The Fourth Industrial Revolution (FIRe): Opportunities and Challenges for the Philippines

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Bohol Tropics, Tagbilaran City, Bohol
March 6, 2019
Agenda

1. Introduction
   - Economic Growth and Technologically-Driven Progress
   - What is the FIRe and its Frontier Technologies?
   - Potential Impacts from FIRe Technologies

2. Innovation Ecosystem
   - Readiness for Future Production
   - Innovation Statistics

3. Gardening Innovation
   - Preparing the Ground (Education)
   - Nurturing the Soil (R&D)
   - Watering the Ground (Support to Innovation)
   - Others: Social Protection, Tax Reform, Whole of Nation Paradigm and Action Agenda
1. Technology and Progress

Since the 1960s, the Philippines has had booms and busts

- Starting 2012, PH economic performance even better than average in East-Asia and the world
- Negative growth in East Asia only in 1998, and across the world in 2009
- Buoyant expectations for global progress in the wake of the emerging Fourth Industrial Revolution (FIRe)
1. Technology & Progress (cont’d)

- Fire
- Agriculture
- Wheel
- Cities
- Manufacturing & Trade

History of Technological Progress
1.1. 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.

1\textsuperscript{st} Revolution (1784)
Steam, water, mechanical production equipment

2\textsuperscript{nd} Revolution (1870)
Division of labor, electricity, mass production, assembly line

3\textsuperscript{th} Revolution (1969)
Electronics, computers, internet, automated production

4\textsuperscript{th} Revolution (???)
Cyber-physical systems
“a fusion of technologies that is blurring the lines between the physical, digital and biological spheres.” –Schwab (2016)
1.2. 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

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

### Sustainable Development Goals (SDGs)

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<tr>
<th>SDG</th>
<th>APPLICATIONS</th>
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<tbody>
<tr>
<td>Agriculture (SDGs 1, 2, 5, 8, 10 and 12)</td>
<td>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</td>
</tr>
<tr>
<td>Healthcare (Goal 3)</td>
<td>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.</td>
</tr>
<tr>
<td>Environment and climate (Goal 13)</td>
<td>AI and deep learning can help climate researchers and innovators test out their theories and solutions as to how to reduce air pollution</td>
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ESCAP (2018)
1.3. Potential Impacts of FIRe (cont’d)

Likely Unintended Consequences

<table>
<thead>
<tr>
<th>Economic Implications</th>
<th>Socio-Cultural Implications</th>
<th>Political &amp; Security Implications</th>
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</thead>
<tbody>
<tr>
<td><strong>Robotics and AI</strong></td>
<td>• Technological unemployment</td>
<td>• Political polarization</td>
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<tr>
<td>• Income Inequality</td>
<td>• Rise of monopolies and oligopolies</td>
<td>• Instability</td>
</tr>
<tr>
<td>• Disruption of traditional business models and global value chains</td>
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<td>• Data and access security risks to automation</td>
</tr>
<tr>
<td><strong>IOT</strong></td>
<td>• Disruption of traditional business models</td>
<td>• Espionage, Terrorism, Autonomous warfare</td>
</tr>
<tr>
<td><strong>3D-printing</strong></td>
<td>• Disruption of existing business processes</td>
<td>• Lack of trust in institutions</td>
</tr>
<tr>
<td>• Disruption of existing business processes</td>
<td>• Erosion of personal privacy</td>
<td>• Cybersecurity problems</td>
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<td>• Data fraud</td>
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<td></td>
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<td>• Weapons proliferation</td>
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<td></td>
<td></td>
<td>• Cyber-sabotage</td>
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</tbody>
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- Technological unemployment
- Income Inequality
- Disruption of traditional business models and global value chains
- Rise of monopolies and oligopolies
- Political polarization
- Instability
- Data and access security risks to automation
- Espionage, Terrorism, Autonomous warfare
- Disruption of traditional business models
- Erosion of personal privacy
- Lack of trust in institutions
- Cybersecurity problems
- Data fraud
- Weapons proliferation
- Cyber-sabotage
Share of wage and salaried employment in key **manufacturing** subsectors at high risk of automation (per cent).

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

1.3. Potential Impacts of FIRe (cont’d)
The Fourth Industrial Revolution will trigger selective reshoring, nearshoring and other structural changes to global value chains (WEF 2018, ILO 2016).
1.3. Potential Impacts of FIRe (cont’d)

Automation and The Future of Jobs

- 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.
2. Innovation Ecosystem

2.1. WEF Assessment on Preparations

The seven ASEAN countries 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.

**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)
2.1. 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)
2.2. Statistics on Innovation in PH

- Innovation is widely regarded as a major driver of economic output, productivity and competitiveness ... but not all firms innovate

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2009 SIA</th>
<th>2015 PIDS</th>
<th>2015 WORLD BANK ENTERPRISE SURVEY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of firms that introduced a new product/service</td>
<td>37.6</td>
<td>30.7</td>
<td>32.9</td>
</tr>
<tr>
<td>Percent of firms that introduced a process innovation</td>
<td>43.9</td>
<td>30.6</td>
<td>40.9</td>
</tr>
<tr>
<td>Percent of firms that spend on R&amp;D</td>
<td>40.3</td>
<td>26.7</td>
<td>21.9</td>
</tr>
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</table>
2.2. Statistics on Innovation in PH (cont’d)

Global Innovation Index (GII), Global Competitiveness Index (GCI), and Existing Competition Policy

<table>
<thead>
<tr>
<th>ASEAN Member State</th>
<th>2017 GII Ranking</th>
<th>2016 GII Ranking</th>
<th>2017 GCI Ranking</th>
<th>2016 GCI Ranking</th>
<th>Existing Competition Policy</th>
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</thead>
<tbody>
<tr>
<td>Singapore</td>
<td>7\textsuperscript{th}</td>
<td>6\textsuperscript{th}</td>
<td>3\textsuperscript{rd}</td>
<td>2\textsuperscript{nd}</td>
<td>Competition Act 2004</td>
</tr>
<tr>
<td>Malaysia</td>
<td>37\textsuperscript{th}</td>
<td>35\textsuperscript{th}</td>
<td>23\textsuperscript{rd}</td>
<td>25\textsuperscript{th}</td>
<td>Competition Act 2010</td>
</tr>
<tr>
<td>Thailand</td>
<td>51\textsuperscript{st}</td>
<td>52\textsuperscript{nd}</td>
<td>32\textsuperscript{nd}</td>
<td>34\textsuperscript{th}</td>
<td>Trade Competition Act 1999</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>47\textsuperscript{th}</td>
<td>59\textsuperscript{th}</td>
<td>55\textsuperscript{th}</td>
<td>60\textsuperscript{th}</td>
<td>Competition Law 2004</td>
</tr>
<tr>
<td>Philippines</td>
<td>73\textsuperscript{rd}</td>
<td>74\textsuperscript{th}</td>
<td>56\textsuperscript{th}</td>
<td>57\textsuperscript{th}</td>
<td>Phil Competition Act 2015</td>
</tr>
<tr>
<td>Indonesia</td>
<td>87\textsuperscript{th}</td>
<td>88\textsuperscript{th}</td>
<td>36\textsuperscript{th}</td>
<td>41\textsuperscript{st}</td>
<td>Law Number 5 Year 1999 on the Prohibition of Monopolistic Practices and Unfair Business Competition</td>
</tr>
<tr>
<td>Cambodia</td>
<td>101\textsuperscript{st}</td>
<td>95\textsuperscript{th}</td>
<td>94\textsuperscript{th}</td>
<td>89\textsuperscript{th}</td>
<td>Draft Competition Law 2016</td>
</tr>
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</table>
3. Gardening innovation

3.1. Preparing the ground (Education)

- Skills and competencies developed in school should be like LEGO blocks which can be 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 is “learning how to learn.”

- Pedagogy should go beyond transmitting knowledge into encouraging reconstruction of knowledge.

Source: WEF (2015)
3.2. Nurturing soil (Research)

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 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. Watering Ground (Finance, Support to Innovation)

- DTI, DOST and CHED working in tandem on Inclusive Innovation Industry Strategy (“i3S”)
- DOST programs to boost innovation support
  - Science for Change Program (S4CP)
  - Balik Scientist 2.0
  - SETUP
- DICT
  - Addressing Issues on coverage, price and quality of internet
  - Formulating successor to Philippines Digital Strategy 2011-2015, developed National Broadband Plan e-Government Master Plan 2016-2020 (EGMP 2.0),
  - Established GovCloud
3.3. Watering (Finance, Support to Innovation) (cont’d)

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

- 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
3.4. 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.
3.5. 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 reforms, reducing tax avoidance.

- Whole of Nation Paradigm and Action Agenda
Preparing the Philippines for the Fourth Industrial Revolution: A Scoping Study
(PIDS Discussion Paper 2018-11)

Harnessing government’s role for the Fourth Industrial Revolution
(PIDS Policy Note 2018-14)

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