#PreparingForTheFourth IndustrialRevolution

2018 Development Policy Research Month (DPRM)
Inter-agency Steering Committee Meeting
May 29, 2017

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

Agenda

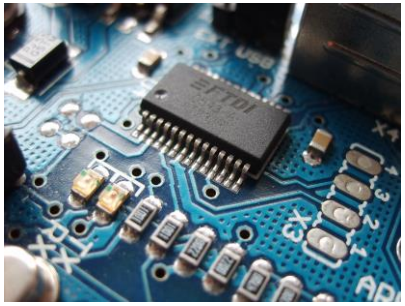
1. What is the Fourth Industrial Revolution (FIRe) ?
2. Frontier Technologies
   - ❑ Emerging, Disruptive Tech that Pose Opportunities and Risks
   - ❑ FIRE and the SDGs
   - ❑ Preparing for the Future
   - ❑ Labor Market and Social Protection
3. Fourth APPC

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

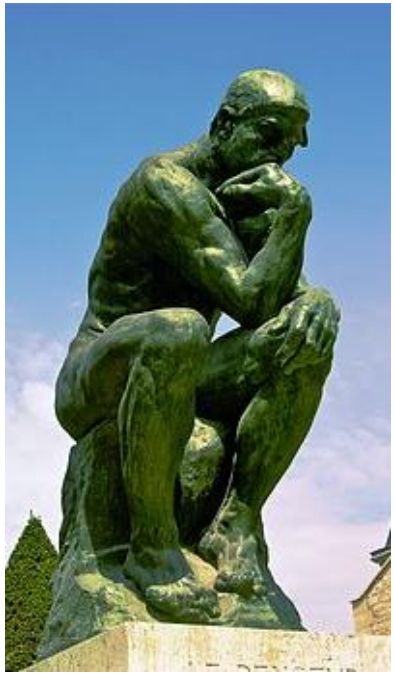
1st Revolution
(1784)
Steam, water, mechanical production equipment

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)

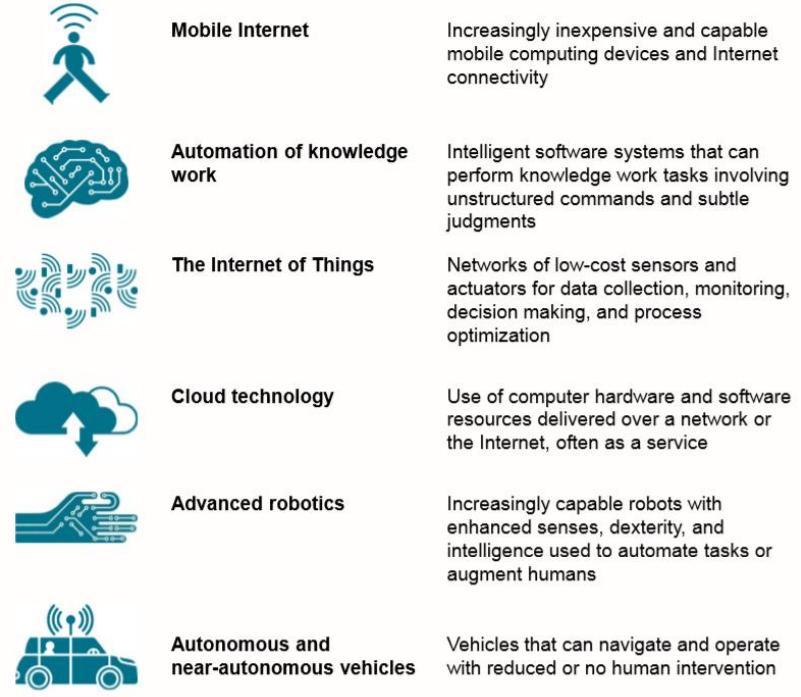
1. What is FIRe? (cont'd)

From WEF : https://www.youtube.com/watch?v=SCGV1tNBoeU

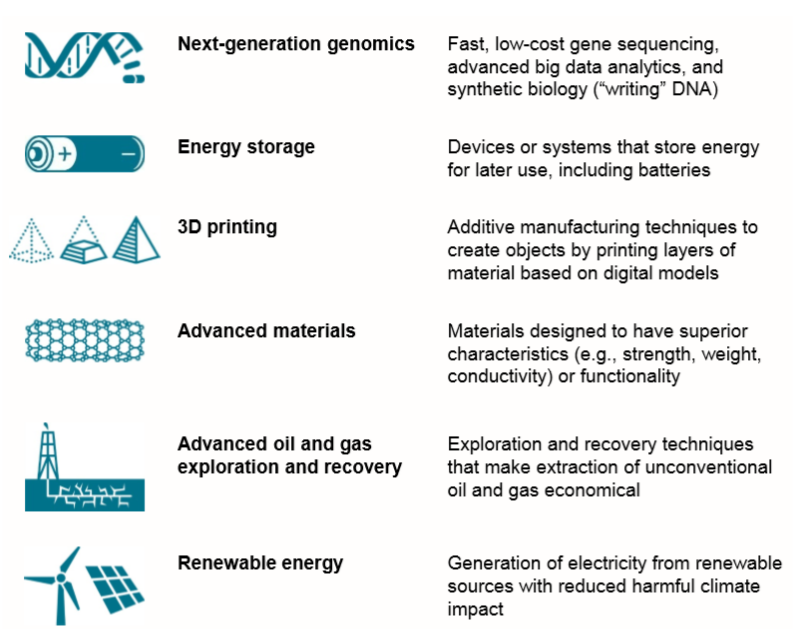
1. What is FIRe? (cont'd)

https://www.youtube.com/watch?v=JKsVYpRp41w

Fig 1. Twelve potentially economically disruptive technologies



Mobile Internet	Increasingly inexpensive and capable mobile computing devices and Internet connectivity
Automation of knowledge work	Intelligent software systems that can perform knowledge work tasks involving unstructured commands and subtle judgments
The Internet of Things	Networks of low-cost sensors and actuators for data collection, monitoring, decision making, and process optimization
Cloud technology	Use of computer hardware and software resources delivered over a network or the Internet, often as a service
Advanced robotics	Increasingly capable robots with enhanced senses, dexterity, and intelligence used to automate tasks or augment humans
Autonomous and near-autonomous vehicles	Vehicles that can navigate and operate with reduced or no human intervention



Next-generation genomics	Fast, low-cost gene sequencing, advanced big data analytics, and synthetic biology ("writing" DNA)
Energy storage	Devices or systems that store energy for later use, including batteries
3D printing	Additive manufacturing techniques to create objects by printing layers of material based on digital models
Advanced materials	Materials designed to have superior characteristics (e.g., strength, weight, conductivity) or functionality
Advanced oil and gas exploration and recovery	Exploration and recovery techniques that make extraction of unconventional oil and gas economical
Renewable energy	Generation of electricity from renewable sources with reduced harmful climate impact

(MGI 2013)

2. Frontier Technologies

Technology	Description
Artificial intelligence and robotics	Development of machines that can substitute for humans, increasingly in tasks associated with thinking, multitasking and fine motor skills.
Ubiquitous linked sensors	Also known as the "Internet of Things." The use of networked sensors to remotely connect, track and manage products, systems and grids.
Virtual and augmented realities	Next-step interfaces between humans and computers involving immersive environments, holographic readouts and digitally produced overlays for mixed-reality experiences.
Additive manufacturing	Advances in additive manufacturing, using a widening range of materials and methods. Innovations include 3D bioprinting of organic tissues.
Blockchain and distributed ledger technology	Distributed ledger technology based on cryptographic systems that manage, verify and publicly record transaction data; the basis of "cryptocurrencies" such as bitcoin.
Advanced materials and nanomaterials	Creation of new materials and nanostructures for the development of beneficial material properties, such as thermoelectric efficiency, shape retention and new functionality.
Energy capture, storage and transmission	Breakthroughs in battery and fuel cell efficiency; renewable energy through solar, wind, and tidal technologies; energy distribution through smart grid systems; wireless energy transfer; and more.
New computing technologies	New architectures for computing hardware, such as quantum computing, biological computing or neural network processing, as well as innovative expansion of current computing technologies.
Biotechnologies	Innovations in genetic engineering, sequencing and therapeutics, as well as biological computational interfaces and synthetic biology.
Geoengineering	Technological intervention in planetary systems, typically to mitigate effects of climate change by removing carbon dioxide or managing solar radiation.
Neurotechnology	Innovations such as smart drugs, neuroimaging and bioelectronic interfaces that allow for reading, communicating and influencing human brain activity.
Space technologies	Developments allowing for greater access to and exploration of space, including microsatellites, advanced telescopes, reusable rockets and integrated rocket-jet engines.

2. Frontier Technologies

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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		

Figure 2. Timeframe to impact industries, business models

WEF (2016)

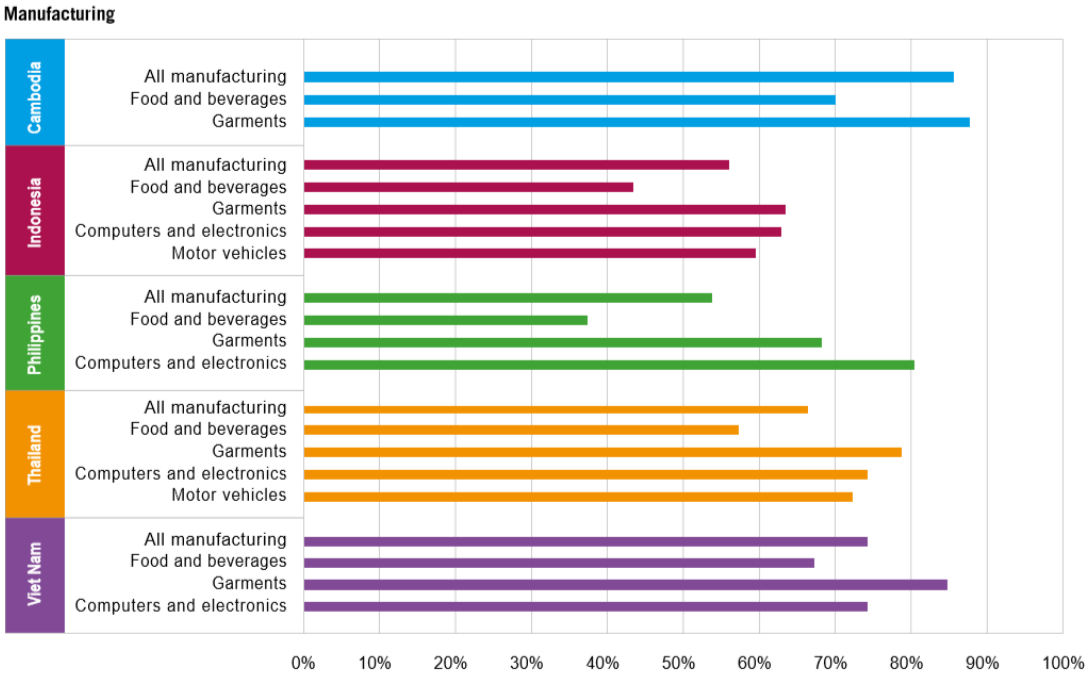
2.1. Impact: Opportunities and Risks



UBER
airbnb

amazon

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



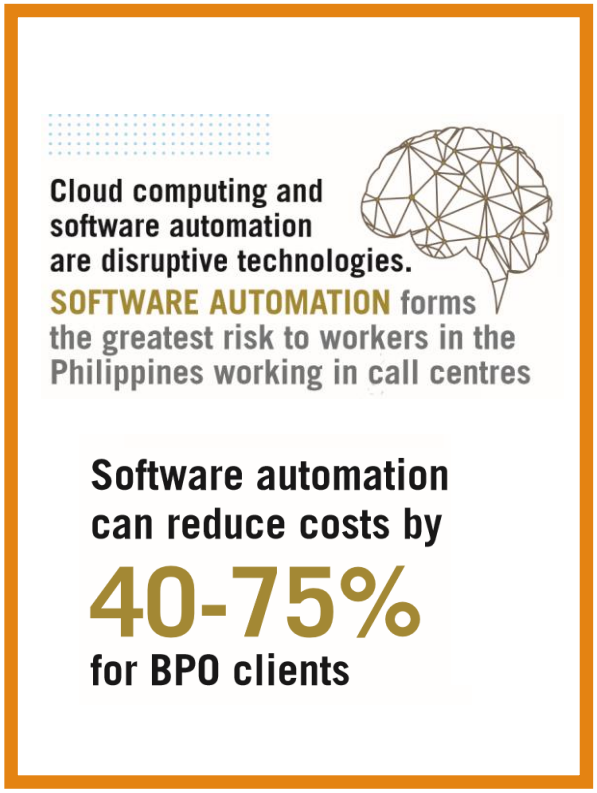
ILO (2016)

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)



Crucial Emerging Technologies for the SDGs until 2030

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 tech	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
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

Crucial Emerging Technologies for the SDGs until 2030 (Cont'd)

Technology cluster	Emerging technologies	Opportunities	Potential Risks/Threats
Green-tech	**Circular economy:** technologies for remanufacturing, technologies for product lifecycle extension such as re-use and refurbishment, and technologies for recycling; multifunctional infrastructures; technologies for integration of centralized systems and decentralized systems for services provision; CO2 mitigation technologies; low energy and emission technology. **Energy:** modern cook stoves with emissions comparable to those of LPG stove; Deployment of off-grid electricity systems (and perhaps direct current); mini-grids based on intermittent renewables with storage; advances in battery technology; heat pumps for space heating, heat and power storage and electric mobility (in interaction with off-grid electricity; smart grids; natural gas technologies; new ways of electrification; desalination (reverse osmosis); small and medium sized nuclear reactors; biofuel supply chains; solar photovoltaic, wind and micro-hydro technologies; salinity gradient power technology; water saving cooling technology; LED lamps; advanced metering. **Transport:** integrated public transport infrastructure, electric vehicles (e-car and e-bike), hydrogen-fueled vehicles and supply infrastructures. **Water:** mobile water treatment technology, waste water technology, advanced metering infrastructure. **Buildings:** sustainable building technology, passive housing. **Agriculture:** Sustainable agriculture technology; Innovations of bio-based products and processing, low input processing and storage technologies; horticulture techniques; irrigation technologies; bio-organometallics which increase the efficiency of biomimetic analogs of nitrogenase. **Other:** Marine Vibroseis, artificial photosynthesis	Environment, climate, biodiversity, sustainable production and consumption, renewable energy, materials and resources; clean air and water; energy, water and food security; development, employment; health; equality	New inequalities, job losses; concerns about privacy, freedom and development.
Other	Assistive technologies for people with disabilities; alternative social technologies; fabrication laboratories; radical medical innovation; geo-engineering technologies (e.g. for iron fertilization of oceans); new mining/extraction technologies (e.g., shale gas, in oceans, polar, glacier zones); deep sea mining technologies;	Inclusion, devt, health, envt, clim. chng mitigation, resource avail.	Pollution, inequalities, conflict

Source: UNDESA, 2016

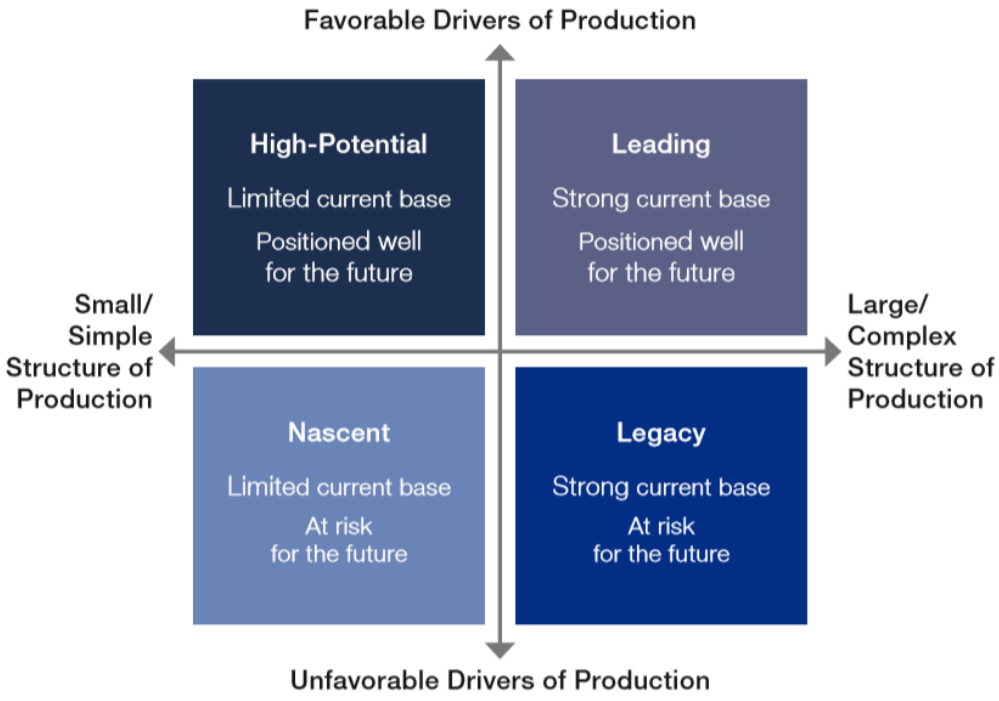
2.2. FIRe and the SDGs

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)

Figure 4. 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)

2.3. Preparing for the Future

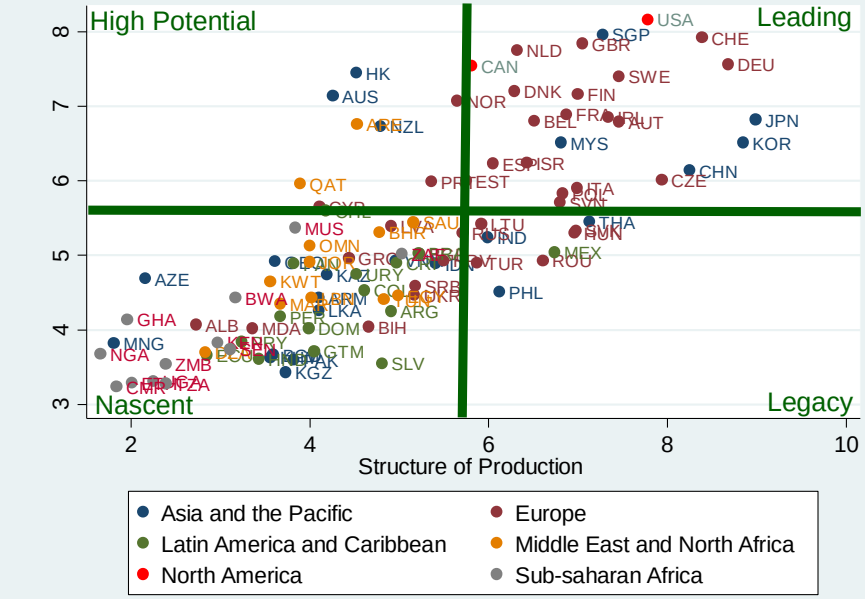
The seven ASEAN countries included in the assessment are spread across three different archetypes: Leading— Malaysia and Singapore; **Legacy**— Philippines and Thailand; and Nascent— Cambodia, Indonesia and Viet Nam.

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.

2.3. Preparing for the Future

- 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**

Figure 5. Drivers and Structure of Production



WEF (2018)

2.4. Labor market and social protection

- Flexible and forward-looking labor market
- Portable social protection systems

3. Fourth APPC (Sept 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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