 2009

Republic Act 10055, also known as the Philippine Technology Transfer Act of 2009, received approval on March 23, 2010. As detailed on the lawphil.net platform, this legislation establishes a comprehensive framework and support system for the management, ownership, utilization, and commercialization of intellectual property originating from government-funded research and development initiatives, among other objectives.

This law is instrumental in facilitating the seamless transition of emerging technologies into the commercial sphere, allowing them to be effectively managed, utilized, and owned by entities within the commercial sector. Specifically, it pertains to technologies that have been developed through government-backed research and development projects. By doing so, this legal framework encourages the sharing and transfer of government-developed technologies, ensuring that their benefits reach a broader audience.

Republic Act 10055 serves as a bridge connecting government research and development institutions with the commercial sector. This connection fosters a mutually beneficial relationship, unlocking numerous opportunities for innovation and ultimately bolstering the nation's economy. One of its primary roles is to facilitate the commercialization of emerging technologies, making them available not only to the government but also to the Filipino population at large. This transfer of ownership and intellectual property rights to the private sector ensures that these technologies are put to their fullest and most efficient use, thus maximizing their benefits for society as a whole.

4) Data Privacy Act of 2012

Republic Act No. 10173, also known as the Data Privacy Act of 2012, was officially passed on August 15, 2012, and is a fundamental piece of legislation in the Philippines. Its primary objective, as delineated in the official gazette of the Republic of the Philippines, is to protect personal information, particularly data collected through information and communication technology (ICT) systems in both the public and private sectors. Additionally, it establishes the National Privacy Commission, which is tasked with overseeing the proper implementation of this law.

In the context of emerging technology, the Data Privacy Act plays a crucial role in regulating the handling of data by these novels and advancing technologies, thereby ensuring that they do not compromise the privacy and data integrity of Filipino citizens. As emphasized in a recent article in the UNESCO Inclusive Policy Lab (Elvy, 2023), the proliferation of emerging technologies, such as the Internet of Things (IoT), raises significant concerns about data privacy. The IoT, which constitutes an interconnected network of devices capable of exchanging data, has the potential to accumulate extensive amounts of personal information.

According to the provisions of the Data Privacy Act of 2012, the establishment of the National Privacy Commission ensures enforcement and oversight of the Act's implementation, thereby guaranteeing that emerging technologies adhere to the Act's guidelines and that personal information is safeguarded.

Hence, legislation related to data privacy holds paramount importance in upholding the confidentiality and security of data. It plays a pivotal role in shaping the data collection and processing practices of emerging technologies like IoT to align with the restrictions and guidelines specified in the Data Privacy Act. This ensures that the deployment of these technologies respects the privacy rights of individuals and mitigates potential risks associated with unauthorized data access or misuse. In essence, the Data Privacy Act serves as a protective barrier, enabling the responsible development and utilization of emerging technologies while preserving the fundamental right to data privacy for all Filipinos.

5) Cybercrime Prevention Act of 2012

On September 12, 2012, Republic Act No. 10175, commonly referred to as the Cybercrime Prevention Act of 2012, was enacted in the Philippines. This legislation, as detailed in the official gazette of the Republic of the Philippines, has a multifaceted purpose. It seeks to define cybercrimes, establish measures for their prevention, investigation, and suppression, and set forth penalties for those found guilty of such offenses. Furthermore, it serves as a protective shield against cyberattacks and works to enhance cyber safety for the Filipino population. In addition to these vital functions, this law plays a pivotal role in overseeing the development of emerging technologies.

A significant revelation from a study by RAND Europe, conducted at the request of the Estonian government and authored by (Bellasio et al.,2020), pertains to the influence of evolving technologies on cybercrime. Notably, the research highlights the emergence of autonomous systems capable of disguising criminal activities and executing intricate,

challenging-to-investigate automated attacks. Furthermore, the study underscores the escalating risk associated with the vast amounts of data gathered by Internet of Things (IoT) devices, which could become vulnerable to theft, corruption, destruction, extortion, or illegal sale. IoT devices also expand the potential target for cyber-dependent crimes and introduce fresh vulnerabilities into complex IT systems and environments. In light of these findings, the research recommends that Estonia adapt its legal, regulatory, and organizational framework to effectively respond to cybercrime challenges arising from technological advancements.

In the context of the Philippines, the Cybercrime Prevention Act of 2012 serves as a crucial legal and regulatory tool for addressing cybercrimes that stem from the ongoing development of emerging technologies. Additionally, it provides guidance on the responsible use of these technologies to bolster the safety and security of cyberspace, aligning with the objectives articulated in the law.

6) Department of Information and Communications Technology Act of 2015

Republic Act No. 10844, officially titled the Department of Information and Communications Technology Act of 2015, received approval on May 23, 2016. This legislation is dedicated to the establishment of the Department of Information and Communications Technology (DICT), outlining its powers, functions, and the allocation of funds for its operation, among other purposes detailed in the official gazette of the Republic of the Philippines. One of the significant functions of the DICT is to oversee and regulate the use and development of Information and Communication Technology (ICT) equipment, which encompasses emerging technologies.

An illustrative example of the DICT's commitment to advancing emerging technologies can be seen in its collaboration with Huawei Philippines, as reported by Backendnews.net in 2021. This partnership facilitated six workshops on emerging technologies for government employees, conducted from June to November of that year. These workshops covered various topics such as 5G, the digital economy, artificial intelligence, big data, cloud computing, and cybersecurity.

In addition, the DICT initiated a program named Tech Trends on April 28, 2022, as reported by newsbyte.ph in 2022. The aim of this program is to raise awareness and stimulate discussions among interested individuals regarding disruptive innovations and emerging technologies in the ICT field.

Secretary Uy of the DICT has affirmed the department's dedication to promoting the use of emerging technologies. During the International Telecommunication Union (ITU) Council 2023 High-Level Segment held in Geneva, Switzerland, as indicated on the department's LinkedIn page in 2023, Secretary Uy emphasized the commitment to providing inclusive access to emerging technologies for Filipinos. Additionally, the secretary highlighted the DICT's plans to bridge the digital divide by promoting free Internet access through two flagship programs: the National Broadband Program (NBP) and the Free Wifi for All (FW4A) program, both of which aim to make disruptive and emerging technologies accessible to every Filipino.

Evidently, the DICT plays a pivotal role in shaping the development of emerging technologies within the Philippines, as well as in promoting and facilitating their use throughout the country.

7) Innovative Startup Act

The Innovative Startup Act, also known as Republic Act 11337, received approval on November 22, 2019. As outlined in the official gazette of the Republic of the Philippines, this law is designed to support startups by offering a range of benefits and incentives, including grants, subsidies, access to venture capital, and expedited application processing, among other advantages. The law defines a startup as "any person or registered entity in the Philippines with the aim of developing an innovative product, process, or business model."

Emerging technologies play a pivotal role in assisting startups in achieving their objectives. Technologies like AI, augmented reality, and edge computing, as highlighted in the Open Growth Website (Paul, 2023), create exciting opportunities for startups. This underscores the importance of regulating the use of emerging technologies to foster a thriving startup ecosystem in the country. A startup ecosystem is a dynamic network of individuals, startups in various developmental stages, and diverse organizations, both physically and virtually, working together as a system to establish new startup companies, as described by startupcommons.org.

A post by GHC Growth Lab on their LinkedIn page on May 17, 2023, emphasizes how emerging technologies have acted as catalysts for the success of startups. Republic Act No. 11337 serves as a mechanism for regulating and harnessing the potential of emerging technologies to support the goals of startups. Consequently, this law plays a crucial role in harnessing emerging technologies to shape an innovative startup ecosystem in the Philippines.

8) Philippine Innovation Act

The Republic Act No. 11293, also known as the Philippine Innovation Act, which was enacted on April 17, 2019, represents a pivotal piece of legislation in the Philippines. This act, as detailed by the Official Gazette of the Republic of the Philippines, places innovation at the forefront of the country's development policies. Its overarching aim is to catalyze inclusive development, foster growth, and enhance the national competitiveness of micro, small, and medium enterprises (MSMEs), allocate necessary financial resources, and serve other pertinent purposes.

The primary objective of this law is to galvanize actions within the realms of education, training, research, and development to stimulate innovation and boost the internationalization endeavors of MSMEs, positioning them as drivers of sustainable and inclusive growth.

Notably, the law introduces the establishment of the National Innovation Council (NIC), which is tasked with formulating

strategies to ignite the creation of novel ideas and their transformation into high-quality products, processes, and services. This endeavor has a dual focus: improving the welfare of low-income and marginalized groups and generating livelihood opportunities for these sectors. Importantly, the law explicitly underscores the strategic deployment of technologies, including emerging technologies, to bolster the government's innovation initiatives.

Emerging technologies hold the potential to disrupt established industries and conventional modes of operation. A defining characteristic of these technologies is their disruptive nature, capable of exerting a substantial impact on society and the economy. In light of this, the Philippine Innovation Act, with its core mission to support MSMEs and foster innovation, is poised to harness the full potential of emerging technologies, positioning the law as an ecosystem for innovation (Bernardo, 2019). This strategic utilization of emerging technologies, such as Artificial Intelligence (AI), holds the promise of generating significant economic growth over the next five to seven years (Bughin et al., 2018).

In summary, this legislation serves as a critical enabler for creating a conducive environment that facilitates the development and widespread adoption of emerging technologies. This, in turn, is expected to drive sustainable economic growth and enhance the overall development outcomes of the Philippines. The Philippine Innovation Act thus emerges as a dynamic and forward-looking framework that aligns the nation with the transformative power of emerging technologies.

9) Philippine Digital Workforce Competitiveness Act

Republic Act No. 11927, also known as the Philippine Digital Workforce Competitiveness Act, was enacted into law on July 30, 2022. According to the Official Gazette of the Republic of the Philippines, the primary purpose of this law is to elevate the competitiveness of the Philippine digital workforce. To achieve this goal, it establishes an inter-agency council dedicated to the development and enhancement of the nation's digital workforce, among other objectives.

The fundamental aim of this act is to equip and ensure the competitiveness of the Philippine digital workforce by furnishing them with essential digital skills and 21st-century competencies. Furthermore, it emphasizes the importance of supporting and safeguarding the digital workforce while striving for the continuous improvement of their skill sets. The main recipients of the law's provisions are government employees, who will be equipped with the necessary digital skills to transform into an "E-Government." E-Government is characterized by the government's utilization of Information and Communication Technologies (ICTs), typically coupled with the modernization and restructuring of traditional governmental structures and business processes (Kalampokis et al., 2023).

In the context of the burgeoning influence of emerging technologies, the potential for advancing E-Government is abundantly clear (Yasser, 2023). Emerging technologies, such as Artificial Intelligence (AI), have the capacity to automate routine tasks, enhance decision-making processes, and offer personalized services. Blockchain technology can reinforce transparency and security in government transactions, while the Internet of Things (IoT) can enhance public service delivery through interconnected devices and real-time data.

To harness the full benefits of E-Government, it is imperative to provide training for the government sector. Research, such as that detailed in "Strengthening Digital Inclusion through E-Government: Cohesive ICT Training Programs to Intensify Digital Competency" (Chohan, 2020), underscores the significant positive impact of ICT training on government employees' self-efficacy in using E-Government applications, including emerging technologies. These training programs not only bridge the digital divide but also enhance the potential of citizens and promote more equitable access to public services in developing societies.

This law emphasizes the importance of incorporating emerging technologies by providing training to the digital workforce, thereby unlocking the full positive impact of E-Government. This legislation represents a pivotal step toward enhancing the digital competency of government employees and ensuring that the Philippines remains competitive in the digital era.

Overall, these legal frameworks play a crucial role in regulating and fostering innovation, digital transformation, and the responsible use of emerging technologies in the country. These legal frameworks not only protect the rights of individuals and organizations but also provide the necessary regulatory framework for the development, adoption, and responsible use of emerging technologies. They reflect the government's commitment to fostering innovation and digital transformation in the Philippines while ensuring that these technologies serve the best interests of the Filipino population.

B. Key Regulatory Agencies and Their Programs That Are Involved in Regulating and Promoting the Development and The Use of Emerging Technologies in The Philippines

1) Department Of Science and Technology (DOST)

One of the executive branches is responsible for the coordination of science and technology-related projects in the Philippines and for formulating policies and projects in the fields of science and technology in support of national development.

The agency hosts a variety of programs, councils, and projects centered around fostering innovation by harnessing emerging technologies and regulating their use to bolster startup development in the country.

Table.1. Comprehensive Invention/Innovation Services Program of DOST
(Source: tapi.dost.gov.ph/programs-and-services)

Program	Objective
The Technology	This program is designed to accelerate the

Innovation for Commercialization Program (TECHNiCOM)	process of transferring, implementing, and commercializing research and development (R&D) outcomes to promote the sustainable development of the country through appropriate technological platforms.
Intellectual Property Rights Assistance Program (IPRAP)	This program offers support in patent consultation and provides grants to cover the expenses of patent agents and intellectual property (IP) officers' fees.
Concept Prototyping Program	This program offers assistance for the creation of an initial working prototype of a prospective invention or innovation. It involves the provision of technical support through collaboration with industry experts, DOST Research and Development Institutes (RDI), and State Universities and Colleges (SUC) or Higher Education Institutions (HEI).
Grants and Assistance to Leverage Innovations for National Growth (GALING) Program	This program is designed to adopt a comprehensive and integrated approach, providing a unified package of support. It seeks to streamline the pre-commercialization initiatives of DOST-TAPI's Invention Development Division (IDD), including the Testing and Analyses Program, Industry-Based Invention Development (IBID) Program, and Invention-Based Enterprise Development (IBED) Program.

The table highlights the various programs offered by the Department of Science and Technology (DOST) in the Philippines to support invention, innovation, and the development of emerging technologies. These programs serve as critical components of the Philippines' innovation ecosystem and play a significant role in advancing technology and fostering entrepreneurship.

- Intellectual Property Rights Assistance Program (IPRAP). The Intellectual Property Rights Assistance Program (IPRAP), established under Executive Order No. 128, is instrumental in assisting developers of emerging technologies in obtaining patents for their innovations. Intellectual property protection is crucial in the fast-paced world of emerging technologies, where ideas can quickly become valuable assets. IPRAP covers professional and government fees, thus reducing the financial burden on innovators, enabling them to focus on the development and commercialization of their technologies (Dela Cruz, 2021).
- Technology Innovation and Commercialization (TECHNiCOM) Program. The TECHNiCOM Program is a pivotal initiative aimed at providing financial grants and technical assistance to developers of emerging technologies. This program recognizes the potential of emerging technologies and provides essential support to bring these innovations to the public. By offering grants for pre-commercialization projects, the DOST expedites the readiness of locally developed technologies for market deployment. (bworldonline.com, 2023).
- Concept Prototyping Program. For inventors in the early stages of developing their innovations, the Concept Prototyping Program offers crucial financial support. As per the source from the DOST website, this program covers expenses related to materials, labor, and testing, ensuring that inventors can refine their initial prototypes. This plays a pivotal role in advancing innovative technologies from concept to reality, aligning with the principles regarding the importance of ICT training and innovation development.
- Grants and Assistance to Leverage Innovations for National Growth (GALING) Program. The GALING Program, which follows a Technology Readiness Level (TRL)-based approach, offers comprehensive assistance to guide pre-commercialization preparations. It supports iterative prototyping and innovation refinement. As outlined in the DOST source, this step-by-step approach ensures that emerging technologies are thoroughly developed and validated before they reach the market, aligning with the research insights about ICT training and innovation development.

These DOST programs collectively support the entire innovation journey, from the early stages of concept and prototyping to securing intellectual property rights and preparing technologies for market entry. By providing financial, technical, and legal assistance, these programs remove barriers that often hinder the progress of inventors and entrepreneurs working on emerging technologies.

Table.2. Technology Transfer and Commercialization Services (Source: tapi.dost.gov.ph/programs-and-services)

Program	**Objective**
Venture Financing Program (VFP)	This program is designed to expedite the commercialization of innovative technologies or inventions by offering essential funding support to Micro, Small, and Medium Enterprises (MSMEs) that are technology-based.
Innovation and Technology (I-Tech) Lending Program under Invention Guarantee Fund (IGF) of R.A. 7459	This program establishes a dedicated lending mechanism in collaboration with the Land Bank of the Philippines (LBP). Its purpose is to complement the utilization of the Invention Guarantee Fund (IGF) as stipulated in Republic Act No. 7459, also known as the Inventors and Invention Incentives Act of the

	Philippines. This initiative aims to provide financial support to creditworthy and certified Filipino male and female inventors for the commercialization of their patented inventions within the Philippines.
Honing Innovations, Research, Agreements and Negotiations of the Government-Funded Technologies (HIRANG) 2.0 Program	This program is intended to offer support in the form of consultancy services, capacity building, and various financial assistance options. Its goal is to enhance the investment readiness of spin-offs and startups that have originated from DOST-generated and funded technologies.

The table showcases a range of DOST programs aimed at facilitating technology transfer and commercialization services. These programs are pivotal in fostering the development and adoption of emerging technologies in the Philippines. By providing financial support, expertise, and capacity-building, they play a crucial role in accelerating the commercialization of innovative technologies:

- Venture Financing Program (VFP). The VFP is an essential initiative designed to offer financial support to startup and technology-based projects (Nazario, 2022). The VFP recognizes the importance of emerging technologies in shaping the future and acknowledges the need for financial support to expedite their commercialization. Emerging technologies with valid intellectual property (IP) or those already in use are eligible for consideration under this program (fundsforngos.org, 2022). This not only incentivizes innovation but also streamlines the process of bringing these technologies to the market.
- Innovation and Technology (I-Tech) Lending Program. The I-Tech Lending Program is a collaborative effort between LANDBANK and DOST-TAPI, aimed at supporting Filipino innovators and inventors in the commercialization of their patented innovations and inventions through credit financing. This program offers significant financial support by allowing inventor-borrowers to secure up to 85% of their total project cost. The project cost-sharing arrangement of 45-40-15 demonstrates a collaborative approach: LANDBANK provides financing for up to 45% of the project cost at an annual interest rate of 5%, TAPI-IGF covers up to 40% of the cost with a 0% interest rate, and the remaining 15% represents the borrowers' equity (pia.gov.ph, 2022). This collaborative financing model eases financial barriers for innovators, ensuring that their emerging technologies can be effectively commercialized.
- Honing Innovations, Research, Agreements, and Negotiations of the Government-Funded Technologies (HIRANG) 2.0 Program. HIRANG 2.0 represents an evolution of its predecessor and has shifted its focus to better align with the current landscape. The earlier iteration primarily emphasized enhancing the expertise of technology transfer officers, particularly in areas such as intellectual property valuation, technology presentation, negotiation, and licensing. In contrast, HIRANG 2.0 has redirected its focus toward the training and capacity-building of startups and spin-off companies (Nazario, 2022). This shift is particularly relevant, given the readiness challenges faced by numerous local micro, small, and medium-sized entrepreneurs (MSMEs) in expanding and attracting investment. By focusing on the development of startups and spin-offs, this program ensures that emerging technologies find support throughout their journey, from inception to market penetration.

These DOST programs serve as essential components of the Philippine innovation ecosystem. They provide vital financial support, expertise, and capacity-building opportunities to innovators, startups, and technology-based projects, aligning with global trends that prioritize the support of startups, innovators, and emerging technologies as drivers of innovation and economic development. These initiatives not only foster an environment conducive to the commercialization of emerging technologies but also contribute significantly to the nation's efforts to remain at the forefront of technological advancement.

Table.3. Other Initiatives of DOST Regarding Emerging Technologies

Program	Objective
Memorandum of Understanding DOST and US-ASEAN Business Council	This MoU provides evidence of the cooperative efforts to advance government-driven research, technology, and innovation projects in the commercial sector. It represents both parties' dedication to promoting technical innovation for the good of the country.
Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD)	It is mandated to serve as the central agency in the formulation of policies, plans, and programs as well as in the implementation of strategies in the industry, energy, and emerging technology sectors

In 2019, the Department of Science and Technology, on behalf of the government, entered into a Memorandum of Understanding (MoU) with the US-ASEAN Business Council. The primary goal of this partnership is to foster the development and execution of initiatives in the field of science, technology, and innovation (STI). The collaboration outlined in the MoU encompasses several facets, including the exchange of information related to industry development projects, research

endeavors, science-driven decision-making, global best practices in terms of transparency, standard establishment, technology regulation, and support for technology transfer.

Moreover, the memorandum actively encourages the transformation of research into commercially viable products through the facilitation of startup initiatives, such as incubation programs and assessments of market needs. Small and medium-sized enterprises stand to gain significant advantages through this collaboration, which includes support in areas like marketing and branding guidance, technology adoption, and improved connectivity. (Myint, 2019).

As a result of this Memorandum of Understanding (MOU), collaborative initiatives have been set in motion to propel government-driven research, technology, and innovation projects within the commercial sector. In 2023, at the annual meeting of the US-Association of Southeast Asian Nations (ASEAN) Business Council 2023 Philippine Business Mission, Secretary Renato Solidum Jr. of the Department of Science and Technology (DoST) expressed his enthusiasm for partnering with the business sector on Science, Technology, and Innovation (STI) projects.

Numerous innovative solutions, encompassing emerging technologies like data analytics, Internet of Things (IoT) sensors, and smart infrastructure, are being implemented in urban centers. These technologies aim to optimize energy consumption, enhance public services, and facilitate more effective traffic management. This collaboration is instrumental in ensuring that all Filipinos, especially those residing in underserved or remote areas, can access such advanced services (Ocampo, 2023).

Another initiative of the DOST is the Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD), which is one of the three specialized planning councils operating under the Department of Science and Technology (DOST).

Its core responsibility is to function as the central agency tasked with the creation of policies, plans, programs, and the execution of strategies in the domains of industry, energy, and emerging technology. This mission is carried out through a range of Science and Technology (S&T) programs, which include

- Support for Research and Development
- Human Resource and Institution Development
- S&T Information Dissemination and Promotion
- Support for Technology Transfer and Commercialization
- Policy Development and Advocacy

- Source: PCIEERD About Us, https://pcieerd.dost.gov.ph/

In 2022, during the period when the country was adapting to the "new normal," the PCIEERD allocated PHP 1.7 billion to support 238 projects. Among these projects, there were notable initiatives aligned with emerging technologies, including those related to or supportive of Artificial Intelligence (AI):

- Project AutoLABS: Developed by Davie Jone Niverca of Adamson University, this project introduces an RFID-based Automated Equipment Borrowing and Management System complemented by a mobile app reservation system. It's tailored for efficient logistics management within school laboratories.
- Development of Platform for Short Range, Heavy Payload, Multi-Mission Unmanned Aircraft System (UAS): Engr. Arnaldo Gutierrez of Holy Angel University spearheads this endeavor. The project's aim is to design an unmanned aircraft system optimized for carrying essential supplies in emergency situations and remote areas.
- Establishment of AI Research Center for Community Development (AIRCoDE): Joseph Onate of the Camarines Sur Polytechnic College is behind this initiative, which seeks to create an artificial intelligence research laboratory. AIRCoDE aims to facilitate AI research, with a focus on deep learning and computer vision, for AI enthusiasts, faculty, and students.
- Establishment of IoT Research Laboratory and Training Center: Engr. Mariciel Marcial-Teogangco of the University of the Perpetual Help System DALTA is working on this project centered around the Internet of Things (IoT). It provides an environment for simulating IoT implementations, thus fostering IoT research and development.
- Proposed Installation of AGT in Bataan Peninsula State University-Main Campus: Nelson Andres of the Bataan Peninsula State University is proposing to operate AGT coaches donated by the Department of Science and Technology within the university's campus. This project serves as a laboratory for the university's proposed railway engineering program.

During this period, PCIEERD actively sought technology solutions and innovations to assist the public in adapting to the challenges presented by the "new normal." (Arayata, 2022).

The information provided regarding these initiatives highlights several key points related to emerging technologies and their integration into the Philippines' science, technology, and innovation landscape:

- Government-Private Sector Collaboration in Emerging Technologies: The partnership between the Department of Science and Technology (DoST) and the US-ASEAN Business Council stands as a prime example of government-private sector collaboration to advance emerging technologies. This collaboration signifies the government's recognition of the pivotal role the private sector plays in driving innovation in areas such as data analytics, the Internet of Things (IoT), and smart infrastructure. It is clear that the integration of emerging technologies is vital for the

Philippines to remain competitive in the global technological landscape.

- Focus on Emerging Technologies for Urban Development: The emphasis on emerging technologies, including data analytics, IoT, and smart infrastructure, points to a strategic approach to urban development. These technologies have the potential to transform urban centers by optimizing energy consumption, enhancing public services, and improving traffic management. The integration of these technologies is not merely a convenience but a necessity for urban areas to become more sustainable, efficient, and responsive to the needs of the population.
- Supporting Small and Medium-Sized Enterprises (SMEs) in Adopting Emerging Technologies: The collaboration outlined in the MoU includes support for SMEs, a critical component of the economy. This support ranges from marketing assistance to technology adoption and connectivity. For SMEs, emerging technologies can be a game-changer, allowing them to compete on a global scale. This support underscores the government's commitment to promoting technology adoption and innovation across all sectors, ensuring that no one is left behind in the technological transformation.
- The Role of PCIEERD in Shaping Policy for Emerging Technologies: The PCIEERD's role in crafting policies, strategies, and executing programs in the domains of emerging technologies is pivotal. It underscores the government's proactive stance in promoting innovation. PCIEERD's specific focus on research and development, technology transfer, and policy development directly relates to the integration of emerging technologies into various sectors. Clear policies and research-driven strategies are essential for fostering an ecosystem conducive to technological innovation.
- Impact of Emerging Technologies on Society: The research and innovation projects supported by PCIEERD, such as AI research centers, IoT laboratories, and unmanned aircraft systems, have the potential to significantly impact society. These projects align with global trends in the technology landscape, contributing to advancements in education, disaster response, and community development. They empower the nation to harness the capabilities of emerging technologies to address societal challenges and enhance the quality of life for its citizens.
- Inclusive Development Through Emerging Technologies: Perhaps the most significant aspect is the commitment to making advanced services and technologies accessible to all Filipinos, including those residing in underserved or remote areas. This commitment aligns with the principle of inclusive development. Emerging technologies play a critical role in bridging the urban-rural divide, ensuring that advanced services are accessible to the entire population, ultimately contributing to equitable technological progress.

The Philippines' strategic approach to integrating emerging technologies into various sectors and fostering innovation reflects a forward-looking stance. The collaboration between the government, private sector, and organizations like PCIEERD is essential to harness the transformative potential of emerging technologies. The integration of these technologies is not only vital for economic growth but also for improving the quality of life for the nation's citizens, ensuring a competitive and technologically advanced future.

2) Department Information and Communications Technology (DICT)

The Department of Information and Communications Technology (DICT) is the primary policy, planning, coordinating, implementing, and administrative entity of the Executive Branch of the government that plans, develops, and promotes the national ICT development agenda. (RA 10844). The agency champions multiple initiatives aimed at raising awareness among Filipinos about emerging technologies, facilitating platforms for accessing and utilizing these technologies, and supporting startups in the development of innovative technologies for the nation. Here are some of the programs and initiatives by the DICT related to the utilization and regulation of emerging technologies:

Table.4. Initiatives of DICT Regarding Emerging Technologies

Program	Objective
Emerging Technologies Workshops	Six workshops on emerging technologies in partnership with Huawei
Tech Trends Project	A program designed to raise awareness about groundbreaking innovations and the latest emerging technologies.
DICT Startup Grant Fund	This program, as mandated by Republic Act No. 11337, also known as the Innovative Startup Act, has the primary objective of offering financial grants to new and fledgling startups operating in Information and Communications Technology (ICT)-enabled sectors.
International Telecommunication Union (ITU) Council 2023	Assuming a leadership role in the establishment of worldwide technical standards, advocating for the dissemination of knowledge and the enhancement of capabilities, and

	providing policy guidance to ensure the responsible and all-encompassing integration of emerging technologies.
National Broadband Plan	Aims to provide faster, more efficient, and equitable broadband connectivity for the Philippines, including its remote areas. It enables Filipinos to access and take advantage of emerging technologies
National Cybersecurity Plan	The primary objectives are to safeguard the critical infrastructures, government systems, and military networks within the country. This entails strengthening the Philippines' capacity to react to cyber threats, collaborating with law enforcement agencies, and promoting the development of a cybersecurity-aware society.

The table shows several significant initiatives undertaken by the Department of Information and Communications Technology (DICT) in the Philippines to regulate the development and use of emerging technologies as well as promote the use of these technologies. These initiatives encompass a wide range of activities, including workshops, programs, and partnerships with the aim of fostering innovation and technology adoption while ensuring cybersecurity and digital inclusion:

- Collaboration with Huawei. In 2021, the Department of Information and Communications Technology (DICT) collaborated with Huawei to organize multiple workshops focused on emerging technologies. The primary aim was to empower Filipinos and enhance the preparedness of government agencies, local government units (LGUs), and educational institutions for the adoption of 5G technology in the Philippines (mb.com.ph, 2021). These webinars saw the active participation of more than 700 government employees from the DICT and various other government agencies.

The series of six workshops on emerging technologies took place between June and November, covering a wide array of topics, including 5G, the digital economy, artificial intelligence and big data, cloud computing, and cybersecurity. (backendnews.net, 2021). This program has effectively raised awareness among government employees about various emerging technologies. The DICT's awareness program is designed to encourage the utilization of these emerging technologies, enabling government personnel to harness their full potential for both their professional duties and daily activities.

- Tech Trends Program. A year later, the DICT launched the Tech Trends Program on April 28, 2022, by the ICT Industry Development Bureau (IIDB), with the primary objective of heightening awareness and fostering dialogue concerning the advancement of the ICT industry. The Tech Trends project encompasses seven distinct tracks that participants can select from, including Data Analytics, the Internet of Things (IoT), Blockchain, Artificial Intelligence, Cybersecurity, Cloud Computing, and the Gig Economy (newsbyte.ph, 2022).

During the launch, several partners, including Asia IoT Business Platform (AIBP), Analytics Association of the Philippines (AAP), Microsoft, Women in Blockchain, Amazon Web Services (AWS), Payoneer, Senti Ai, and Digital Pilipinas, as well as the National ICT Confederation of the Philippines (NICP), Philippine Society of IT Educators (PSITE), Chief Information Officers Forum Foundation Inc. (CIOFF), Chief Information Officers Forum, Inc. (CIOF), and Filipina Homebased Moms (FHMoms), are present that participated and voiced their support for the program.

They emphasized how the program aligns with and can contribute to the objectives of their respective organizations. (dict.gov.ph, 2021) The DICT's programs facilitate discussions that encourage participants to pose questions and express concerns about emerging technologies. Furthermore, these initiatives enable the agency to collect valuable insights from diverse sectors, shedding light on the challenges and requirements associated with the adoption of these emerging technologies.

- Startup Grant Fund. Aims to assist the development of emerging technologies is the Start-up fund. Section 11 of Republic Act 11337, commonly referred to as the Innovative Startup Act, the DICT establishes the Start-up Grant Fund. This fund is designed to offer financial grants to new and early-stage startups, with a specific focus on supporting their development, enhancing their capabilities, and fostering network building (Dela Cruz, 2022).

The grant, catering to early-stage ICT-based startups who wish to develop their products or services, shall sustain its goal by guiding grantees in order to successfully (1) create a prototype or (2) create a minimum viable product (MVP) (startup.gov.ph, 2023).

This program is of utmost importance to technopreneurs who aspire to innovate and develop emerging technologies but lack the necessary financial resources and support to bring their technological projects to fruition.

- International Engagement with ITU Council. To support their initiatives, the DICT joined the International Telecommunication Union (ITU) Council 2023. As highlighted in the article shared by the Department of Information and Communications Technology (DICT) on their LinkedIn account, their

involvement in the International Telecommunication Union (ITU) Council 2023 is noteworthy. Through this council, the Philippines assumes a leading role in shaping universal technical standards, promoting knowledge sharing and capacity building, and offering policy guidance for the responsible and inclusive adoption of emerging technologies.

The country's active participation in the highest policymaking body for Information and Communications Technology (ICT) within the United Nations allows it to contribute to the formulation of guidelines and strategies. This involvement aids the Philippines in overseeing the use and advancement of emerging technologies and facilitates the implementation of programs geared toward ensuring that Filipinos have comprehensive access to these emerging technologies.

- National Broadband Plan and "Broad Band ng Masa" Project. Aims to provide access to various emerging technologies. The National Broadband Plan, initiated by the Department of Information and Communications Technology (DICT) in 2016 during the Duterte administration, aimed to provide free public WiFi access and enhance the overall internet speed in the Philippines (Ronquillo, 2017).

In 2022, President Marcos, in his first State of the Nation Address (SONA), acknowledged the growing digitalization and the increasing digital divide, leading him to assign the DICT with the task of deploying digital connectivity to cover the country's various islands. This initiative was launched as the "Broad Band ng Masa" project under the National Broadband Plan (pco.gov.ph, 2022). Through this program, every Filipino will have the opportunity to access emerging technologies inclusively, even in remote areas.

- National Cybersecurity Plan. The national cybersecurity strategy is designed to protect the critical infrastructure, government systems, and military networks of the Philippines. Its objectives include enhancing the country's ability to respond to cyber threats, collaborating with law enforcement agencies, and fostering a society that is well-informed about cybersecurity (Navallo, 2022). The current plan in place is the NCSP 2022, with plans for a new national cybersecurity strategy spanning from 2023 to 2028 aimed at ensuring compliance with globally recognized cybersecurity standards, protocols, and best practices (Balinbin, 2022).

This initiative by the DICT aims to enable Filipinos to harness the benefits of emerging technologies while simultaneously shielding them from potential threats associated with these advancements.

3) Department of Trade and Industry (DTI)

DTI is responsible for realizing the country's goal of a globally competitive and innovative industry and services sector that contributes to inclusive growth and employment generation. (dti.gov.ph, n.d). The agency also plays a role in regulating the development and supporting the use and innovation of emerging technologies:

Table.5. Initiatives of DTI in promoting 4th Industrial Evolution (Source: https://innovate.dti.gov.ph/programs)

Programs / Initiatives	**Objective**
Inclusive Innovation Industrial Strategy	Aims to grow innovative and globally competitive manufacturing, agriculture and services industries, while strengthening their linkages in the global value chain to achieve an inclusive and sustainable growth that generates more opportunities for employment and entrepreneurship in the country.
Digital Transformation Collaboration with Siemens	DTI and Siemens will partner to advance the digital transformation of the Philippines' industrial sector by introducing state-of-the-art automation and digitalization technology to specific industries.
Industry 4.0 Pilot Factory	A program that will incorporate cutting-edge manufacturing technologies, including advanced robotics, Internet of Things (IoT) intelligence, drones, and virtual and augmented reality for simulating factory operations, among other innovations.
ASEAN SME Academy	It is an online learning platform which was built in 2016 as a joint initiative between US-ABC, USAID, and the ASEAN Coordinating Committee on Micro, Small, and Medium Enterprises (ACCMSME).
Securing Manufacturing Revitalization and Transformation (SMART)	The program's primary objectives include promoting the integration of Industry 4.0 technologies, solutions, and business models, facilitating industry-driven innovation and research and development, enhancing global value chain capabilities, establishing industry standards, and encouraging technology-intensive investments, particularly in rural regions.
Artificial Intelligence (AI) Roadmap	Aim to provide an analysis of the impact of AI on Philippine agribusiness, manufacturing, and services industries and the country's workforce and recommend policies and programs to achieve the

	country's target of becoming a center for AI in the region.
Philippine Skills Framework. A collaboration with SkillsFuture Singapore (SSG)	The goal is to improve the human capital in the Philippines by providing opportunities for reskilling and skills upgrading of the country's workforce. This preparation is crucial to align their abilities with the requirements of industry and the ever-evolving demands of the global market, particularly in the context of the Fourth Industrial Revolution.

The table presented above displays a range of undertakings by the Department of Trade and Industry (DTI) aimed at enhancing and fostering innovation. These initiatives encompass the advancement of emerging technologies to drive the nation's technological innovation and provide assistance for the commercialization of these inventive technologies. The following section outlines several projects that DTI has undertaken and is presently carrying out.

- Inclusive Innovation Industrial Strategy. ItThe Inclusive Innovation Industrial Strategy is a key agenda of the Department of Trade and Industry (DTI), with the primary objective of fostering the growth of innovative and globally competitive manufacturing, agriculture, and services industries. This strategy emphasizes the strengthening of global value chain linkages to achieve inclusive and sustainable growth, ultimately creating more employment and entrepreneurial opportunities within the country (innovate.dti.gov.ph, 2021). Among the six strategic actions outlined in this agenda, one significant focus is on the adoption of Industry 4.0 technologies.

Industry 4.0, in essence, involves the integration of intelligent digital technologies into manufacturing and industrial processes. This integration encompasses a set of technologies, some of which are well-known emerging technologies, including industrial IoT networks, artificial intelligence, Big Data, robotics, and automation (sap.com, n.d). The central aim of this initiative is to prioritize the incorporation of these emerging technologies into manufacturing processes, often referred to as "Smart Factories." Industry 4.0 is fundamentally reshaping the way companies manufacture, enhance, and distribute their products through the seamless integration of these advanced technologies (ibm.com, n.d).

- Digital Transformation Collaboration with Siemens. In a 2019 report by The Philippine Business and News, it was highlighted that the Department of Trade and Industry (DTI) had formed a collaboration with Siemens. Siemens was chosen as the digital transformation partner to offer technological solutions to manufacturing companies in the Philippines. Siemens is actively engaged in cooperation with the government, educational institutions, and the private sector to support the digital transformation endeavors of Filipino manufacturers. This partnership aims to tap into the potential of industries by promoting Industry 4.0 technologies, which involves integrating emerging technologies into various sectors, including manufacturing, in the Philippines (thephilbiznews.com, 2019).
- Industry 4.0 Pilot Factory. In a 2022 report by the Philippine News Agency titled "DTI to Open P400-M Cutting-Edge Tech Factory in 2023," it was revealed that the Department of Trade and Industry (DTI) has ambitious plans to inaugurate an Industry 4.0 pilot factory in Calabarzon. This facility is designed to be a testament to the DTI's commitment to its Inclusive Innovation Industrial Strategy (i^3S), aimed at fostering innovation and enhancing the global competitiveness of Philippine industries.

The Industry 4.0 pilot factory is set to showcase cutting-edge technologies, including robotics, the Internet of Things (IoT), drones, and virtual and augmented reality, among others. This initiative is expected to provide local micro, small, and medium enterprises (MSMEs) as well as startup businesses with access to these emerging and advanced technologies.

4) Siemens and Unionbank have joined hands as partners in this pioneering initiative by the DTI (Crismundo, 2022).

- ASEAN SME Academy. The ASEAN SME Academy, established in 2016 through a collaborative effort involving the US-ASEAN Business Council (US-ABC), the United States Agency for International Development (USAID), and the ASEAN Coordinating Committee on Micro, Small, and Medium Enterprises (ACCMSME), serves as an officially recognized online educational platform in the ASEAN region. It operates under the joint administration of the US-ABC, the Bureau of Small and Medium Enterprise Development (BSMED) under the Philippines Department of Trade and Industry (DTI), and the Philippine Trade and Training Centre (PTTC) (ASEAN SME Academy 2.0 Launching Event, 2022).

The Academy offers access to approximately 90 courses, curated from 15 prominent U.S. companies, covering a diverse array of subjects. These subjects span across finance and accounting, operational procedures, marketing strategies, and trade and logistics. Notably, among the diverse course offerings, digital marketing and payments emerge as two of the most highly sought-after topics among small and medium-sized enterprises (SMEs) (Michalak, 2022).

Additionally, the Academy features courses related to the utilization of Emerging Technologies for SMEs, including Internet of Things, Google Cloud Training, Big Data, and

Machine Learning (asean-sme-academy.org, n.d). These courses play a pivotal role in assisting SMEs in harnessing advanced technologies to maximize their business potential.

- Securing Manufacturing Revitalization and Transformation (SMART). This program is designed to facilitate the adoption of Industry 4.0 technologies, solutions, and business models, as well as promote industry-led innovation and research & development. It also focuses on upgrading global value chains, developing standards, and encouraging technology-intensive investments, particularly in rural areas (innovate.dti.gov.ph, n.d). The program was introduced by DTI in 2019 to assist the industrial sector in transitioning to Industry 4.0, with the following support measures as outlined by a report in OpenGov.ph (umali, 2020)

1. Soft loans
2. Grant vouchers
3. Incentives through the Strategic Investment Priorities Plan (SIPP)
4. Safeguard measures
5. Fund support, which is similar to the Comprehensive Automotive Resurgence Strategy (CARS) Program
6. Reduction in trade barriers

To implement these measures effectively, the Department proposed a budget of PHP 25-30 billion, intended to support small, medium, and large companies over a 3-year period (Talavera, 2019). This program is expected to play a crucial role in aiding the industrial sector as it embraces the technologies associated with the fourth industrial revolution, including emerging technologies in the manufacturing sector.

- Artificial Intelligence (AI) Roadmap. In 2021, the Department of Trade and Industry (DTI) introduced the national Artificial Intelligence (AI) Roadmap, making the Philippines one of the pioneering 50 countries globally to establish a national strategy and policy for AI, as reported by Ponti in 2021.

As per the information provided on the AI Roadmap within DTI's official website (innovate.dti.gov.ph, n.d), the primary purpose of this roadmap is to recognize the significance of AI, one of the emerging technologies, in driving swift transformation across various industries. AI is acknowledged as one of the most disruptive technologies, offering substantial potential to impact businesses, industries, societies, and economies significantly. According to a recent report from PwC, AI has the potential to contribute a staggering $15.7 trillion to the global economy by 2030 and more than $92 billion to the Philippine economy.

The roadmap delineates the necessary steps, infrastructure, and investments to address four crucial dimensions for AI readiness, which are: (1) Digitization and Infrastructure, (2) Research and Development, (3) Workforce Development, and (4) Regulation.

This roadmap aims to establish regulations for governing AI technologies and applications, facilitating the adoption of AI technologies to enhance efficiency and productivity across various sectors.

- Philippine Skills Framework. Through a partnership with SkillsFuture Singapore (SSG), the Department of Trade and Industry (DTI) introduced the Philippine Skills Framework (PSF) Initiative. This inter-agency collaboration is dedicated to enhancing the skills and competencies of the Philippine workforce, ensuring their readiness for the future economy (innovate.gov.ph, 2021).

The objective of this initiative is to reskill and upskill the workforce, ultimately creating a future-ready Filipino workforce. With these efforts, Filipinos will gain the skills necessary to effectively embrace emerge.

In summary, these initiatives collectively create an environment where emerging technologies are not only adopted but also integrated into various sectors of the economy, resulting in several key outcomes:

- Economic Growth: These initiatives are pivotal in driving economic growth by focusing on key sectors such as manufacturing, agriculture, and services. The adoption of emerging technologies enhances the competitiveness of these industries on a global scale.
- Competitiveness: The integration of Industry 4.0 technologies enhances the competitiveness and efficiency of businesses. "Smart Factories" streamline production processes and elevate product quality, making them more competitive in the market.
- Technology Transfer: Collaborations, such as with Siemens, facilitate the transfer of cutting-edge technologies to local manufacturing companies. This enables these companies to access advanced solutions and adopt Industry 4.0 practices.
- Technology Showcase: The Industry 4.0 pilot factory serves as a demonstration of advanced technologies, allowing local enterprises to visualize the potential of these technologies and gain practical experience, encouraging their adoption.
- Skills Development: Offering courses in digital marketing, IoT, Big Data, and Machine Learning is essential for preparing small and medium-sized enterprises (SMEs) to leverage emerging technologies, enabling them to remain competitive in the digital age.
- Technology Adoption: Initiatives like SMART support the adoption of Industry 4.0 technologies by providing essential measures and reducing trade barriers. This modernizes the manufacturing sector,

enhancing its global competitiveness.

- Global Competitiveness: The establishment of a national AI strategy places the country on the global map for AI development. AI is a transformative technology that enhances productivity across various sectors, making local industries more competitive.
- Workforce Preparedness: With emerging technologies continually shaping industries, having a skilled and adaptable workforce is essential. The Philippine Skills Framework ensures that the labor force is ready to meet the challenges and opportunities presented by advanced technologies.

Overall, these initiatives not only boost the competitiveness of local industries but also ensure that the workforce is equipped with the necessary skills to harness these technologies. Consequently, the country is better positioned to thrive in the digital age and the global economy.

5) National Privacy Commission (NPC)

From their LinkedIn profile, it becomes evident that this organization serves as the nation's privacy regulatory authority, functioning as an independent entity responsible for administering and enforcing the Data Privacy Act of 2012. Additionally, it monitors and ensures the country's compliance with international data protection standards, as stipulated in Republic Act 10173, which established the Data Privacy Act of 2012.

In keeping pace with evolving technology, the agency hosted the 52nd Asia Pacific Privacy Authorities (APPA) Forum in Cebu in 2019. This event brought together privacy commissioners from the Asia Pacific region, along with guest ASEAN representatives, who gathered at the Shangri-La's Mactan Resort and Spa on December 2-3, 2019. The forum's discussions encompassed best practices, the formation of partnerships, the exchange of information on emerging technology and trends, and the exploration of new policy directions across the region (Dagooc, 2019).

Privacy Commissioner Raymund Enriquez Liboro, speaking during the event, emphasized the agency's commitment to engaging in thoughtful discussions and collective action to address evolving privacy challenges driven by technological advancements (“PH to host 52nd APPA Forum in Cebu,” 2022).

In addition to its primary role of enforcing Republic Act 10173, the agency is actively engaged in several other initiatives. One notable endeavor is its proactive participation in the 52nd Asia Pacific Privacy Authorities (APPA) Forum that took place in Cebu in 2019. Furthermore, the agency is deeply involved in the proactive regulation of emerging technologies to safeguard data privacy. It collaborates with diverse organizations to address the challenges presented by these advancing technologies.

6) Intellectual Property Office of the Philippines (IPOPHL)

As per their LinkedIn profile, the Intellectual Property Office of the Philippines (IPOPHL) serves as a governmental body responsible for safeguarding and upholding the exclusive rights of individuals, including scientists, inventors, artists, and other talented citizens, regarding their intellectual property creations. This protective role is particularly significant when these creations hold the potential to benefit the public, and the duration of this protection adheres to the stipulations of relevant laws.

IPOPHL plays a central role in the realm of emerging technologies by actively engaging with intellectual property matters and promoting the dissemination of knowledge. Through a diverse array of initiatives and programs, IPOPHL seeks to equip individuals, particularly within the ASEAN region, with the necessary tools and expertise to effectively address the challenges and opportunities presented by emerging technologies.

Their webinars, such as the "IP and Emerging Technologies – with Special Focus on Artificial Intelligence," illustrate a commitment to fostering understanding and awareness of intellectual property issues within the context of rapidly evolving technologies. By addressing subjects such as generative Artificial Intelligence, the Internet of Things, Metaverse, Blockchain, and Non-Fungible Tokens, IPOPHL aids stakeholders in recognizing the importance of intellectual property protection in these innovative domains. Furthermore, exploring the intersection between artificial intelligence and human creativity within the scope of copyright law underscores the dynamic nature of intellectual property in the digital age (ilaw.ipophil.gov.ph, n.d).

In addition to webinars, IPOPHL's organization of the 2023 MCLE (Mandatory Continuing Legal Education) program for lawyers underscores its dedication to enhancing expertise within the legal community. This program equips legal professionals with the knowledge and skills necessary to navigate the complexities of intellectual property and technology law, which are continually evolving. The program's extensive curriculum, led by expert lawyers and subject matter specialists, covers patents, trademarks, copyrights, as well as the legal and ethical challenges arising from new technologies like the internet, blockchain, and artificial intelligence (ipophil.gov.ph/mcle-on-ip-and-technology-laws/, n.d).

IPOPHL's role in the realm of emerging technologies is multifaceted. It not only safeguards the intellectual property rights of creators in the Philippines by enforcing Republic Act No. 8293 or the Intellectual Property of the Philippines but also contributes to a broader understanding of intellectual property in the context of innovative technologies. Through its initiatives and programs, IPOPHL empowers individuals, including IP officials, researchers, technology specialists, policymakers, and legal professionals, to effectively address the evolving landscape of intellectual property in the digital age. By doing so, IPOPHL plays a central role in fostering innovation and ensuring the upholding of intellectual property rights within a rapidly changing technological environment.

7) Philippine Finance & Technology (PhiliFinTech) Innovation Office

Fintech, a shortened term for Financial Technology, is

defined by Investopedia as a novel technology aimed at enhancing and automating the delivery and utilization of financial services (Kagan, 2023). BuiltIn.com also characterizes it as a fusion of "financial" and "technology," signifying the application of recent technological advancements to products and services in the financial sector (Daley, 2022).

In order to regulate these Fintech entities, the Securities and Exchange Commission (SEC) introduced the Philippine Finance & Technology (PhiliFinTech) Innovation Office (PIO) on July 30, 2021. The primary role of this office is to oversee the fintech industry with the goals of promoting financial inclusion and safeguarding the interests of consumers and investors. Operating under the Corporate Governance and Finance Department (CGFD), the PhiliFintech Innovation Office (PIO) will concentrate on regulating the utilization of fintech or financial technology in the Philippines (Hani, 2021). The establishment of this office is grounded in the SEC's mandate to oversee innovative trading markets and technology-driven ventures, as prescribed by Republic Act No. 8799, also known as the Securities Regulation Code (pna.gov.ph, 2021).

8) The PIO is mandated to accomplish the following objectives (Hani, 2021):

- Bridge gaps in consumer and investor protection while simultaneously fostering financial inclusion, integrity, and stability through a dedicated focus on the regulation and advancement of fintech activities.
- Formulate well-informed policies for both new and existing fintech innovators.
- Equip the SEC with the necessary expertise to effectively regulate fintech activities and cultivate an environment of innovation in the corporate sector.

In summary, the PhiliFinTech Innovation Office (PIO) in the Philippines functions as a regulatory body and advocate for emerging fintech technologies. Its responsibilities encompass the regulation of fintech, the safeguarding of consumers and investors, the advancement of financial inclusion, policy development, expertise enhancement, and the encouragement of innovation within the financial services sector. By carrying out these functions, the PIO facilitates the responsible and secure adoption of emerging technologies within the realm of financial services.

4. Conclusion

Based on the research findings, the researchers have reached these conclusions:

The country has established comprehensive legal frameworks and programs for the regulation of the development and utilization of emerging technologies.

Legal frameworks have been implemented to protect users of emerging technologies, exemplified by acts like the Cybersecurity Prevention Act of 2012 and the Data Privacy Act of 2012. These frameworks are considered integral in the development of emerging technologies, safeguarding people from potential harm and associated risks. The absence of such legal structures could lead to the misuse of emerging technologies for malicious purposes or to gain an unfair advantage.

In addition to user protection, legal frameworks such as the Philippine Technology Transfer Act and the Intellectual Property Code of the Philippines provide crucial protection for technology developers, including those working on emerging technologies. These provisions create an environment that fosters innovation, where developers can focus on creating emerging technologies with confidence that their efforts will be acknowledged, potentially leading to patents, copyrights, or trademarks.

The country has also established legal frameworks designed to support innovators in the creation and enhancement of emerging technologies, such as the Innovative Startup Act. This law offers a range of incentives and benefits for startups, including grants, subsidies, access to venture capital, and expedited application processing, among other advantages. The Philippine Innovation Act further aligns micro, small, and medium enterprises (MSMEs) with the transformative potential of emerging technologies.

Legal frameworks for the use of emerging technologies are in place to enhance the digital competitiveness of the government workforce by maximizing the adoption of technologies, including emerging ones. The E-Commerce Act promotes the use of technologies to facilitate electronic commerce, including emerging technologies, to strengthen both e-commerce and the broader national economy.

The researchers have also identified various government agencies and initiatives responsible for regulating the development and use of emerging technologies, such as the Department of Science and Technology (DOST), the Department of Information and Communications Technology (DICT), and the Department of Trade and Industry (DTI). These agencies offer initiatives like the Concept Prototyping Program, the Technology Innovation for Commercialization Program (TECHNiCOM) of DOST, and the Startup Grant Fund of DICT, among others.

Collaborative efforts with other countries and private organizations are evident in promoting the development and use of emerging technologies. Memoranda of Understanding between DOST and the US-ASEAN Business Council, as well as joint initiatives with the USAID and the ASEAN Coordinating Committee on Micro, Small, and Medium Enterprises (ACCMSME), underscore the commitment to advancing government-driven research, technology, and innovation projects in the commercial sector.

Sub-agencies have been established to ensure the effective implementation of laws created to protect users and developers. Examples include the National Privacy Commission for the Data Privacy Act of 2012 and the Intellectual Property Office of the Philippines for the Intellectual Property Rights Law, both crucial in regulating emerging technologies to protect users and developers.

Numerous programs identified in the research demonstrate the country's concerted efforts to regulate the development and use of emerging technologies while prioritizing user protection.

In summary, the researchers conclude that the country has established regulatory frameworks that encompass emerging technologies. These efforts and plans by the government are poised to have a significant positive impact on developers (startups) and industries, facilitating the responsible use and maximization of emerging technologies while ensuring compliance with legal frameworks to safeguard users, developers, and the nation as a whole.

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