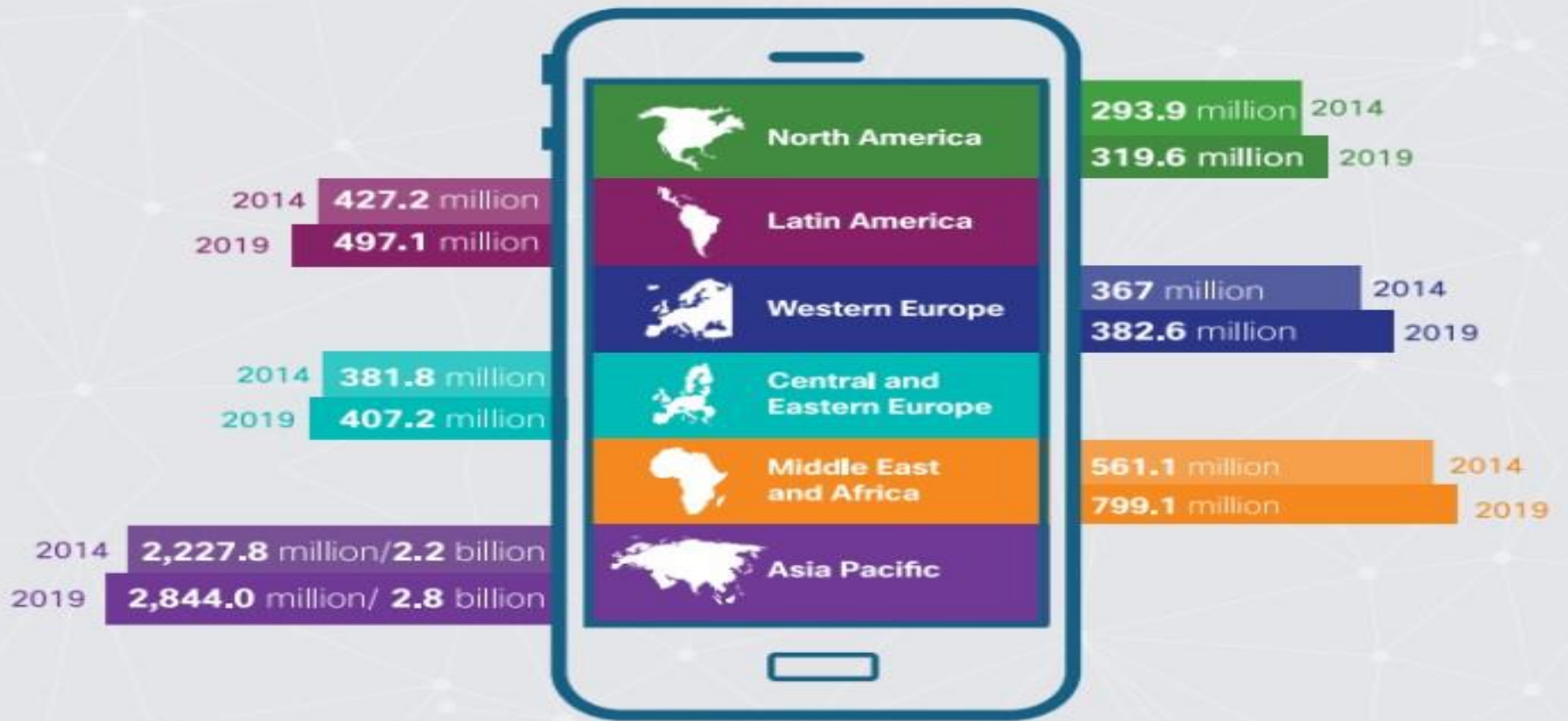# Impact of FIRe on TVET in Asia: Challenges and Prospects

**Engr. Abdul Ghani Rajput**
**Faculty Specialist,**
**CPSC, Manila, Philippines**

North America
293.9 million 2014
319.6 million 2019

Latin America
2014 427.2 million
2019 497.1 million

Western Europe
367 million 2014
382.6 million 2019

Central and Eastern Europe
2014 381.8 million
2019 407.2 million

Middle East and Africa
561.1 million 2014
799.1 million 2019

Asia Pacific
2014 2,227.8 million/2.2 billion
2019 2,844.0 million/ 2.8 billion

- Annual global mobile data traffic will increase by 873% from 30 Exabytes in 2014 to 292 Exabytes by 2019, according to IT networking vendor Cisco's Visual Networking Index (VNI).

# Global Mega Trends and Influences

- Aging
- Migration

Demographic Change

- Changing global value chain requires new thinking

Globalization

- Virtual activities lead new businesses

Learning: Anytime, Any where

- Integration aims for Innovations based on user needs

Cross disciplinary Technology

- ESD, Green Economy, Green Jobs
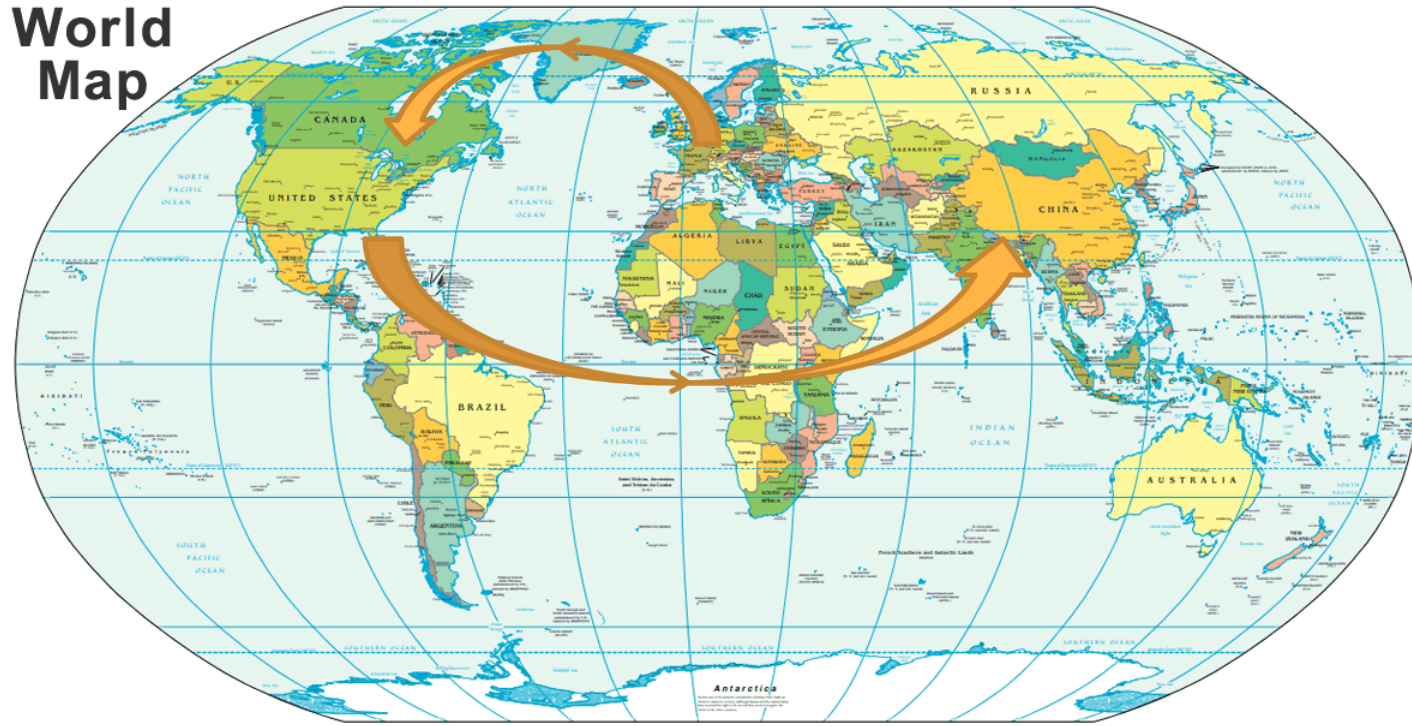
Sustainable development

Source: Doode EFC Analysis

# Industrial Shift: The Structure of the New World Economy

Source: Industrial Shift Book

# Why Aisa Pacific?

- Asia and Pacific region that made up over 60 percent of the world's population (4.3billion out of 7.1billion).

- If Asia Pacific continue to grow on its projected curve, it could by 2050, account for more than 50% of world's GDP(as compared to 27% in 2010).

- Seven Asian nations – Japan, South Korea, China, India, Malaysia, Thailand and Indonesia – are projected to account for 87% of the total GDP growth in Asia and almost 55% of the global GDP growth between 2010 and 2050(ADB, 2011).

- However, the incidence of those living below the poverty line is as high as 40% is existed in a number of Asian countries(UNESCAP,2011).
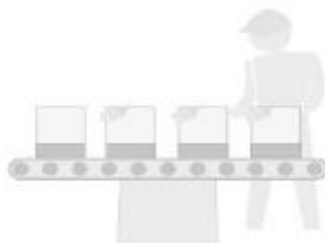
# The Fourth Industrial Revolution

## Industrial Revolutions: From steam engines to smart phones

| 1st Industrial Revolution | 2nd Industrial Revolution | 3rd Industrial Revolution | 4th Industrial Revolution |
|---|---|---|---|
| **1760s–1900** Use of steam and mechanically driven production facilities | **1900–1970s** Electric power driven mass production based on division of labor | **1970s– to date** Extensive use of controls, IT and electronics for an automated and high productivity environment | **Future** Smart: based on integration of virtual and physical production systems |

Source: *Asian Development Outlook 2018*: How Technology Affects Jobs.
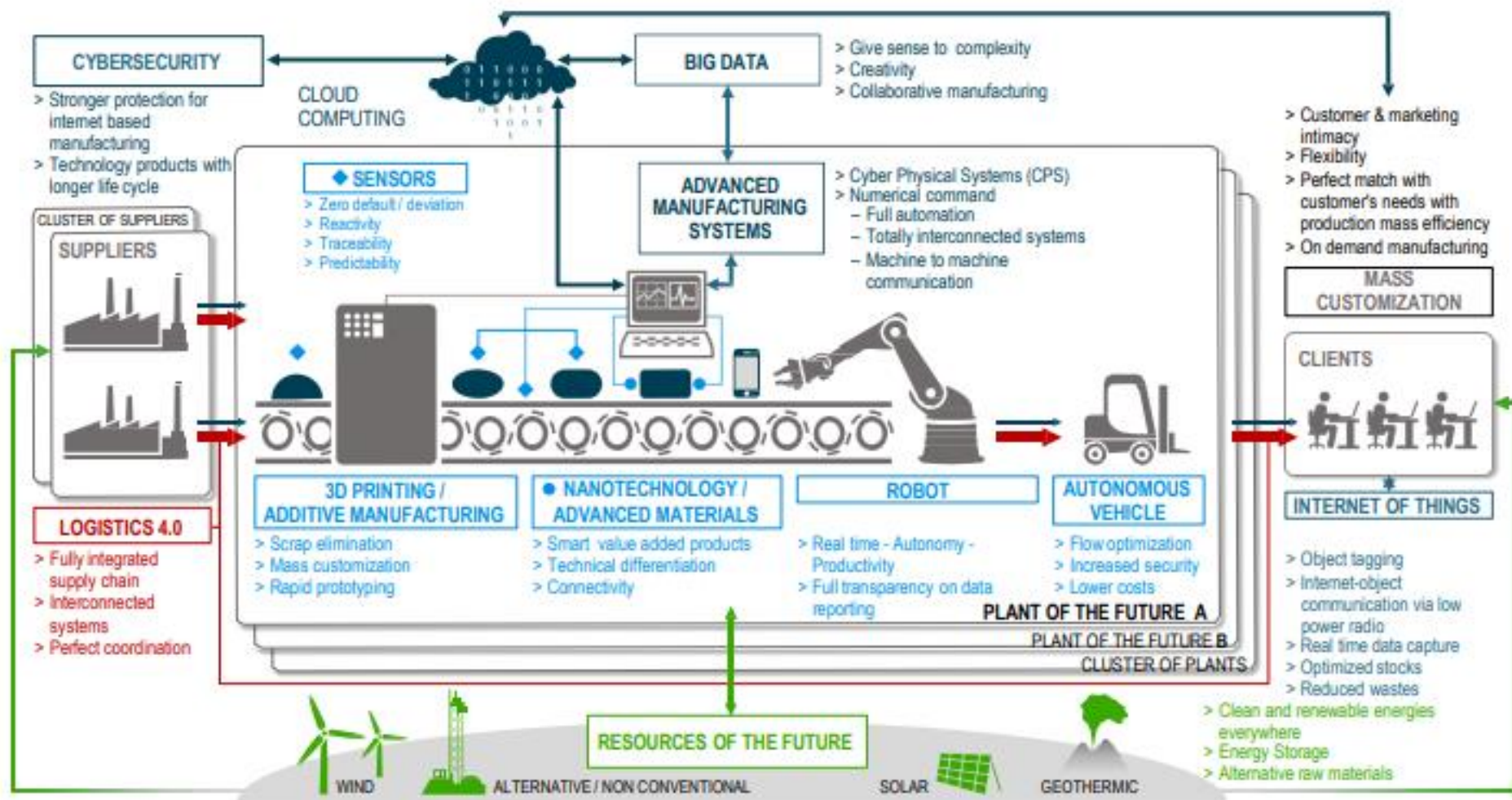
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**Drivers of 4IR (with Artificial Intelligence being cross-cutting)**
1) Physical → autonomous vehicles, 3D Printing, advanced robotics, new materials
2) Digital → internet of things (IoT), distributed ledger (blockchain), on-demand economy/platforms
3) Biological → gene editing, synthetic biology, bio-printing
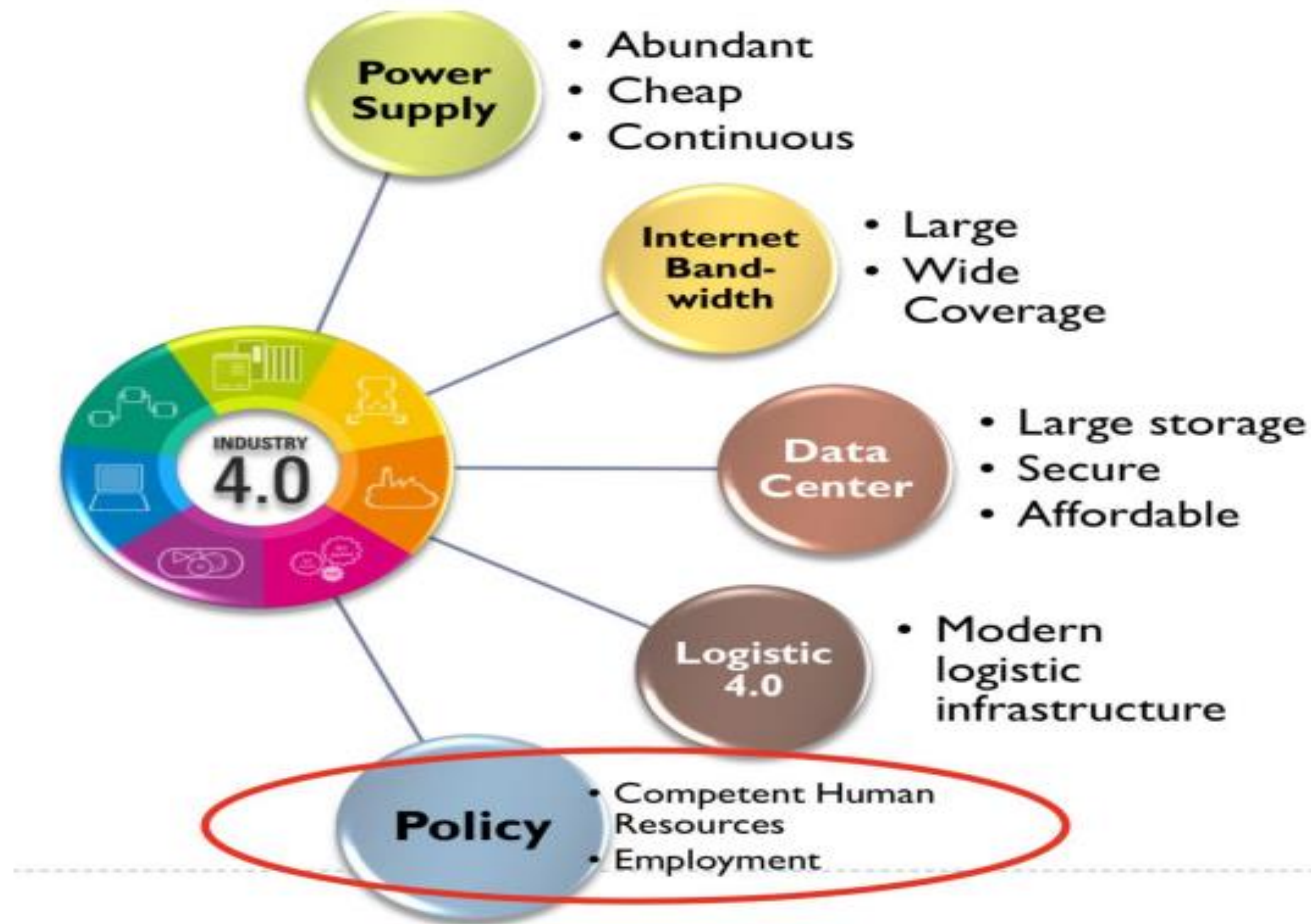
# FIRe – 9 Technology Pillars



Source: PSDC

**CYBERSECURITY**

> Stronger protection for internet based manufacturing
> Technology products with longer life cycle

**CLOUD COMPUTING**

**BIG DATA**

> Give sense to complexity
> Creativity
> Collaborative manufacturing

> Customer & marketing intimacy
> Flexibility
> Perfect match with customer's needs with production mass efficiency
> On demand manufacturing

**MASS CUSTOMIZATION**

CLUSTER OF SUPPLIERS

SUPPLIERS

◆ **SENSORS**
> Zero default / deviation
> Reactivity
> Traceability
> Predictability

**ADVANCED MANUFACTURING SYSTEMS**

> Cyber Physical Systems (CPS)
> Numerical command
  – Full automation
  – Totally interconnected systems
  – Machine to machine communication

**CLIENTS**

**INTERNET OF THINGS**

**LOGISTICS 4.0**

> Fully integrated supply chain
> Interconnected systems
> Perfect coordination

**3D PRINTING / ADDITIVE MANUFACTURING**
> Scrap elimination
> Mass customization
> Rapid prototyping

● **NANOTECHNOLOGY / ADVANCED MATERIALS**
> Smart value added products
> Technical differentiation
> Connectivity

**ROBOT**
> Real time - Autonomy - Productivity
> Full transparency on data reporting

**AUTONOMOUS VEHICLE**
> Flow optimization
> Increased security
> Lower costs

> Object tagging
> Internet-object communication via low power radio
> Real time data capture
> Optimized stocks
> Reduced wastes

**PLANT OF THE FUTURE A**
PLANT OF THE FUTURE B
CLUSTER OF PLANTS

**RESOURCES OF THE FUTURE**

WIND          ALTERNATIVE / NON CONVENTIONAL          SOLAR          GEOTHERMIC

> Clean and renewable energies everywhere
> Energy Storage
> Alternative raw materials

Source: Roland Berger

# What's is needed to drive IR 4.0?



- **Power Supply**
  - Abundant
  - Cheap
  - Continuous

- **Internet Bandwidth**
  - Large
  - Wide Coverage

- **INDUSTRY 4.0**

- **Data Center**
  - Large storage
  - Secure
  - Affordable

- **Logistic 4.0**
  - Modern logistic infrastructure

- **Policy**
  - Competent Human Resources
  - Employment

# FIRe Disruption

**60%**
There will be mass jobs automatization

**30%**
World jobs will be substituted by sophisticated machines

**26 million**
New jobs created by the advent of online services

**Soft Skill**

- Problem Solving
- Critical Thinking
- Creativity
- Coordination Capability
- Emotional Capability
- Decision Making
- Service orientation
- Negotiation
- Cognitive flexibility

**Hard Skill**

- IT and mathematics skills
- Troubleshooting & repair skills
- Engineer
- Technicians
- Data Science
- IoT, AI etc
- *STEM*

**Future Jobs**

*Source: McKinsey, 2018. "The digital archipelago: How online commerce is driving Indonesia's economic development."*

# Skills of Future Industry

**Scale of Skill Demand in 2020**

15%
17%
36%
10%
18%
19%
13%
12%
4%
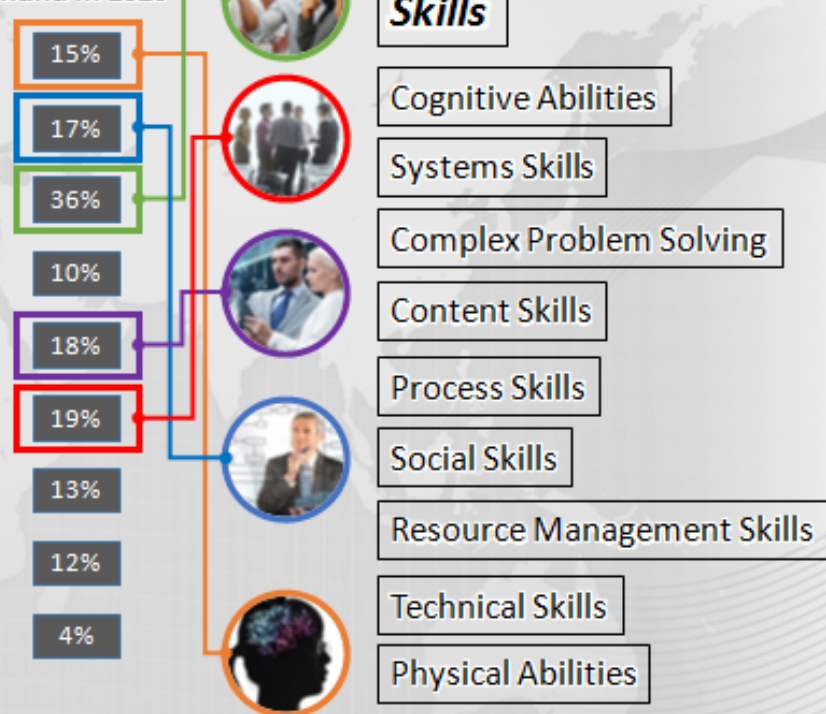
**Skills**

Cognitive Abilities

Systems Skills

Complex Problem Solving

Content Skills

Process Skills

Social Skills

Resource Management Skills

Technical Skills

Physical Abilities

(Share of jobs requiring skills family as part of their core skill set, %)

## *Complex Problem Solving*
Skill to solve alien problem in the real world.

## *Social Skill*
Execute coordination, negotiation, persuade, mentoring, sensitivity of giving help and emotional intelligence.

## *Process Skill*
The skill consisted of: *active listening, logical thinking, dan monitoring self and the others.*

## *System Skill*
Conduct judgement and make decision with cost-benefit consideration and thorough knowledge how a system constituted and operated

## *Cognitive Abilities*
The skill consisted of: Cognitive Flexibility, Creativity, Logical Reasoning, Problem Sensitivity, Mathematical Reasoning, dan Visualization.

Source: The Future of Jobs Report, WEF

# Most Effective Solution



Skills Development:
Not just Skills,
but the RIGHT SKILLS...

FILLING THE GAP

Source: Amatrol

# What doesn't Work?

➢ **Copy and Paste a System**

• Simple and schematic transfer of one system to another context generally do not work.

➢ **Thinking that TVET lives in isolation**

• Complex economic, labor market and education sector challenges are not solved by improvements in the TVET system alone.

*TVET has to be Contextualized*

# Role of TVET I: Picture of Human

- LLL and Learning Society

| | Analyzing, Decision Making, Leading | VQF Level | Analyzing, Decision Making, Leading | White Collar "Thinking and Decision Making |
|---|---|---|---|---|
| | | 8 | | |
| | | 7 | | |
| | | 6 | | |
| | | 5 | | |
| | Practical Voc. Skills, Operating | 4 | Practical Voc. Skills, Operating | Blue Collar "Manual Work and Labour" |
| | | 3 | | |
| | | 2 | | |
| | | 1 | | |

# Role of TVET II: The overall objective

**Education (Vocational College)**

- Bridging towards H.Edu
- provision of technical know.
- critical thinking and reflection
- creating a basis for LLL

**Vocational Competence Development**

**TVET Objective** as determine
- Vocational Training
- Curriculum Framework
- Training Regulation

- Efficiency of work process and
- quality of outcome
- Repetitive skills training

**Training / Skills Development**

# Role of TVET III: Vocational Didactics

Technical and theoretical knowledge

| Input | Input | Input | Input |

Work process | Participatory Planning

Experience based learning through action orientation

Final Goal | Reflection
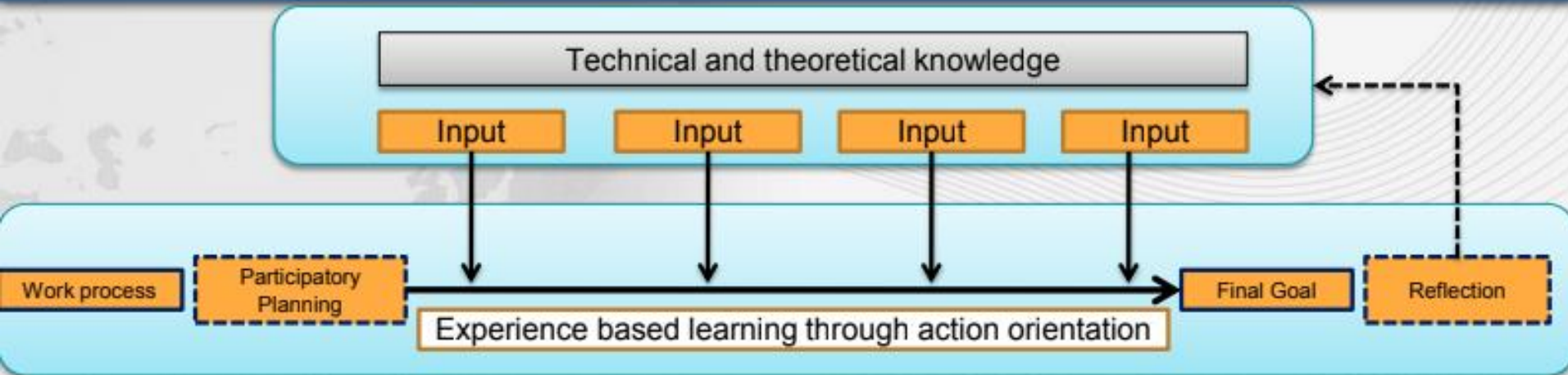
- Worktask- and workprocess based experiential learning
- Combination of input and action planning
- Participatory planning and decision making and reflection as a basis of LLL
- Development of other competences such as: Critical thinking, problem solving, innovation etc

# Role of TVET IV: Innovation in Curriculum



University, Engineering

**Technology**
Innovation in:
Material
Components/part
Tools/IR4.0
etc

*Transformation*

**Labour Market**
-enterprise
-chamber

**Word of Work**
Work task
Processes
Machinery
etc

*Transformation*

**TVET System**
Teacher/trainer education,
Organizational development
Curriculum development
Learning methodology
Assessment tools
etc

VET, enterprise
-RD,
-college

# PROBLEMS

# Results show lack of thinking and problem-solving skills

PUTRAJAYA: While the overall UPSR results may be satisfactory, the same cannot be said of the thinking and problem solving skills of the pupils.

The Education Ministry's first Aptitude Test for Year Six pupils during the UPSR exam shows that only 5.7 per cent (29,084 students) of 509,885 are skilled at problem solving and decision making.

It also shows that only 34.34 per cent (175,101) are skilled in thinking. The candidates sat for the test on the last day of the UPSR examination.

Director-general of Education Tan Sri Alimuddin Mohd Dom said yesterday that 29,084 pupils scored the highest (Band 4) for problem solving and decision making skills while the majority (243,258 pupils) only managed to score

had 60 multiple-choice (objective) questions in three areas — thinking skills, problem-solving and decision-making.

Speaking at a press conference, Alimuddin said a pupil's aptitude level was categorised from Band One (lowest skilled) to Band Four (highest skilled).

The test results for Problem Solving and Decision Making show that the majority of Year Six pupils, 47.71 per cent (243,258 pupils), remained in Band Two, followed by 28.24 per cent (143,971 pupils) in Band Three and 18.35 per cent (93,572 pupils) in Band One.

In the Skilled Thinking section, 41.04 per cent (209,244) of the pupils were in Band Three, 20.71 per cent (105,580 pupils) in Band Two

# Teachers need to be creative

STUDYING Bahasa Malaysia would be more joyful and effective when the approach to teaching is made simple and relevant. Just avoid making students feel that they are studying the language to pass an examination. Being the national language, instil in students a sense of pride and pa-

tionally made difficult for students, they end up having an aversion for the language. We may no doubt force students to learn and memorise complex words and idioms in the language but the purpose here then is only for them to pass the examination. Beyond this, they may even cast off fathom-

Internet that are suitable for students. The failure on the teachers' part to improvise the contents or materials would further make Bahasa Malaysia a dry subject to learn. Teachers, therefore, need to be more creative.

Students pick up a language with ease if the language is an

read and explore things with an imaginative mind. Their minds can function without manuals when it comes to operating the computer or the hand phone. Often their minds delve into fantasies and mysteries with scientific nuances to them. Though not many such materials are found in

of little help if they are not taught to use them in communication. If we made a random survey of the language genre people are generally involved in, it normally revolves around the use of simple words and expressions. Seldom do we hear people use archaic
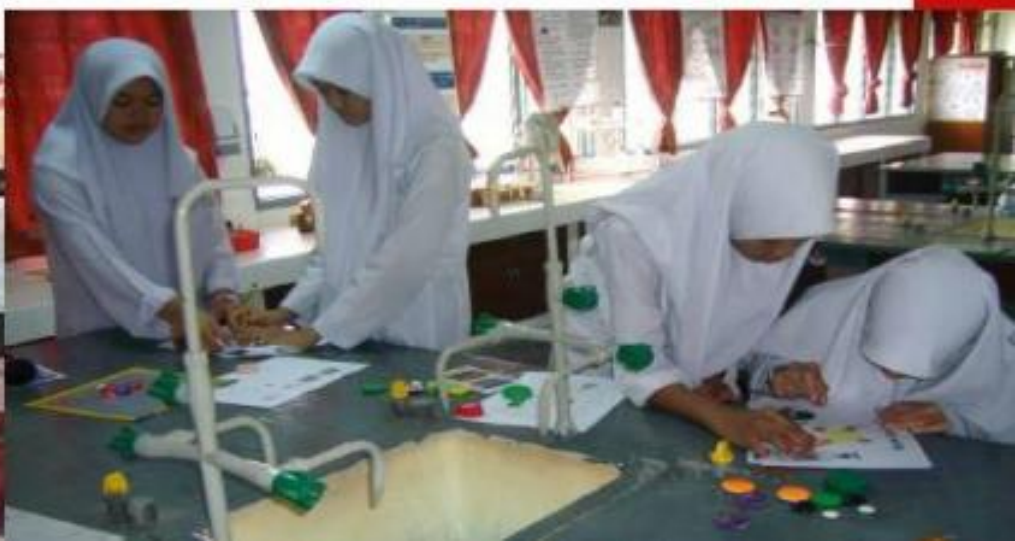
# 19th Century Classroom

# 20th Century Curriculum and Teachers

# 21st Century Learner

- The following key areas are considered to build new TVET.

 Hybrid / Blended Learning, online

 Establishing life-long learning setup

 Re-Engineering of occupational profiles & curricula

 Qualification concepts for TVET staff

 Concepts for learning environments

# Digital Learning Process in FIRe

- In order to produce skilled workers, curriculum needs a new orientation due to FIRe.

  - Data Competence – ability to analyze big data

  - Technology Competence – ability to understand AI.

  - Human Competence – ability to communicate & design.

Anytime, Anywhere


Personal


Flexible Delivery


Why/Where not just What/How

# TVET 4.0

➢ Ensuring that our students and graduates are well equipped to secure PRODUCTIVE EMPLOYMENT in their chosen career path
➢ Technology-driven
➢ Tightly aligned with the practical needs of the economy


Evaluate not just Examine


Modular and Projects


Practical Application


Peers and Mentors


Student Ownership

# Learning Anytime, Any where

24/7 days
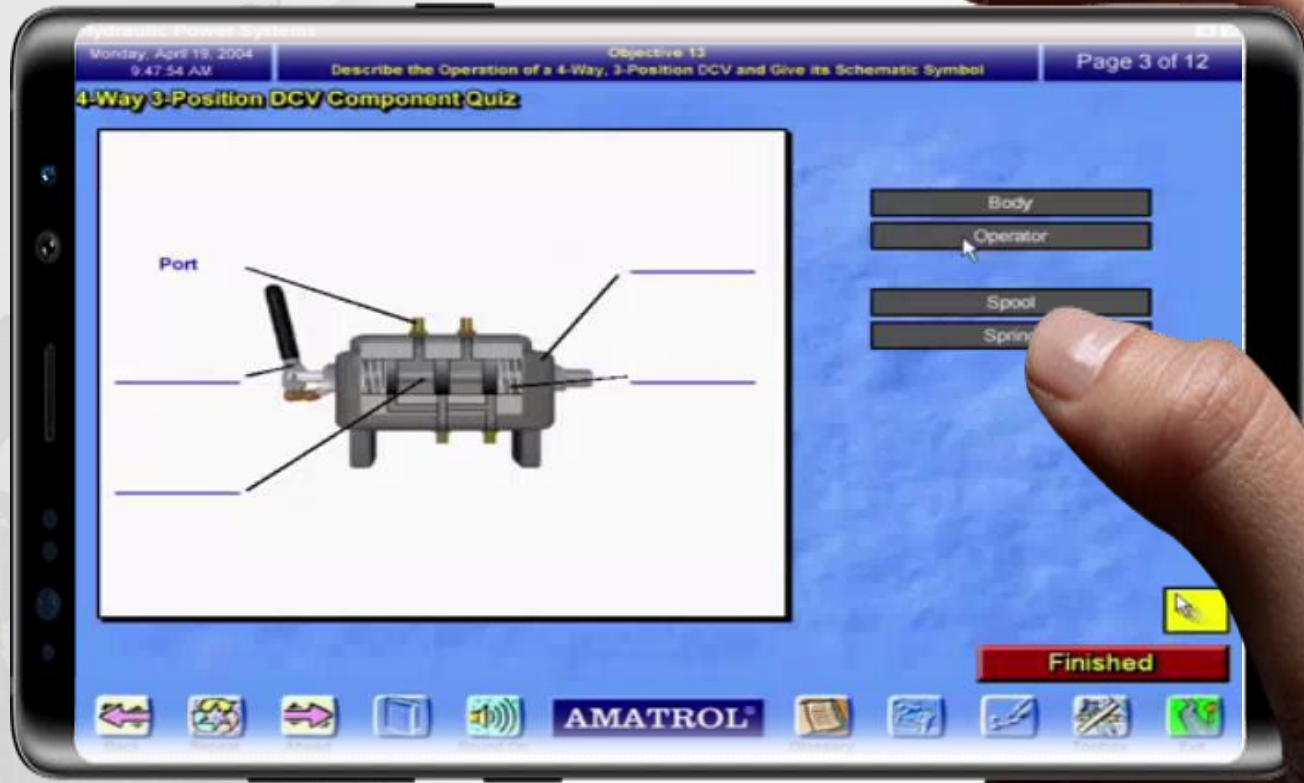
# Tools

**A variety of effective teaching tools such as:**

Video

Virtual animation

3D animation

Text

Audio.
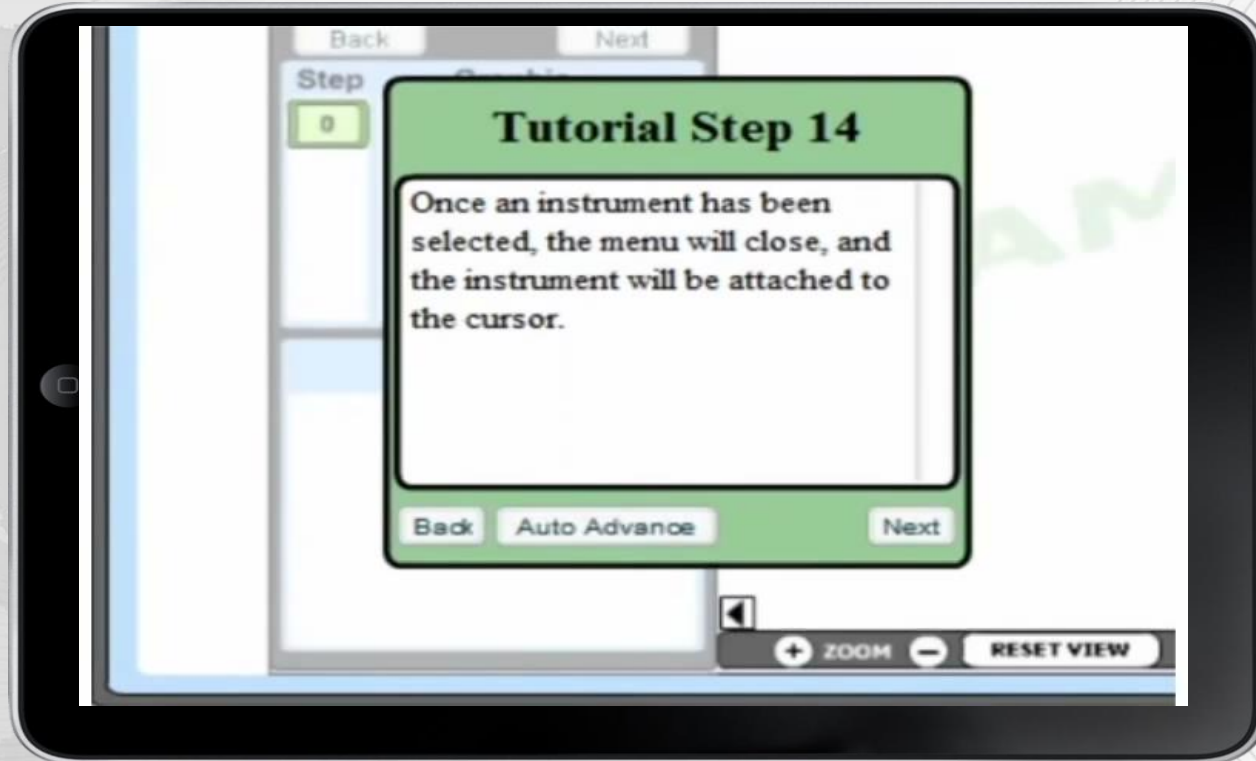
# Online Resources/Tools

- CPSC OnCourse (http://oncourse.cpsctech.org/)
- Google Classroom (https://classroom.google.com )
- Moodle Platform (https://gnomio.com )

Technical Skills Development tools

- Industry 4.0 Fundamentals (https://amatrol.com/)
- Virtual system design and simulation (http://www.automationstudio.com/)
- Lab Tech (https://www.labtechsrl.com/en/)
- Famic Tech (https://www.famictech.com/en/)

# Online Resources/Tools

- Adobe Captivate – Design awesome courses and assessment
- Menti meter – Design online discussion tools (www.menti.com )
- Class Maker (www.classmaker.com )
- ASSistments (www.assistment.com )
- Lectora online Assessment (www.trivantis.com )

# Approaches and Practices on Lifelong Learning
# of CPSC Member Countries - FIRe

# Regional Training modules on "Fit for Industry 4.0"

- Regional In-Service Training Modules for the ASEAN Region by RECOTVET



| Module 1 | Module 2 | Module 3 | Module 4 | Module 5 |
|---|---|---|---|---|
| Innovative Teaching and Learning for Industrial Changes | Professional development training for TVET teachers | Work process and competency based curriculum development | Quality assurance and quality development in TVET | Partnering with Industry: Industry and Vocational Institute Linkages |

**Fit for Industry 4.0**

- **Complete 3 out of 5 modules under respective track to receive the Digital Readiness Certificate    to be a true Worker 4.0!**



**Technical Track**

Hands-on training in digital equipment and devices

Complete 3 modules to receive **Digital Readiness: Technical**

- CoC in Introduction to Industrial Robot
- CoC in Smart Living Solutions (eHome)
- CoC in Internet of Things (Using Sigfox Technology)
- CoC in VTOL Aircraft (Drone) Operation
- CoC in Internet of Things (Smart Energy Fundamentals)

**Emerging Technologies Track**

Understanding new technologies and their applications

Complete 3 modules to receive **Digital Readiness: Emerging Technologies**

- CoC in Target Market with Data Analytics
- CoC in Customer Engagement with ChatBot
- CoC in Marketing Campaign with Augmented Reality
- COC in Cybint Cyber Security Protection Programme
- COC in Fundamentals of Cloud Computing

**Coding & Software Track**

Learning fundamental software programming skills

Complete 3 modules to receive **Digital Readiness: Coding & Software**

- COC in Computational Thinking using Python
- COC in RPA Developer Foundation Training
- COC in Data Engineering using Power Query
- COC in Create Visualization with Qlik Sense
- COC in Agile and Scrum Fundamentals

**FOUNDATION MODULES**

- CoC in Micro:bit Applications
- SkillsFuture for Digital Workplace

Training Partners: *ITE* Institute of Technical Education

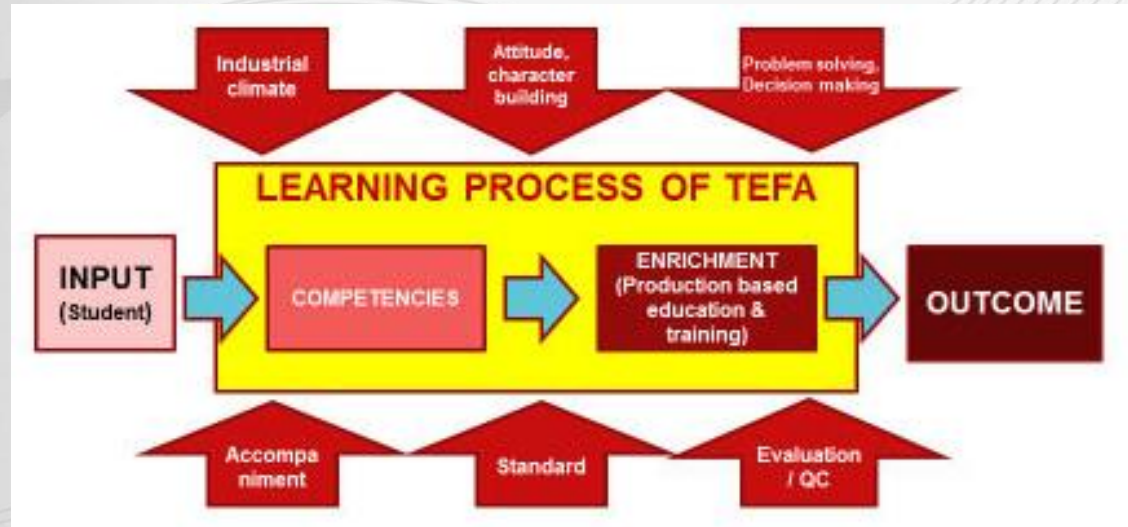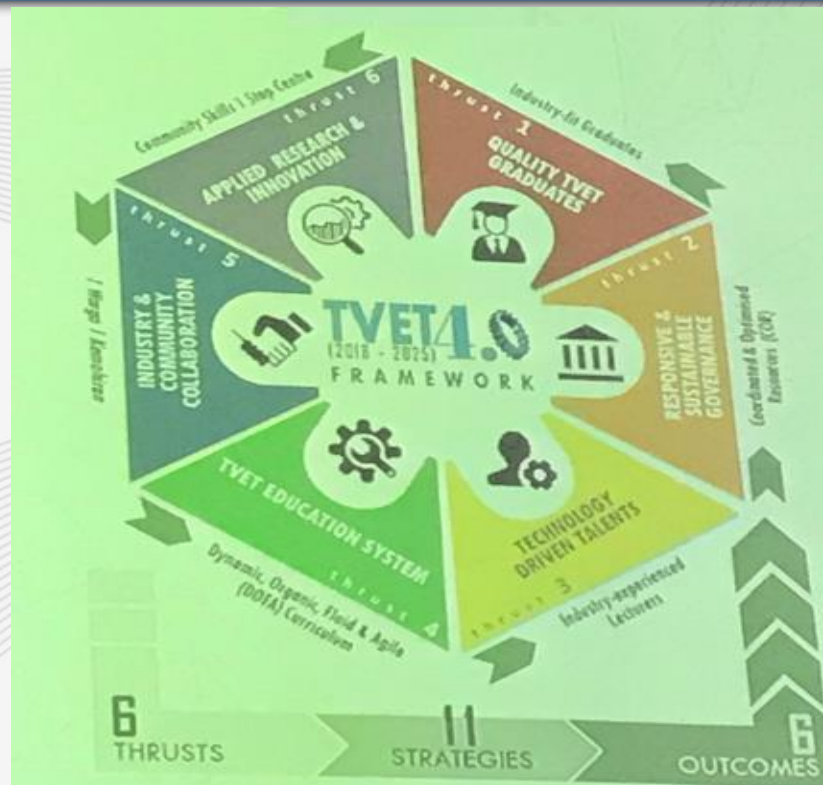Agencies: **IIM** INFOCOMM MEDIA DEVELOPMENT AUTHORITY

**ntuc**

**ntuc LearningHub**

**SKILLS future SG**

**e2i**

**ULeap**

- **The Teaching Factory is an efficient and effective learning method, which adopts a practice and application-oriented training that combines the learning and working environment from realistic and relevant industrial atmosphere and experiences.**
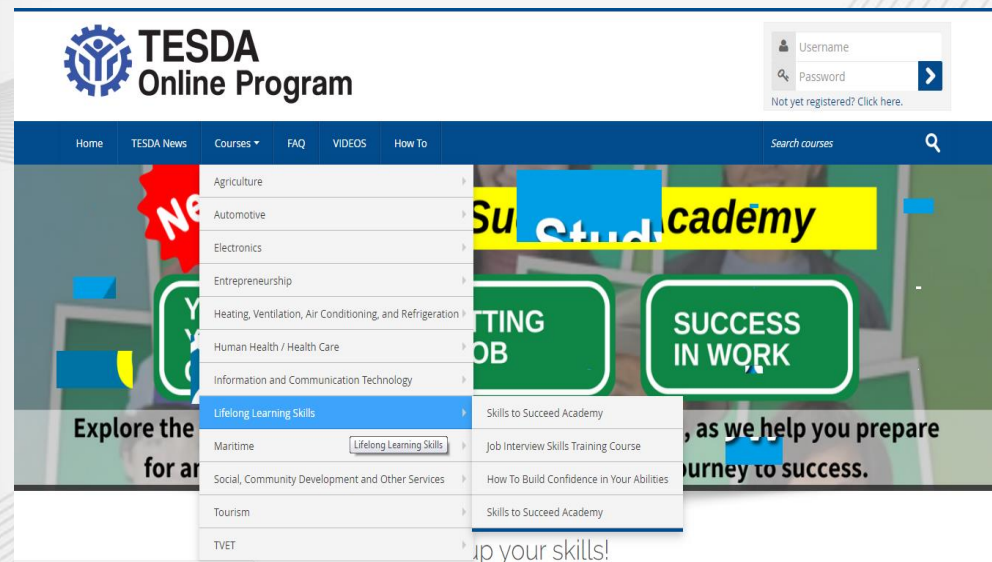
- **6 Thrusts Areas**

- **11 Strategies**

- **6 Outcomes**

- **Initiatives**
  - **Upskilling and Reskilling Programmes**
  - **4IR driven institutions**
  - **4IR Awareness Programes**
  - **4IR Entrepreneurship Programes**
  - **4IR Infrastructure**
  - **4IR Communities Programes**



Source: Dr. Naim Yaqoob, Presentation on Opportunities and Challenges of IR4.0

Planning Prosperity Together

**Planning Prosperity Together**

- **Online Training Programs on:**

  - **Trainers Methodology**
  - **21$^{st}$ Century Skills**
  - **Skills to Succeed**

CPSC Strategy on FIRe

Awareness Programs on FIRe

Develop teaching & learning material in line with FIRe

Implementation of Plan

CPSC Strategy on FIRe

Capacity Development Plan on FIRe

Planning Prosperity Together
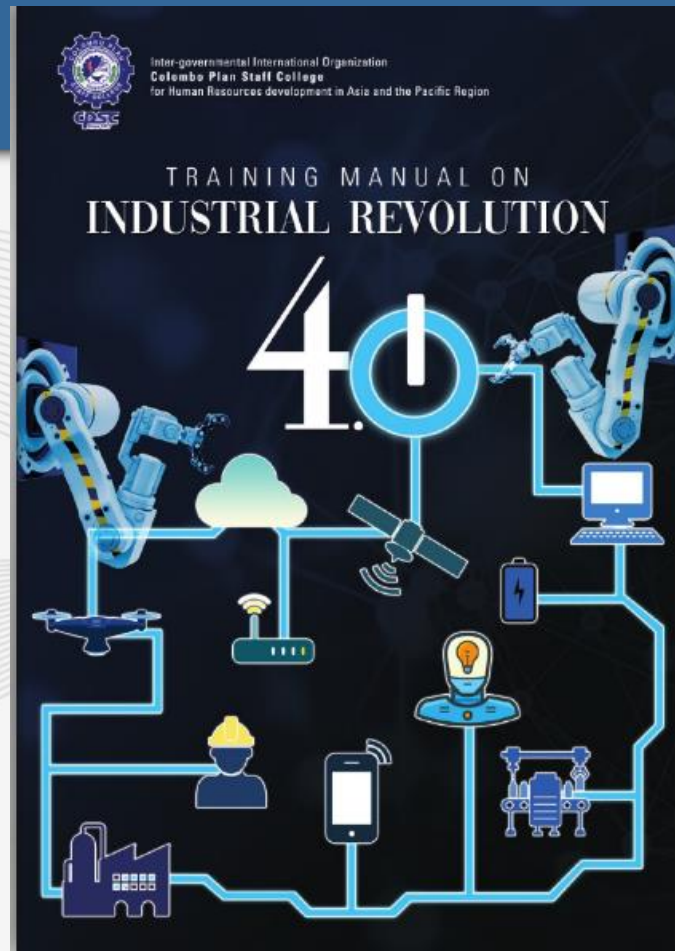
# CPSC Initiatives on FIRe

- **Developed a Training Manual on IR4.0 for capacity building of CPSC member countries TVET stakeholders on FIRe.**
  - **Trained 30 TVET instructors on FIRe**
  - **Organized capacity building workshop to develop and update TVET curricula in line with IR4.0**

- **Future Initiatives**

  - **Readiness of TVET for IR 4.0, 8 -12 Dec 2019, Bangladesh**
  - **Regional Program on Skilling TVET in the Era of Industrial Revolution 4.0 on August 25-29, 2019 in Manila, Philippines.**

Inter-governmental International Organization
Colombo Plan Staff College
for Human Resources development in Asia and the Pacific Region

TRAINING MANUAL ON
INDUSTRIAL REVOLUTION
4.0

# Win or Lose? depends on absorptive capacity

- **Now**

  - **Build Capacity**

    - **Infrastructure**

      - Physical + Digital

      - Social

# Win or Lose? depends on absorptive capacity

- **Now**

  - **Build Capacity**

    - **Infrastructure**

    - **Institutions**

      - IR 4.0 policy

      - Competitiveness policy

      - Capacity building policy

# Win or Lose? depends on absorptive capacity

- **Now**

  - **Build Capacity**

    - **Infrastructure**

    - **Institutions (different policies)**

    - **Intelligence (learn how to learn fast)**

# Win or Lose? depends on absorptive capacity

- **Soon**

  - **Re-equip the workforce (again and again) Infrastructure**

    - Skill acquisition as a continuing process of lifelong learning

    - More cost-efficient modes of learning

      - TVET including apprenticeships

# Win or Lose? depends on absorptive capacity

- **Soon**

  - **Re-equip the workforce (again and again) Infrastructure**

    - Skill acquisition as a continuing process of lifelong learning

    - More cost-efficient modes of learning

      - TVET including apprenticeships

  - **Re-imagine TVET**

    - **IR4.0 enabled learning**

    - **Training the trainers**

# Key Messages

- A college or university degree does **<u>not</u>** guarantee immunity from automation.
- BUT having the right skills set matters.
- The **youth, less educated, and lower-income groups** have a higher proportion of high risk workers.

Thank You!