TVET Today, 4th Industrial Revolution Tomorrow!

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The Burning Questions!

- What does Industry 4.0 really mean? Is it Digital Transformation?
- What does digitization entail for manufacturing/services?
- How profound will its impact be on our value pools?
- What are the near-term business opportunities for the organisation?
- What type of skills should we focus on?
- Whether the term is simply hype?

This myriad of mixed reactions reveals the intense uncertainty associated both with what Industry 4.0 actually is and how government, companies and individual should respond to the changing industrial environment.
Content

- Demystifying the 4th Industrial Revolution
- Industry 4.0 and Digital Transformation
- Industry 4.0/Digital Transformation: The Malaysian Context
- Way forward – Skills for IR4.0
The 4th Industrial Revolution/ Industry 4.0

**First Industrial Revolution**
- Based on the introduction of mechanical production equipment driven by water and steam power
- First mechanical loom, 1784

**Second Industrial Revolution**
- Based on mass production achieved by division of labor concept and the use of electrical energy
- First conveyor belt, Cincinnati slaughterhouse, 1870

**Third Industrial Revolution**
- Based on the use of electronics and IT to further automate production
- First programmable logic controller (PLC) Modicon 084, 1969

**Fourth Industrial Revolution**
- Based on the use of cyber-physical systems
A **cyber-physical system (CPS)** is a system of collaborating computational elements controlling physical entities. CPS are physical and engineered systems whose operations are monitored, coordinated, controlled and integrated by a computing and communication core. They allow us to add capabilities to physical systems by merging computing and communication with physical processes.
Key Drivers for IR4.0

- Opportunity to integrate and better manage horizontal and vertical value chains.
- More than 18% higher productivity over the next five years.
- The digitization and interconnection of products and services (Internet of Things/Services) ensuring competitiveness and promises additional revenues of 2% to 3% per year on average.
- The newly emerging, often disruptive, digital business models that offer significant additional value to customers through tailor-made solutions.
Building Blocks of Industry 4.0

- Autonomous Robots
- Simulation
- Horizontal and vertical system integration
- Cyber Security
- Industrial Internet of Things
- Additive Manufacturing
- Augmented reality
- Big data analytics
Industry 4.0: Combination of a Wide Set of Technologies
The Goal of Industry 4.0: Intelligent Factory

Characterized by adaptability, efficiency and a full digital integration

Factory 4.0 – Overview

Source: Roland Berger
Data and communication will be the backbone of Industry 4.0

Positioning of different players for Industry 4.0 – Factory view

ERP System

MES System

Factory 4.0

Controls & Automation

MES System

Client

"Virtual" Production routing

Building automation

Big Data Services

> Storage capacity
> Algorithms and analytics
> Connectivity

3D Data

> Product 3D data
> Factory 3D data
> PLM data

Players¹

> Oracle
> SAP
> SIEMENS

Data/Func.¹

> All transaction data
> Asset data
> Price/cost data

ERP System

MES System

Sensors/Automation

> Sensor status like pressure, position etc., communication with other sensors
> Machine control data

Building Automation

> Status of all building data, e.g. temp., light, access control, ventilation

3D Data

> Product 3D data
> Factory 3D data
> PLM data

MES= Manufacturing Execution System

¹ Not exhaustive; examples only

Source: Roland Berger
Potential Industry 4.0 Solutions
Value Drivers of Industry 4.0

- Resource/Process
- Asset Utilisation
- Labour
- Inventories
- Quality
- Supply/demand match
- Time to market
- Services/After sales

Source: McKinsey
Indicative Quantification of Value Drivers – Impact of IR 4.0

1. 10 - 40% reduction of maintenance costs
2. 20 - 50% reduction in time to market
3. Forecasting accuracy increased to 85+
4. Costs for quality reduced by 10 - 20%
5. Costs for inventory holding decreased by 20 - 50%
6. Productivity increase by 3 - 5%
7. 30 - 50% reduction of total machine downtime
8. 45 - 55% increase of productivity in technical professions through automation of knowledge work

Source: McKinsey
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“The investment in and development of new technologies, mindsets, and business and operational models to improve work and competitiveness and deliver new and relevant value for customers and employees in an ever-evolving digital economy.”

Industry 4.0 is part of Digital Transformation!
Digitization of Everything

### Extent of Digitization Varies by Sector

**MGI Sector Digitization Index**  
2015 or latest available US data

<table>
<thead>
<tr>
<th>Sector</th>
<th>Assets</th>
<th>Usage</th>
<th>Labor</th>
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<tbody>
<tr>
<td></td>
<td>Overall</td>
<td>Digital</td>
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<td></td>
<td>digitization</td>
<td>spending</td>
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<td>Transactions</td>
<td>Digital</td>
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<td>asset stock</td>
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<tr>
<td>Professional services</td>
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<td></td>
<td></td>
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<tr>
<td>Finance and insurance</td>
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<td></td>
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<tr>
<td>Wholesale trade</td>
<td>5</td>
<td></td>
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<tr>
<td>Advanced manufacturing</td>
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<td></td>
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<tr>
<td>Oil and gas</td>
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<td>Utilities</td>
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<tr>
<td>Chemicals and pharmaceuticals</td>
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<tr>
<td>Basic goods manufacturing</td>
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<tr>
<td>Mining</td>
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<td></td>
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<tr>
<td>Real estate</td>
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<td></td>
<td></td>
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<tr>
<td>Transportation and warehousing</td>
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<tr>
<td>Education</td>
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<tr>
<td>Retail trade</td>
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<td></td>
<td></td>
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<tr>
<td>Entertainment and recreation</td>
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<td></td>
<td></td>
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<tr>
<td>Personal and local services</td>
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<tr>
<td>Government</td>
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<tr>
<td>Health care</td>
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<tr>
<td>Hospitality</td>
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<td></td>
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<tr>
<td>Construction</td>
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<td></td>
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<tr>
<td>Agriculture and hunting</td>
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<td></td>
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</tbody>
</table>

**Sources:** BEA; BLS; US Census; IDC; Gartner; McKinsey social technology survey; McKinsey Payments Map; LiveChat customer satisfaction report; Appbrain; US contact center decision-makers guide; eMarketer; Bluewolf; Computer Economics; industry expert interviews; McKinsey Global Institute analysis

**Notes:**
1. Knowledge-intensive sectors, highly digitized
2. Capital-intensive, potential to further digitize their assets
3. Service sectors with long tail of small firms having room to digitize customer transactions
4. B2B sectors with the potential to digitally engage and interact with their customers and users
5. Labor-intensive sectors with the potential to provide digital tools and skills to their workforce
6. Large, localized, low productivity could transform for productivity and delivery of services
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IMD Digital Competitiveness Ranking

The IMD World Digital Competitiveness Ranking 2017

One year change

Digital Competitiveness Factors and Sub-factors

**Factors**
- Knowledge
- Technology
- Future Readiness

**Sub-factors**
- Knowledge: Know-how necessary to discover, understand and build new technologies.
- Technology: Overall context that enables the development of digital technologies.
- Future Readiness: Level of country preparedness to exploit digital transformation.

**Factors**
- Talent
- Training and Education
- Scientific Concentration

**Sub-factors**
- Regulatory Framework
- Capital
- Technological Framework
- Adaptive Attitudes
- Business Agility
- IT Integration

Computing the Rankings

Hard Data
- Statistics from international regional and national sources

Survey Data
- International panel of experts Executive Opinion Survey

Compute STD Values
- Individually, for all criteria used in the rankings

Criteria Rankings
- Each of the 50 criteria is individually ranked for the countries

Factor Rankings
- Knowledge, Technology, Future Readiness

Overall Rankings
- Aggregates the STD values for all the 50 ranked criteria
Top 10 Countries

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Technology</th>
<th>Future Readiness</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>6</td>
<td>Singapore</td>
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<tr>
<td>2</td>
<td>5</td>
<td>5</td>
<td>Sweden</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>2</td>
<td>USA</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
<td>4</td>
<td>Finland</td>
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<tr>
<td>8</td>
<td>10</td>
<td>1</td>
<td>Denmark</td>
</tr>
<tr>
<td>11</td>
<td>9</td>
<td>3</td>
<td>Netherlands</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>17</td>
<td>Hong Kong SAR</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>13</td>
<td>Switzerland</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>8</td>
<td>Canada</td>
</tr>
<tr>
<td>15</td>
<td>2</td>
<td>12</td>
<td>Norway</td>
</tr>
</tbody>
</table>


Digital Evolution Index -2017

**Stand Out** countries are both highly digitally advanced and exhibit high momentum.

**Stall Out** countries enjoy a high state of digital advancement while exhibiting slowing momentum.

**Break Out** countries are low-scoring in their current states of digitalization but are evolving rapidly.

**Watch Out** countries face significant challenges with their low state of digitalization and low momentum.

The Fletcher School, Tufts University
IR 4.0 In Malaysia

Spearheading the formulation a national policy on Industry 4.0
Where are we on IR 4.0 Journey

- Awareness
- Industry Consultation
- Talent Ecosystem
- Policy Paper WIP

Government initiated Development
What’s the progress with Industry?

Why

1. Lack of resources both capital & talent
2. Lack of Awareness
3. Don’t know where they are in the industrial revolution continuum.....

The Multinationals are leading the pack whilst the SMEs are still struggling
IR 4.0 Digital Initiatives Clusters and Complexity

Source: McKinsey
What’s is needed to drive IR 4.0?

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

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

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

- **Logistic 4.0**
  - Modern logistic infrastructure

- **Policy**
  - Competent Human Resources
  - Employment
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Top 5 Challenges

- Employee Pushback
- Lack of Expertise to Lead IR 4.0 Initiatives
- Organizational Structure
- Lack of Overall Strategy
- Limited Budget
- Lack of Talent
IR 4.0 Readiness - Assessment

- Employees
  - Smart operations
  - Smart products
  - Smart factory
- Data-driven services
  - Data analytics in usage phase
  - Information sharing
- ICT add-on functionalities
- Data usage
- Equipment infrastructure
- Digital modeling
- Investment
- Innovation management

Levels:

1. Level 0: Outsider
2. Level 1: Beginner
3. Level 2: Intermediate
4. Level 3: Experienced
5. Level 4: Expert
6. Level 5: Top performer

Categories:

1. Leaders
2. Learners
3. Newcomers
Sample Industry 4.0 Readiness Assessment Template

Industry 4.0 readiness self-assessment templates

These templates will help to document and benchmark your company’s current level of Industry 4.0 readiness. For each of the dimensions, use the readiness assessment criteria to identify your current level of readiness (1, 2, 3, or 4) for each of the sub-dimensions. Transfer those levels to the summary table below. If a sub-dimension is not relevant, mark it as NR. Repeat the exercise to document your future ambition.

You can then benchmark your company results by listing the scores for your current Industry 4.0 readiness on the relevant spidergram and joining them together. In different colour, repeat for future ambition to highlight the gap between current readiness and future ambition.

Overall Industry 4 readiness

Consider your company’s overall Industry 4.0 readiness. Plot the scores for the current state dimension averages to the spidergram and join them together. In a different colour, repeat for future ambition.
## Top 10 Skills to be relevant in Industry 4.0

<table>
<thead>
<tr>
<th>in 2020</th>
<th>in 2015</th>
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<tbody>
<tr>
<td>1. Complex Problem Solving</td>
<td>1. Complex Problem Solving</td>
</tr>
<tr>
<td>2. Critical Thinking</td>
<td>2. Coordinating with Others</td>
</tr>
<tr>
<td>3. Creativity</td>
<td>3. People Management</td>
</tr>
<tr>
<td>4. People Management</td>
<td>4. Critical Thinking</td>
</tr>
<tr>
<td>5. Coordinating with Others</td>
<td>5. Negotiation</td>
</tr>
<tr>
<td>6. Emotional Intelligence</td>
<td>6. Quality Control</td>
</tr>
<tr>
<td>7. Judgment and Decision Making</td>
<td>7. Service Orientation</td>
</tr>
</tbody>
</table>

Source: Future of Jobs Report, World Economic Forum
Categorisation of Skills

**Cognitive Analytics**
- Cognitive Flexibility
- Creativity
- Logical Reasoning
- Problem Sensitivity
- Mathematical Reasoning
- Visualization

**Content Skills**
- Active learning
- Oral expression
- Reading comprehension
- Written expression
- ICT literacy

**Social Skills**
- Coordinating with others
- Emotional intelligence
- Negotiation
- Persuasion
- Service orientation
- Training & teaching others

**Physical Abilities**
- Physical strength
- Manual dexterity
- Manual precision

**Process Skills**
- Active listening
- Critical thinking
- Monitoring self and others

**Resource Management Skills**
- Managing financial resources & material resources
- People management
- Time management

**Systems Skills**
- Judgement and decision making
- Systems analysis

**Complex Problem Solving Skills**
- Complex problem solving

**Technical Skills**
- Equipment maintenance, repair, operation & control
- Programming
- Quality control
- Troubleshooting
- Technology & user experience design

[Diagram with categories and subcategories of skills]
Change in Demand for Core-Work Related Skills

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<tbody>
<tr>
<td>2015</td>
<td>11%</td>
<td>16%</td>
<td>36%</td>
<td>10%</td>
<td>18%</td>
<td>20%</td>
<td>14%</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>2020</td>
<td>15%</td>
<td>17%</td>
<td>36%</td>
<td>10%</td>
<td>18%</td>
<td>19%</td>
<td>13%</td>
<td>12%</td>
<td>4%</td>
</tr>
</tbody>
</table>

Source: Future of Job Survey, World Economic Forum

Note: In above chart, the percentage in bar chart indicates the percentage of jobs indicating growing / stable / declining demand for a particular skill family as core skill set.
Important Qualifications & Skills for Industry 4.0

1. Knowledge about ICT
   - Basic Information Technology knowledge
   - Ability to use and interact with computers and smart machines like robots, tablets etc.
   - Understanding machine to machine communication, IT security & data protection

2. Ability to work with data
   - Ability to process and analyze data and information obtained from machines
   - Understanding visual data output & making decisions
   - Basic statistical knowledge

3. Technical know-how
   - Inter-disciplinary & generic knowledge about technology
   - Specialized knowledge about manufacturing activities and processes in place
   - Technical know-how of machines to carry out maintenance related activities

4. Personal Skills
   - Adaptability & ability to change
   - Decision making
   - Working in team
   - Communication skills
   - Mindset change for lifelong learning

Source: Roland Berger
Creation of a Robust Vocational Education & Training

Characteristics of a good VET System

- **Curriculum**
  - Providing access to up-to-date curriculum which is in-line with the industry's skill requirement

- **Practical Training**
  - Providing opportunities for students to learn & practice in industry setting through apprenticeships or dual training system

- **Infrastructure**
  - Creating holistic learning environment by providing access to state-of-art industrial machinery, equipment & tools

- **Standards & Qualification**
  - Providing widely recognized standards & qualifications (NQF), which also allows students to change education tracks

- **Quality of trainers**
  - Availability of sufficient numbers of qualified trainers who have industry experience & knowledge about latest industrial practices

- **Positive Image**
  - Creating a positive image of vocational education such that young people find it attractive as a career opportunity
THANK YOU