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Harnessing government's role for the Fourth Industrial Revolution

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New, innovative, emerging technologies are being used more than ever across homes, factories, farms, cities, and nations. These are disrupting traditional commerce and business models, thus ushering the Fourth Industrial Revolution (FIRe). Also known as Industry 4.0, the FIRe is "characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres" (Schwab 2016).

This *Policy Note* describes how the main FIRe technologies are altering patterns of consumption and production, which are not only resulting in opportunities for productivity growth but also heralding a lot of uncertainty, including likely unintended consequences. It also discusses extensively the need for government to take a decisive action particularly in instituting regulatory reforms in preparing the current and future workforce for future jobs, and in strengthening social protection to counter the likely negative effects of the FIRe.

What is the FIRe?

Throughout history, industry has radically improved by moving away from using established production methods to employing cutting-edge technologies. These improvements have yielded profound impacts, such as increased productivity, improved accuracy and precision of manufacturing processes, and reduced labor costs—all of which are considered an industrial revolution (Landes 1969).

The first three industrial revolution involved the use of steam and water power (in the mid-1700s), then electricity and assembly lines (in the latter half of the 19th century), then computerization (toward the end of the last millennium). Now, we are transitioning to the era of the Fourth Industrial Revolution, also called FIRe in this Note. What makes the FIRe a revolution is not the technologies that come along with it, as they (e.g., robots, computers, digital platforms, wireless connectivity) have been around for some time. What makes this period different is the interaction or fusion of these technologies in ways that have not been

done before. Although there is some disagreement whether FIRe is separate to, or an extension of Industry 3.0, there is no debate about the disruptions it brings to industry and society (Rifkin 2016).

What are the frontier technologies of the FIRe and how will they affect us?

Different organizations have identified various frontier technologies that are powering up the FIRe, but the commonly identified technologies include robotics, artificial intelligence (AI), internet of things, and 3D printing (WEF 2017; UNESCAP 2018). The FIRe can bring us closer to attaining sustainable development goals and targets, including increasing prosperity, attaining food security, improving health care, and caring better for the planet (UN 2015). These aspirations are mainstreamed in the Philippines' development plans and long-term vision (NEDA 2016; NEDA 2017).

Frontier technologies of the FIRe can be powerful agents for good, but they also involve risks. The late physicist Stephen Hawking suggested that AI provides an existential threat to humanity (Cellan-Jones 2014). Nobel laureate Joseph Stiglitz warns that inequalities existing in society will become even larger as a result of Industry 4.0 (Stiglitz 2017). Disruptions to traditional business models and processes are happening, and thus the FIRe frontier technologies can yield uncertainties, particularly in the future job market.

From 2005 to 2015, jobs created by rising domestic demand in developing Asia have compensated for job losses from automation (ADB 2018). However, this does not mean that the future will behave like the past. A study of the International Labour Organization (ILO) suggests that over the next decade or two, more than half (56%) of jobs in five Southeast Asian countries (Cambodia, Indonesia, Philippines, Thailand, Viet Nam) are at high risk of automation (Chang and Huynh 2016). The same ILO report suggests that in the Philippines, women, as well as workers who finished only primary school or less, are more likely to be in jobs that are at high risk of automation. Jobs in the information technology–business process management sector are also estimated to have 9 out of 10 workers at high risk of getting affected.

The phenomenon of technology affecting jobs, however, is not equivalent to that of technology replacing labor. New technologies often automate only some tasks and not the entire job. For instance, the introduction of automated teller machines did not eliminate bank tellers; it even increased their number with the addition of new tasks such as customer relationship management (Autor 2015). Technology can also complement labor and create new jobs.

How the Philippines can successfully navigate through the FIRe depends crucially on its capability to cope with the disruptive consequences to the job market. Concomitant to some losses in jobs with repetitive tasks is a likely rise in inequality, uncertainties in security, and other possible unintended consequences across various domains (Table 1).

Regardless of how one views the effect of technology on jobs, specifically of AI and robotics, there is unanimity in recognizing that some jobs will be displaced. Autor (2015) argues that the threat of machine substitution for human labor is overstated but also warns that even if robots and AI do not reduce the quantity of jobs, automation may affect the qualities of jobs that are available.

How prepared are we for the FIRe?

The World Economic Forum (WEF) has assessed the future readiness of 100 countries by examining structures of production, as well as the drivers

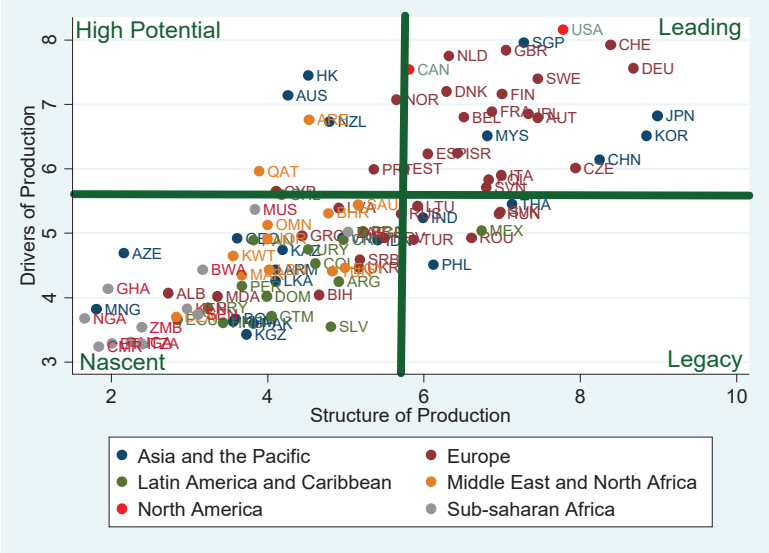
Table 1. Potential consequences of frontier technologies of the Fourth Industrial Revolution

	Economic Implications	Sociocultural Implications	Political and Security Implications
Robotics and artificial intelligence	Technological unemployment	Rise of monopolies and oligopolies	Political polarization
	Income inequality		Instability
	Disruption of traditional business models and global value chains		Data and access security risks to automation
			Espionage and terrorism
			Use of autonomous warfare
Internet of things	Disruption of traditional business models	Erosion of personal privacy	Lack of trust in institutions
			Cybersecurity
			Data fraud
3D printing	Disruption of existing business processes		Weapons proliferation
			Cyber sabotage

Source: Adapted from Tan and Shang-su (2017)

of production (WEF 2018). The seven Association of Southeast Asian Nations (ASEAN) member-states included in the assessment are spread across three archetypes: (1) Leading—Malaysia and Singapore; (2) Legacy—Philippines and Thailand; and (3) Nascent—Cambodia, Indonesia, and Viet Nam. Singapore, Malaysia, China, and several rich economies are leading in the preparations for Industry 4.0, on account of past investments in building their innovation ecosystems. As a legacy country, the Philippines has a strong production base, but it is at risk for the future due to its weak performance across the drivers of production, which include technology and innovation, human capital, global trade and investment, institutional framework, sustainable resources, and the demand environment (Figure 1).

Figure 1. Future readiness of 100 countries in terms of structures and drivers of production



Source: World Economic Forum (2018)

For developing countries such as the Philippines, the diffusion of technology depends both on access to foreign technology and ability to absorb technology (WB 2010). Trade, foreign direct investment, international migration, and networks (including information networks such as the academe and media) act as transmission channels while factors such as quality of government policy and institutions, stock of human capital, research and development (R&D) efforts, and the financial system, among others, determine absorptive capacity for new technologies.

The Philippines faces challenges in advancing science, technology, and innovation (STI) with only two out of five firms being innovation active as of 2015 (Albert et al. 2017). Furthermore, the country ranks 73rd out of 127 economies in the 2018 Global Innovation Index (GII), an overall measure of the innovation climate (Cornell University et al. 2018). Out of seven ASEAN member-states, it ranks fifth, behind Singapore, Malaysia, Thailand, Viet Nam, but ahead of Indonesia and Cambodia. Further examination of the GII components shows that although the Philippines tops exports of information and communications technology (ICT) services in ASEAN, it is second lowest (next only to Indonesia) in scientific and technical publications. As for institutions, the country ranks lowest in ASEAN in political stability and absence of violence/terrorism, and second lowest (next to Cambodia) in ease of starting a business.

Various studies on innovation point out that countries that are not in the forefront of STI have difficulties in making catch-ups and leapfrogs (Cirera and Maloney 2017). Additional financial investments in R&D alone are not enough. Hard and soft infrastructure, as well as capacity development of human resources and institutions, are complementary factors to R&D investments in improving readiness to the FIRe.

In recent years, the country's innovation ecosystem has been getting increased financing and support. The Department of Trade and Industry is working with several agencies on implementing the country's industrial road map called the Inclusive, Innovation-led Industrial Strategy (i3S, also known as "i-cube"). The Department of Science and Technology is also working on support for several programs, especially the Science for Change Program (S4CP), the *Balik* Scientist 2.0 program, and the Small Enterprise Technology and Upgrading Program (SETUP).[1] The Department of Information and Communications Technology is also addressing coverage, price, and quality of internet; developing a successor to the Digital Strategy; and implementing a National Broadband Plan e-Government Master Plan. However, it is important to know if the impact of these initiatives is maximized, if efforts are well coordinated, and if there are duplications that can be put to better use elsewhere.

How should government respond to the emerging FIRe landscape?

Borrowing the analogy articulated in a report of the World Bank on innovation (WB 2010) (Figure 2), the government should be like a good gardener, which "prepares the ground" (i.e., building up human resources); "fertilizes the soil" (i.e., boosting R&D); "waters the plant" (i.e., providing financial support for innovation), and "removes weeds and pests" (i.e., removing regulatory, institutional, or competitive obstacles to innovation).

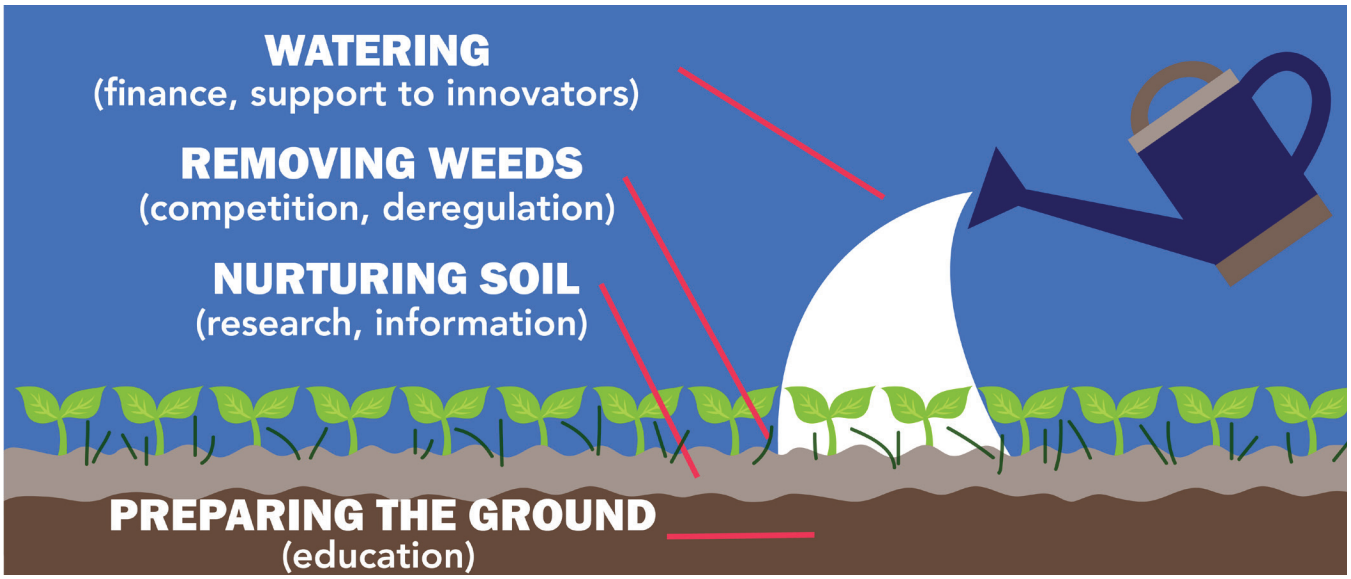
Develop human capital

The WEF lists and describes future skills required and clusters them into three groups, namely, (1) foundational literacies, (2) competencies, and (3) character qualities (WEF 2015).[2] The introduction of the K to 12 Program through the Enhanced Basic Education Act of 2013 (Republic Act [RA] 10533) is the most radical change to basic education in recent

[1] The S4CP entails massive investments in science and technology education, training, and services to significantly accelerate STI toward social progress and global competitiveness. The Balik Scientist 2.0 program provides improved benefits and incentives to Filipino scientists, engineers, and innovators of Filipino descent residing overseas who return to the country and work for national development. The SETUP aims to help micro, small, and medium enterprises improve their productivity and efficiency by addressing the technological needs and constraints of firms.

[2] The foundational literacies are the basis on which students will build the competencies and character qualities. The competencies are what is needed to face complex challenges. Finally, the character qualities are what students need to navigate changing environments.

Figure 2. Gardening innovation



Source: Adapted from World Bank (2010)

years. It made kindergarten mandatory, adding two years to secondary education, aside from other institutional reforms. But are these changes enough to prepare our future workforce for future jobs? Are there opportunities for lifelong learning (WB 2018)?

Improve STI investments

The bulk (60%) of R&D spending across sectors is supported by government. While the Philippines has had a slight increase in R&D expenditure to the gross domestic product (GDP) in recent years, this spending is still less than a fifth of 1 percent of GDP, which is below the 1-percent benchmark recommended by the United Nations Educational, Scientific, and Cultural Organization, and the level of spending of several ASEAN member-states, especially Singapore (2.4%) and Malaysia (1.3%). Even if the Philippines spends more on R&D, there are concerns about absorptive capacity as well as complementary factors for innovation that may be absent. There are a lot of missing requirements—sizeable investments, competent human resources, R&D support and incentives, and an improved ICT infrastructure to bring the unconnected groups, especially those in the rural areas, to the digital world. Leapfrogging seems a far-fetched dream.

Address regulatory barriers and bottlenecks to innovation

Removing weeds and pests is probably one role government has neglected the most given the significant restrictions to trade and investment as compared to other countries in the region and globally (OECD 2016). To hasten technology transfer and diffusion, there is an urgent need to remove the barriers including the burdensome regulations and procedures that add to the cost of doing business in the country.

The current procurement process should likewise be reformed to facilitate the work of those undertaking R&D in or on behalf of the government. The existing procurement system, which came about as a result of RA 9184, was designed to minimize corruption and increase transparency and accountability in government transactions. However, it has also made it

Sophia, a social humanoid robot, is an example of the application of artificial intelligence (AI), one of the frontier technologies of the Fourth Industrial Revolution (FIRe). As in the case of other frontier technologies, AI is also altering patterns of consumption and production, not only resulting in opportunities for productivity growth but also heralding a lot of uncertainty, including likely unintended consequences. As such, the government needs to take a decisive action particularly in instituting regulatory reforms, in preparing our current and future workforce for future jobs, and in strengthening social protection to counter the likely negative effects of the FIRe. (Photo: International Telecommunication Union/Flickr)

difficult for government agencies to procure external knowledge, technology, and other goods and/or services needed for innovation activities.

Various government agencies with regulatory functions play a critical role in creating an enabling environment that fosters technological upgrading and innovation. Regulators should be able to adapt to the emergence of new technologies, products, and business models. The regulatory sandbox approach used by many monetary authorities particularly in Singapore, Malaysia, and the United Kingdom that are working with financial technology services could provide useful lessons that other industry regulators in the country could replicate. This implies that regulatory capacities will need to be strengthened.

Strengthen social protection

The FIRe could possibly lead to job displacement. Some people may lack either the ability or the opportunity to reach their creative potentials and will thus require social protection, possibly even some universal basic income. However, public support for social protection has weakened, with most, especially those from middle- and upper-income families, preferring that government spend on entitlements such as free college education that have adverse effects to equity, possibly crowding out the poor from state universities that offer free tuition (Orbeta and Paqueo 2017).

Increasing social protection in developing countries to anticipate possible widening inequalities entails

having the political will to battle this sense of entitlement to social assistance, aside from working on progressive universalism that emphasizes expansion in overall coverage of social protection to the vulnerable class but prioritizing the most in need and vulnerable.

The government should also revamp pension models to make them responsive to the new realities of work and aging, including providing greater support for working into old age.

Furthermore, social security benefits need to be portable so that people do not experience loss of contributions and benefits from moving from one job to another, or even from one country to another. It is also important to increase public spending on active labor market policies that reduce labor costs (from providing labor security) or help people easily find jobs. Policies have to shift from job security to income security.

Reform taxation policy

All the social protection costs and human capital development can be borne by taxation reform, such as improving collection of property taxes, instituting subsidy reforms, and reducing tax avoidance. Currently, taxation reform is being instituted largely to fund infrastructure development plans and not with regard to needs for improving preparations for the FIRe.

Develop a whole-of-nation paradigm and action agenda

The effort to prepare the Philippines for the FIRe requires everyone to work together to steer emerging technologies in ways that limit risks and create a Philippines that aligns with common goals for the future. While it is difficult to see definitively how fast and to what extent the FIRe will disrupt our way of life, and to determine the links between the ways in which society responds to automation and the future pace of innovation, we should have a framework for assessing alternative possibilities and policies. We need a rough guide to the likely consequences of the FIRe so that we can have a "whole-of-nation" understanding of what is to come, and have an action agenda to improve our readiness for the future today.

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