Challenges and Opportunities facing Government in the Wake of #Industry4.0

Jose Ramon G. Albert, Ph.D.
and
Ramonette Serafica, Ph.D.

Philippine Institute for Development Studies
Surian sa mga Pag-aaral Pangkaunlaran ng Pilipinas

Agenda

1. What is the Fourth Industrial Revolution (FIRe)?
2. Potential impacts of FIRe
3. Preparing for FIRe
   - Readiness for future production
   - Industry 4.0 policies
   - Gardening innovation

What is the Fourth Industrial Revolution (FIRe)?

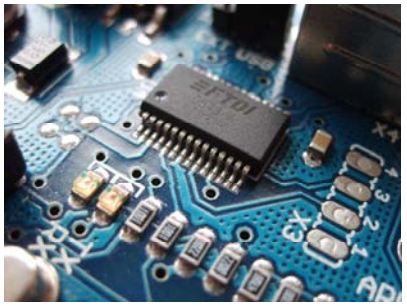
(INDUSTRY 4.0)

1. What is the Fourth Industrial Revolution (FIRe)?

First came steam and water power; then electricity and assembly lines; then computerization. Throughout history, we have improved industry by migrating from established production methods to utilizing cutting-edge technologies

1st Revolution
(1784)
Steam, water, mechanical production equipment

2nd Revolution
(1870)
Division of labor, electricity, mass production, assembly line



3th Revolution
(1969)
Electronics, computers, internet, automated production

4th Revolution
(???)
Cyber-physical systems

1. What is FIRe (cont'd)?

"*Characterized by a fusion of technologies that is blurring the lines between the physical, digital and biological spheres.*" – Schwab (2016)

1.1. Frontier Technologies in FIRe

Frontier technologies identified by select organizations (ESCAP, 2018)

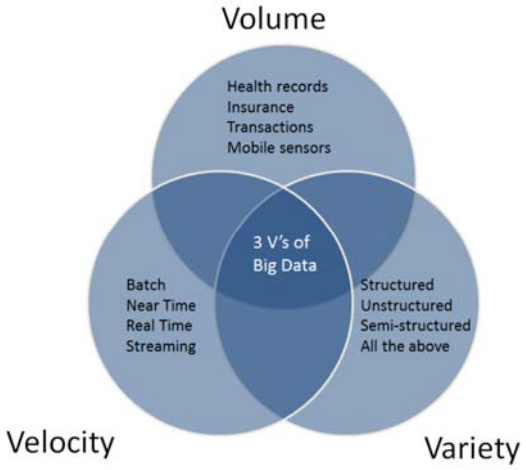
- No universally agreed definition of frontier technology

- It shows that the following technologies have been most commonly identified as frontier: 3D printing, the Internet of Things, AI, and robotics

OECD	World Bank	World Economic Forum	McKinsey Global Institute	Institute of Development Studies	MIT Technology Review 2018
Internet of Things	Fifth-generation (5G) mobile phones	Artificial intelligence	Mobile internet	3D printing	3D Metal Printing
Big data analytics	Artificial intelligence	Robotics	Automation of knowledge work	Collaborative economy tools	Artificial Embryos
Artificial intelligence	Robotics	Internet of Things	Internet of Things	Alternative internet delivery	Sensing City
Neuro technologies	Autonomous vehicles	Autonomous vehicles	Cloud technology	Internet of Things	Artificial intelligence for Everybody
Nano/micro satellites	Internet of Things	3D printing	Advanced robotics	Unmanned aerial vehicles/drones	Dueling Neural Networks
Nanomaterials	3D printing	Nanotechnology	Autonomous and near-autonomous vehicles	Airships	Babel-Fish Earbuds
3D printing (additive manufacturing)		Biotechnology	Next-generation genomics	Solar desalination	Zero-Carbon Natural Gas
Advanced energy storage technologies		Materials science	Energy storage	Atmospheric water condensers	Perfect Online Privacy
Synthetic biology		Energy storage	3D printing	Household-scale batteries	Genetic fortune-telling
Blockchain		Quantum computing	Advanced materials	Smog-reducing technologies	Materials' Quantum Leap
			Advanced oil and gas exploration		
			Renewable energy		

1.2.Example: Big Data

- While big data has no definition, it has **3Vs** (Gartner, 2001) **:**



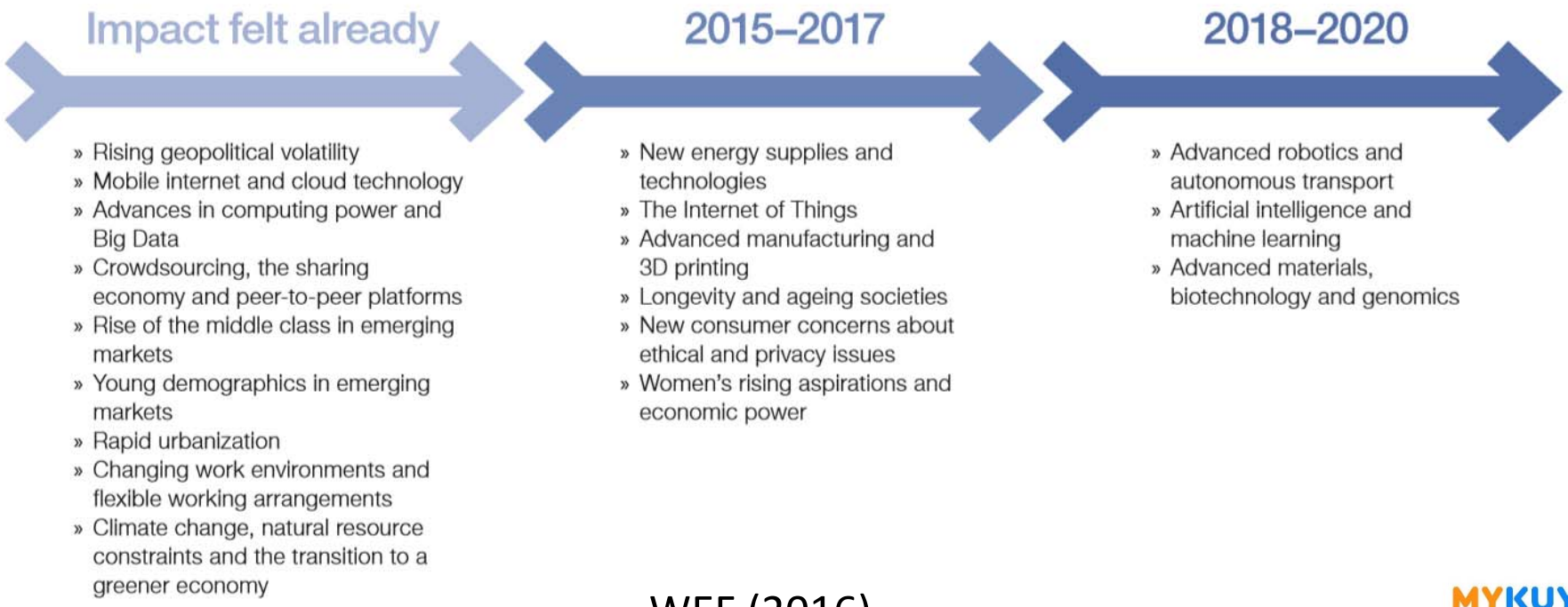
Information is power !

- Awash in a flood of data !!! : *"drowning in numbers"*
  - 25 years ago, the first SMS was sent. We now send 23 billion text messages worldwide every day — or 16 million every minute. We type 156 million emails, 452,000 tweets and 3.5 million queries into Google every 60 seconds.
  - **From** the **beginning of** recorded **time until 2003, we created 5 billion gigabytes** (exabytes) of data. **By 2012**, about 2.5 exabytes of data were created per day, or 5 exabytes created **every 2 days**.
  - **In 2016,** around 16.1 zettabytes of data has been produced — 1 zettabyte = 1021 bytes, enough to fill 320 billion 16GB iPhones (which would circle the earth more than 400 times). **5 exabytes** were then being created **every 10 minutes**. By 2025, 163 zettabytes would be produced.

DATA: "the new oil"
a driver of growth and change

Potential Impacts of the Fourth Industrial Revolution (FIRe)

Timeframe to impact industries, business models



WEF (2016)

MYKUYA
#YourHelpingHandOnDemand

2.1. Impact: Opportunities and Risks

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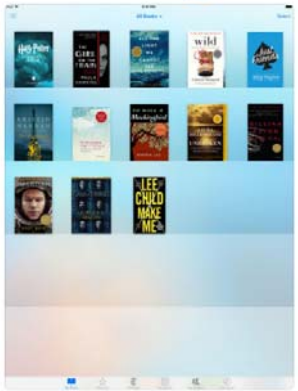
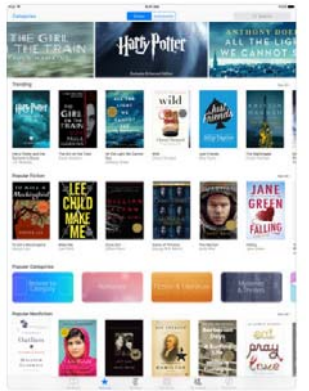
- From E-commerce to Digital Trade

Figure 1. Dimensions of digital trade[1]

Nature ('how')	Product ('what')	Actors ('who')
Digitally ordered	Goods	Business
Platform enabled	Services	Consumer
Digitally delivered	Information	Government

Source: López González and Jouanjean (2017); OECD (2017)





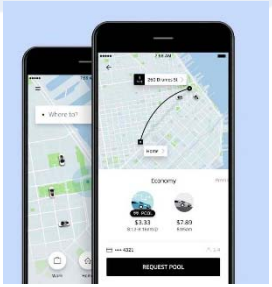
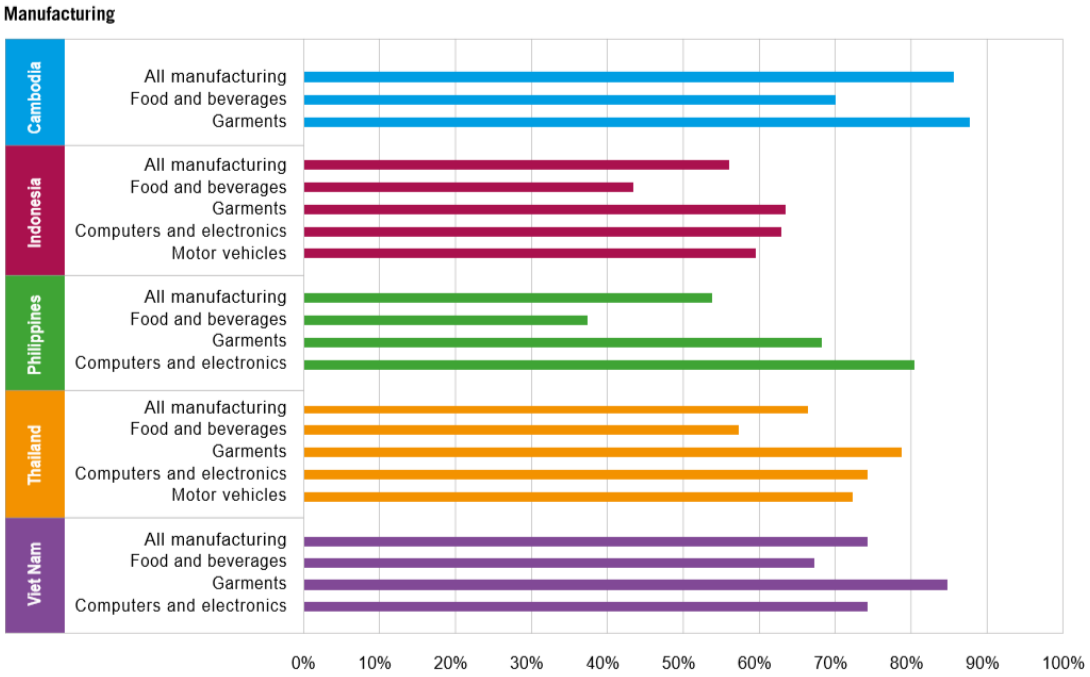


Figure 3. Share of wage and salaried employment in key **manufacturing** subsectors at high risk of automation (per cent).



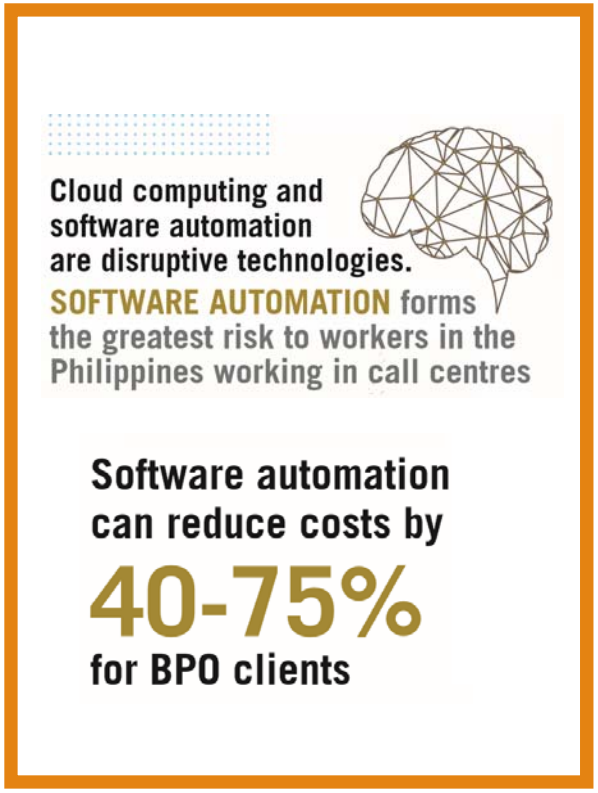
ILO (2016)

Acc to ILO, in the Philippines:

- nearly half (49%) of wage workers (males: 44%, females : 52%) face a high probability of getting affected by automation
- those working as fishery labourers (580,000), waiters (574,000), carpenters (525,000) and office cleaners (463,000) face a high potential of automation
- around 89 per cent of salaried workers in BPO sector fall into the high risk category of automation

2.1. Impact: Opportunities and Risks (cont'd)

The Fourth Industrial Revolution will trigger selective reshoring, nearshoring and other structural changes to global value chains (WEF 2018, ILO 2016)



2.1. Impact: Opportunities and Risks (cont'd)

- Autor (2015) argues that **extent of machine substitution** for jobs tend to be **overstated** by ignoring strong complementarities which increase productivity, raise earnings and augment demand for labor
- Autor adds that **even if automation does not reduce quantity of jobs, it may affect the qualities of jobs that are available**
- Policy implication: **human capital investments** must be at the **heart of any long-term strategy** on preparation for impact of technology on jobs

Crucial Emerging Technologies for the SDGs until 2030 (examples) (1/2)

Technology cluster	Emerging technologies	Opportunities	Potential Risks/Threats
Bio-tech	Biotechnology, genomics, and proteomics; gene-editing technologies and custom-designed DNA sequence; genetically modified organisms; stem cells and human engineering; bio-catalysts; synthetic biology; sustainable agriculture	Food crops, human health, pharmaceuticals, materials, environment, fuels	Military use; irreversible changes to health and environment
Digital-tech	Big Data; Internet of Things; 5G mobile phones; additive manufacturing; Cloud computing; open data technology; free and open source; Massive open online courses; micro-simulation; E-distribution; systems combining radio, mobile phone, satellite, GIS, and remote sensing data; data sharing technologies, including citizen science-enabling technologies; social media technologies; mobile Apps to promote public engagement and behavioral change; pre-paid system of electricity use and automatic meter reading; digital monitoring; digital security	Development, employment, manufacturing, agriculture, health, cities, finance, absolute "decoupling", governance, participation, education, citizen science, environmental monitoring, resource efficiency, global data sharing, social networking and collaboration	Unequal benefits, job losses, skills gaps, social impacts, poor people priced out; global value chain disruption; concerns about privacy, freedom, and development; data fraud, theft, cyber attacks

Source: UNDESA, 2016

Crucial Emerging Technologies for the SDGs until 2030 (examples) (2/2)

Technology cluster	Emerging technologies	Opportunities	Potential Risks/Threats
Nano-tech	Nano-imprint lithography; nanotechnology applications for decentralized water and wastewater treatment, desalination, and solar energy (nanomaterial solar cells); promising organic and inorganic nanomaterials, e.g., graphene, carbon nanotubes, carbon nano-dots and conducting polymers graphene, perovskites, Iron, cobalt, and nickel nanoparticles, and many others	Energy, water, chemical, electronics, medical and pharmaceutical industries; high efficiencies; resources saving; CO2 mitigation.	Human health (toxicity), environmental impact (nanowaste)
Neuro-tech	Digital automation, including autonomous vehicles (driverless cars and drones), IBM Watson, e-discovery platforms for legal practice, personalization algorithms, artificial intelligence, speech recognition, robotics; smart technologies; cognitive computing; computational models of the human brain; meso-science powered virtual reality	Health, safety, security (e.g., electricity theft), higher efficiency, resource saving, new types of jobs, manufacturing, education	Unequal benefits, de-skilling, job losses and polarization, widening technology gaps, military use, conflicts.

Source: UNDESA, 2016

FIRe and the SDGs

2.2. How frontier technologies could support the Sustainable Development Goals

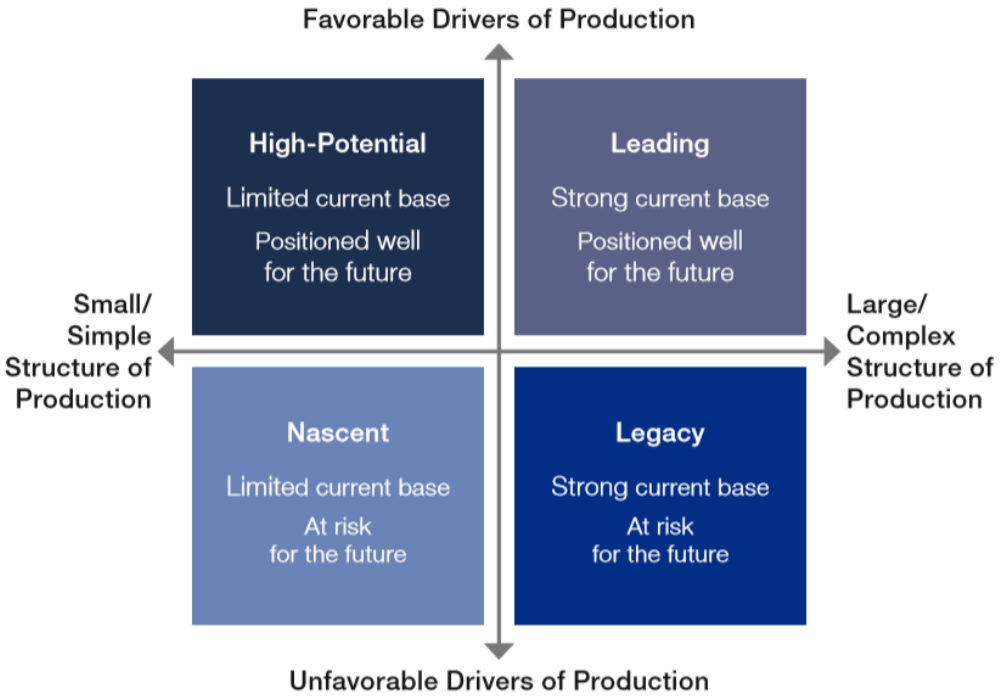
SDG	APPLICATIONS
Agriculture (SDGs 1, 2, 5, 8, 10 and 12)	Recent advances in image recognition allowed researchers to scan more than 50,000 photos of plants to help identify crop diseases at sites using smartphones with a success rate of over 99 per cent
Healthcare (Goal 3)	AI applications have been developed that substitute and complement highly educated and expensive expertise by analyzing medical images. 3D printing produce patient specific prosthetics, orthotic braces and customized medical implants.
Environment and climate (Goal 13)	AI and deep learning can help climate researchers and innovators test out their theories and solutions as to how to reduce air pollution

ESCAP (2018)

Preparing for Industry 4.0

3.1. WEF Assessment on Preparations

Country Archetypes



Note: Average performance of the top 75 countries (weighted average driver score, weighted average structure score) is at the intersection of the four quadrants to create the archetype borders.

WEF (2017)

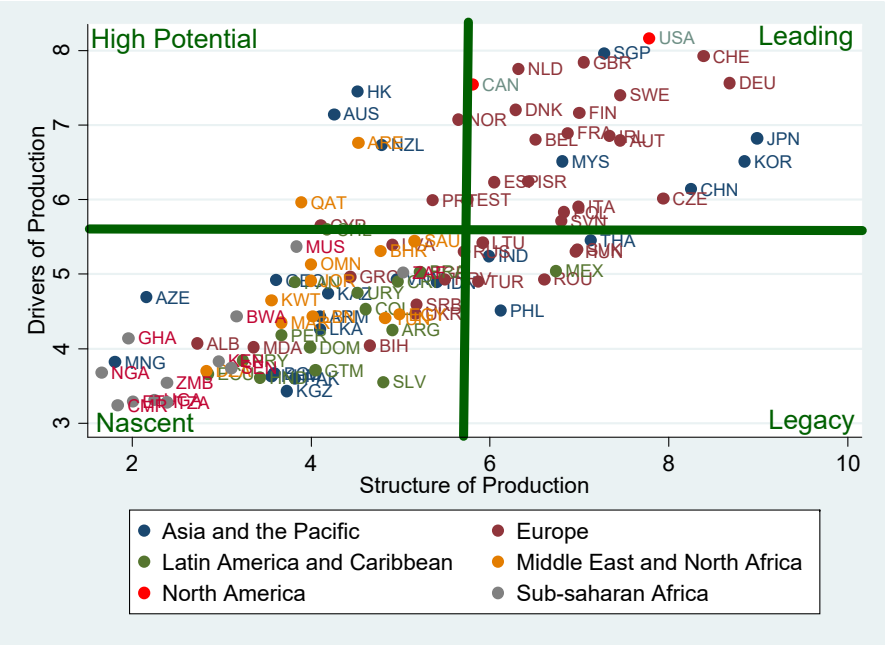
The seven ASEAN countries included in the assessment are spread across three different archetypes: Leading— Malaysia and Singapore; **Legacy**— Philippines and Thailand; and Nascent— Cambodia, Indonesia and Viet Nam.

Legacy country **-** has a strong production base today, but it is at risk for the future due to weaker performance across drivers of production, which include technology and innovation, human capital, global trade and investment, institutional framework, sustainable resources, and the demand environment.

3.1. WEF Assessment on Preparations (cont'd)

- Investments in R&D, hard and soft infrastructure, as well as capacity dev't of human resources and institutions are complementary factors for Inclusive Development and for **Readiness for Future of Production**

Drivers and Structure of Production



WEF (2018)

3.2. Select Industry 4.0 policies in ASEAN Member States

Indonesia: Launch of 'Making Indonesia 4.0' Roadmap (2017); Indonesia Broadband Plan 2014-2019

Malaysia: Development of the National Industry 4.0 Policy Framework (2018); Establishment of Industry 4.0 High Level Task Force (2017); Launch of the Centre of Excellence on Industry 4.0 (2017);); Launch of the Digital Free Trade Zone (DFTZ) Initiative and Pilot Project(2017); The Malaysian ICT Strategic Plan 2016-2020 (2016); Launch of the National e-Commerce Strategic Roadmap (2016); 11th Malaysia Plan 2016-2020 (2015); National IoT Roadmap (2015); National Broadband Initiative (2006)

Source: ASEAN Secretariat Draft Report

3.2. Select Industry 4.0 policies in ASEAN Member States (cont'd)

Singapore: AI.SG Initiative (2017); Research Innovation Enterprise 2020 Plan (2016); Industry Transformation Programme (2016); Intelligent Nation 2015 (2015); National Robotics Program (2015); Smart Nation (2014)

Thailand: Digital Government 2017-2021 (2017); Thailand 4.0 (2016); National Digital Economy Master Plan (2016-2020); Digital Economy Master Plan (2015)

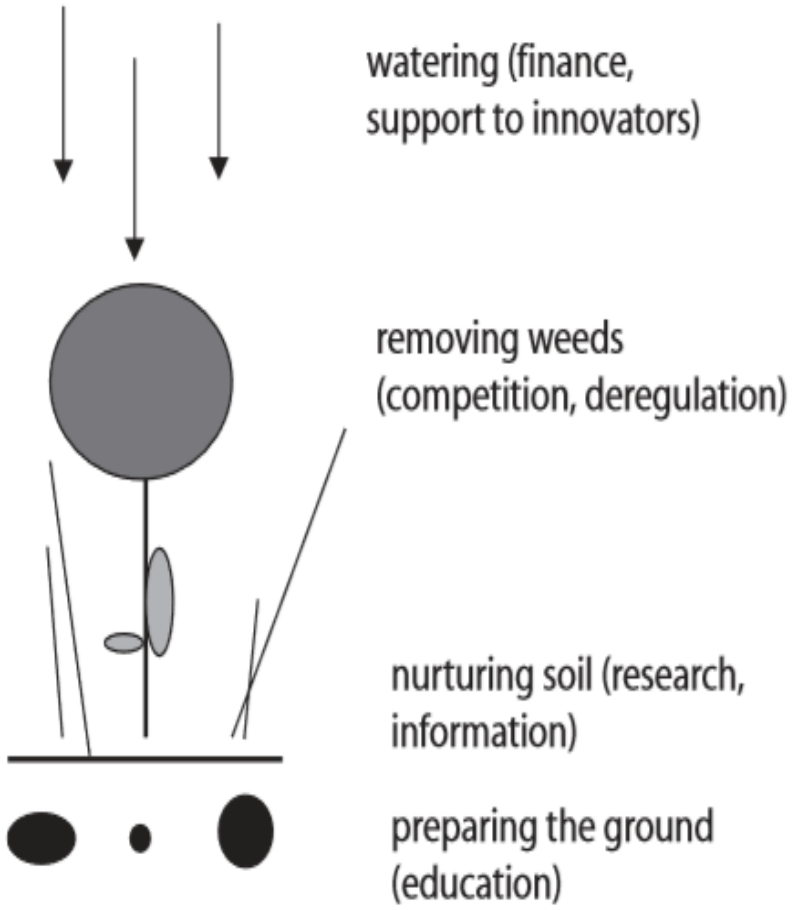
Viet Nam: Prime Minister's Directive 16/CT-TTg on Strengthening Access to the Fourth Industrial Revolution (2017); 2020 Broadband Plan (2016)

Source: ASEAN Secretariat Draft Report

3.2. Select Industry 4.0 policies in ASEAN Member States (cont'd)

Philippines:

- Inclusive, Innovation-led Industrial Strategy (i3s) (2017)
- Philippines Digital Strategy 2011-2015 (2011) (successor plan still being developed)
- National Broadband Plan
- e-Government Master Plan 2016-2020 (EGMP 2.0)



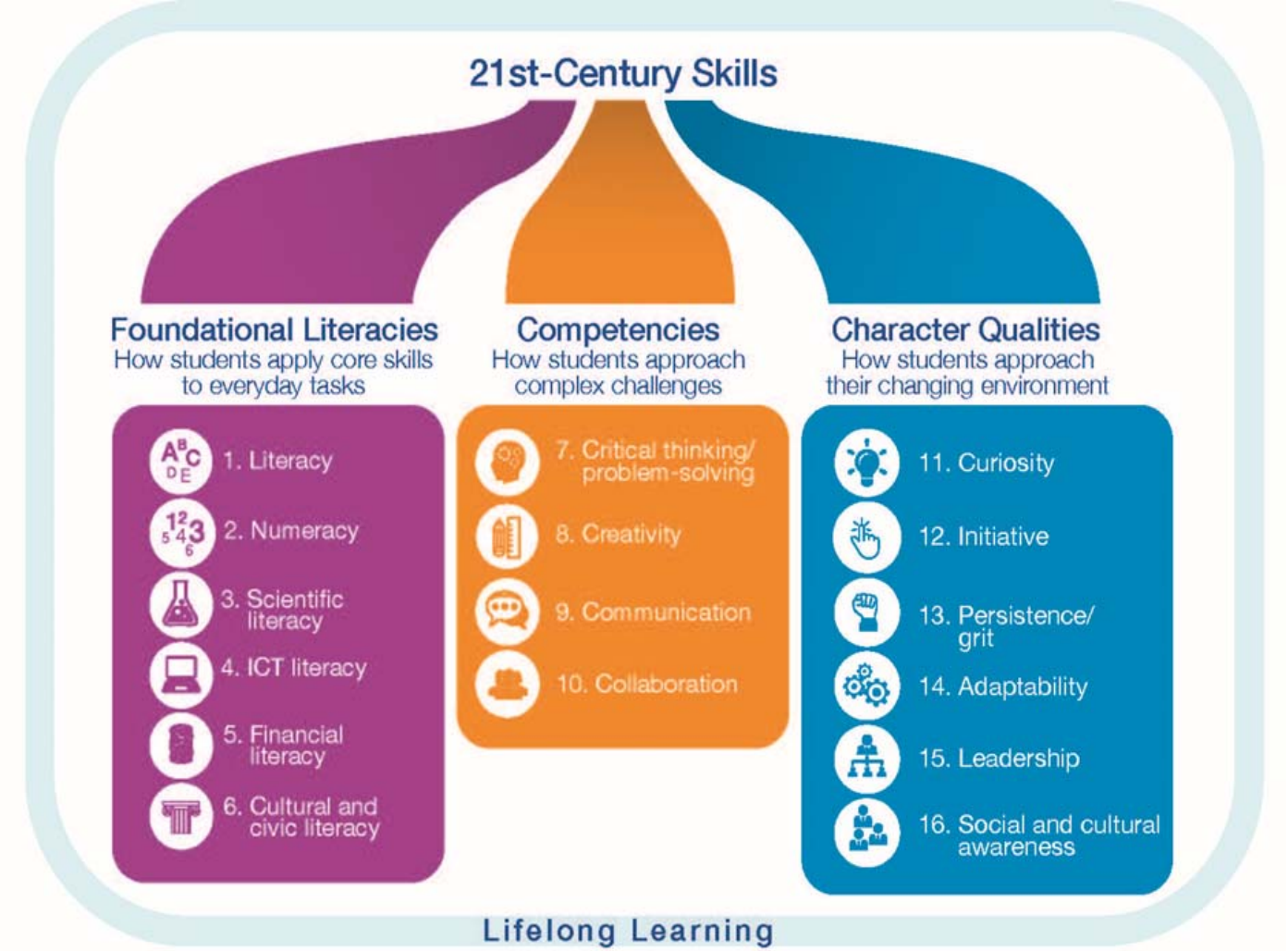
3.3. Gardening innovation

Source: World Bank (2010)

3.3.1. Preparing the ground (Education)

- Skills and competencies developed in school should be like LEGO blocks which can used to create different figures using the same building blocks
- Need for lifelong learning, continuous training and retraining; the only way to keep up is to continuously learn, unlearn, and re-learn
  - A key skill that needs to be developed among learners is “learning how to learn.
- Pedagogy should go beyond transmitting knowledge into encouraging reconstruction of knowledge

3.3.1. Preparing the ground (Education)



Source: WEF (2015)

3.3.2. Nurturing soil (Research, Information)

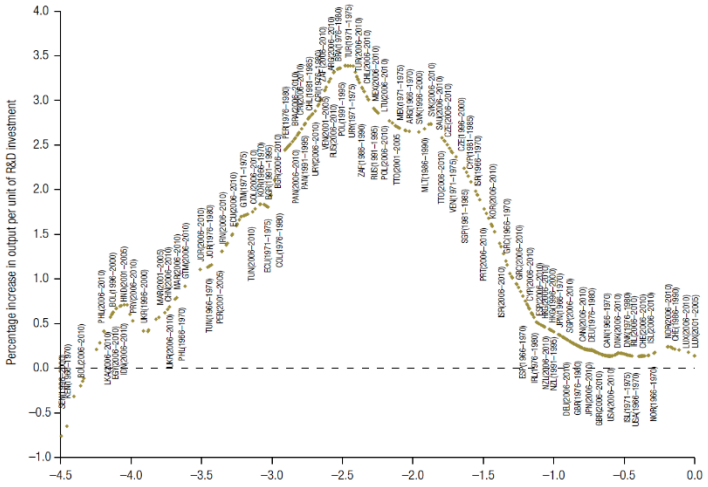
The bulk (60%) of R&D spending across sectors is actually supported by government (Albert *et al*., 2015). While the Philippines has had a slight increase in R&D expenditure to GDP in recent years, this spending is still at less than a fifth of one percent of GDP, which is below the one percent benchmark recommended by the United Nations Educational, Scientific, and Cultural Organization (UNESCO). The country's share of spending in GDP also falls below spending of several ASEAN member states, especially Singapore (2.4 %) and Malaysia (1.3 %), and even including Thailand (0.5 %) and Viet Nam (0.2 %).

3.3.3. Watering (Finance, Support to Innovation)

- Science for Change Program (S4CP)
- Balik Scientist 2.0
- SETUP
- DTI, DOST and CHED working in tandem on “i3S”
- Addressing issues on coverage, price and quality of internet

3.3.3. Watering (Finance, Support to Innovation)

CAUTION: Returns to R&D Trace an Inverted U-Shape across the Dev't Process



Source: Goñi and Maloney 2017.

Note: Graph uses quinquennials of cross-country data from 1960 to 2010 to estimate the rates of return to research and development (R&D) across the development process: 0 is the frontier, and moving left represents progressively less developed countries.

- ROI on Innovation/R&D Spending rate of return begins to fall and may even be negative for quite poor countries
- Explanation: when countries are far from the technological frontier, the potential gains from "catch-up" increases but when stock of complementarity factors (human capital, firm and management capabilities, financial markets) are missing, returns will be low
- Issues about absorptive capacity

SOURCE: Innovation Paradox

3.3.4. Removing Weeds (Competition, Deregulation)

- In the most recent *Doing Business 2018* (2018) report, the Philippines ranking slipped from 99th in 2017 to 113th behind Vietnam and Indonesia at 68th and 72nd, respectively. Among the indicators, the Philippines was ranked lowest in "starting a business"
- According to the OECD (2016), foreign direct investment (FDI) restrictions in the Philippines are high by both regional and global standards. Based on OECD FDI Regulatory Restrictiveness Index, the Philippines is the most restrictive economy among the 62 OECD and non-OECD countries included in the database. Compared to other countries (e.g. China, Vietnam, India, Indonesia, and Malaysia) the regulatory environment for FDI in the Philippines has not changed much in the last 20 years.

3.4. Other challenges and issues

- Responsive and adaptive regulation
  - Regulatory sandbox
  - “Whole of Government”
- Labor market and social protection
  - Flexible and forward-looking labor market
  - Strengthening social protection systems: progressive universalism and portable social protection systems
  - universal basic income (???)
- Taxation reform/upgrade (???) : : improve collection of real property tax, provision of excise taxes on sugar, tobacco and alcohol, subsidy refo=rms, reducing tax avoidance.

Fourth PIDS Annual Public Policy Conference (APPC) on Sept 19, 2018

- *A broad view of the technological landscape, technological breakthroughs, and a glimpse into the future*
- *Socio-economic consequences of FIRe and related policy ideas: How does it affect the poor and marginalized?*
- *Parallel sessions*
  - *Agriculture, manufacturing, and services*
  - *Science, Technology, and Innovation (STI)*
  - *Labor market and social protection*
  - *Human capital development (education and training)*
- *Ways forward*

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EMAIL jalbert@mail.pids.gov.ph ;
rserafica@mail.pids.gov.ph;