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Industry 4.0 – Competence requirement of key personnel

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Foreword

This SIRIM Standard was developed by the Project Committee on Industry 4.0 competency established by SIRIM Berhad.

This standard was developed with the following objectives:

- a) to provide understanding on the competency requirements for key personnel in an organisation adopting Industry 4.0 technology;
- b) basis in setting a framework for competency of personnel in an Industry 4.0 organisation;
- c) developing a guidance document for those involved in educating and training of skill workforce and talent for Industry 4.0;

This standard will be reviewed periodically, and if necessary, revised, to ensure that it reflects current needs and conditions. Users and other interested parties may submit comments on the contents of this standard for consideration in future versions.

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Industry 4.0 – Competence requirement of key personnel

0. Introduction

0.1 Competence

Competences are the knowledge, skills, displaying professional attitudes, and behavior that relate to a successful performance of people in their work, functions or responsibilities. This set of knowledge, skills and attitude are applied in situations of the productive field and results in effective results that contribute to the achievement of the organisation objectives.

Competence can be developed by:

- learning, which can be formal, non-formal and informal or a combination of each;
- training and experience;
- combining knowledge and skills with a professional attitude;
- experiential

0.2 Industry 4.0

The idea behind industry 4.0 is to blend systems and people – creating an integrated smarter workforce that achieves more. One of the challenges involved in making this into reality is making sure the teams have the skills needed to work alongside the machines. The skills needed for Industry 4.0 are numerous and diverse has been recognized in various studies. Most study clustered the identified competencies into four main categories which are:

- Technical competence: competences in Information system and operational system.
- Methodological competence including creativity, entrepreneurial thinking, problem solving, conflict solving, decision making, and analytical skills.
- Social competence such as intercultural skills, language skills, communication skills, networking skills, and ability to work in a team, ability to be compromising and cooperative, ability to transfer knowledge and leadership skills.
- Personal competence that includes flexibility, motivation to learn and sustainable mindset.

1. Scope

This standard defines the competence consisting of knowledge, skill and attributes of key personnel involved in an organisation implementing Industry 4.0. This standard establishes the base for professional knowledge, skills, and attributes necessary for the key personnel in an Industry 4.0 organisation to perform a job effectively.

2. Normative references

The following normative references are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the normative reference (including any amendments) applies.

SIRIM 36; *Industry 4.0 organisations – maturity level*

3. Terms and definitions

3.1 competence

Demonstrated personal attributes and ability to apply knowledge and skills

3.2 competency

Knowledge, understanding, skill or attitude that is observable and/or measurable, which is applied and mastered in a given work situation and in professional development and/or in personal development.

3.3 skill

Ability to apply knowledge to complete tasks and solve problems.

4. Industry 4.0 competences

4.1 General

Organisation implementing Industry 4.0 can be from all type of sector, be it manufacturing, services, trading company or even public sector. Each different sector or industry will require a different set of competences according to their sector need. The development of Industry 4.0 in an organisation or enterprise is possible only if the competences required for its implementation is there. Managers, engineers, supervisors and operators need a certain competence to perform their role and task successfully. Competence can be defined as knowledge, skills and attributes as in Figure 1 below:

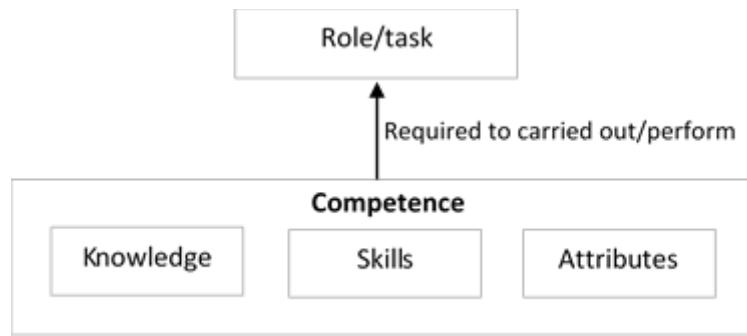


Figure 1. Relationship between task and competence

4.2 Implementation of Industry 4.0

4.2.1 To adopt and implement the technologies of Industry 4.0, the workforces should have several skills and competencies such as:

- a) fundamental understanding of ICT systems, automation technology, and data analysis;
- b) being aware of issues concerning data abuse and ICT security;
- c) interdisciplinary knowledge and an understanding of interconnected systems;
- d) decision-making competence of the workers, especially when automation of processing steps increases planning and controlling tasks

These skills and competencies can be developed and improved through trainings and education programs, for example, scenario-based or e-learning program.

4.2.2 In ensuring that the workforces are prepared for implementation of Industry 4.0, the organisation shall:

- a) determine the necessary competencies for its key personnel subject to the minimum competencies as given in this standard;
- b) provide training or take other actions to achieve the necessary competency, where applicable;
- c) evaluate the competencies of its personnel through the effectiveness implementation of the enabling technologies; and
- d) maintain the competencies of its personnel at appropriate levels.

4.2.3 The organisation should work closely together with training centre or institute of higher learning to ensure that future workforces are equipped with the skills and competencies required by new job profiles.

4.2.4 The recommended type of knowledge for the workforces for the implementation of Industry 4.0 are:

- a) Knowledge in information system and technology (big data analytics, cloud-based services, smart operation technology).
- b) Knowledge in operational technology (cyber physical system, smart factory).
- c) Knowledge in managing and developing people.
- d) Knowledge in data collection, data extraction and data analytics.
- e) Knowledge in managing and maintaining digital systems and networks.
- f) Knowledge in managing analytics.
- g) Knowledge in cybersecurity.
- h) Knowledge in management of software and interfaces that support operations management (resources, people, production).
- i) Knowledge in management of simulation system.
- j) Knowledge of lean manufacturing methodologies, technique and tools.
- k) Knowledge in management of software and interfaces.
- l) Knowledge in statistics

4.2.5 The recommended skill set for the workforces for implementation of Industry 4.0 includes:

- a) Ability to understand the enabling technology for integration between operational technology and information technology.
- b) Ability to analyse data and the use of tools for understanding the business.
- c) Ability to use and interact with computers and smart machine like robots, tablet etc.
- d) Ability to translate vast amounts of data into abstract concepts and to understand data-based reasoning.
- e) Ability to process and analyse data and information obtained from machines or equipment.
- f) Ability to understand visual data output and making decision based on the data.
- g) Ability to understand machine to machine communication, IT security, data protection and data integrity.
- h) Ability to effectively collaborate between virtual team members via technology.
- i) Ability to filter information by importance and maximise cognitive functions.

- j) Ability to convey concepts and be able to sense and stimulate reactions.

4.2.6 To support and ensuring effective adoption and implementation of the technologies, the workforces in an Industry 4.0 organisation shall have the following attitudes or attributes, including but not limited to:

- a) Adaptability and flexibility i.e. to adjust readily to changes and open to innovation.
- b) Analytical and critical i.e. evaluate information effectively, articulate and analyze the information.
- c) Decisive i.e. data-driven decision making.
- d) Be perceptive, i.e. aware and capable of understanding situations and able to analyse data behaviours.
- e) Responsible and accountable; i.e. willingness to learn from mistakes.
- f) Observant.
- g) Collaborative/cooperative; i.e. be able to communicate and exchange information.
- h) Optimistic.
- i) Creativity and innovative; i.e. creativity in designing strategies to introduce new practices or solution.
- j) Globally minded and teamwork i.e. able to work with people worldwide

5. Key personnel and role

5.1 Key personnel in an organisation implementing Industry 4.0 can be categorised into four which are:

- a) Management personnel/manager
- b) Technical middle management (including engineer, technician)
- c) Supervisor (may or may not be directly reporting to the management team)
- d) Operator (support the production system)

5.2 Management personnel/manager

The management of an organisation deciding to adopt Industry 4.0 is responsible in setting the organisation strategic thrust. To set and execute the organisation strategic thrust in implementing Industry 4.0, management personnel shall have the appropriate competences through training, experience, expertise and/or qualifications to run the task which include:

- a) identify strategy needed by the organisation
- b) managing risk
- c) assessing organisation's current technical capabilities
- d) identifying potential Industry 4.0 enabling technology for I4.0 implementation
- e) formulating the technology roadmap
- f) designing sustainable implementation plan
- g) developing a system of rules, practices, cultures and processes to translate the industry 4.0 vision into real business value.

NOTE. In conducting management task, management should meet the expectations of the organisation's stakeholder, employee and customer.

5.3 Technical middle management (Engineers)

The main task of technical middle management which include engineers, in organisations implementing Industry 4.0 generally is to perform a range of activities within manufacturing methods and production lines, and other related services which include, but not limited to, task below that can be repeated or extended:

- a) Product development and design
- b) Coordination, planning, and feasibility studies
- c) System integration and development (architecture of Industry 4.0)
- d) Control, monitoring, and handling of disturbances based on data driven decision making (i.e. assuring normal operations and high quality).
- e) Handling of data-based systems.

5.4 Supervisor

The role of a supervisor is generally to supervise a specific division or monitoring the plant operations which includes task of:

- a) ensuring supplies and materials are in a positive flow.
- b) ensuring and that all equipment is functional and safe for use.
- c) maintain a clean and safe working environment
- d) monitor and prioritize workflow of production to meet deadlines.

5.5 Operator

In an organisation adopting technology of Industry 4.0, it is expected that the task of operators is upgraded as from their traditional job. The adoption of Industry 4.0 is to support manufacturing workforce environment in the factories, where smart and skilled operators should perform not only cooperative work with robots, but also work aided by machines.

6. Competencies of key personnel

The role of the human factor will be necessary for smart manufacturing. The skills and qualifications of the workforce will become the key to success of a highly innovative factory. Organisation should focus on the development of qualified workforce. The knowledge, qualification framework and staff training will be an essential part of Industry 4.0. Key personnel shall possess at the minimum basic knowledge of ICT, data analytics, cloud computing, artificial intelligence, machine learning additive manufacturing etc.,

Table 1 describes the fundamental technical competences required for key personnel for Industry 4.0 adaptation. This competency requirements is in accordance with level 4 of maturity index in SIRIM 36.

Table 1. Fundamental technical competences required for key personnel

<p>Operator</p>	<ul style="list-style-type: none"> • Be able to adopt new models of work and organisation (open to change). • Be able to understand, use and interact with computers and smart machines like robots, tablets etc. • Having the generic knowledge about the technology.
<p>Supervisor</p>	<ul style="list-style-type: none"> • Having the Inter-disciplinary & generic knowledge about technology. • Having the intermediate knowledge and implementation understanding of lean manufacturing methodologies, technique and tools. • Be able to understand and are able to manage the software and interface. • Having the ability of logical thinking and problem solving includes skills such as comparing, evaluating and selecting logical framework for problem solving. • Be able to see and understand the data in the granular scale. • Be able to process and analyses data and information obtained from machines or equipment. • Ability to understand visual data output and making decision based on the data.
<p>Technical middle management (Engineer)</p>	<ul style="list-style-type: none"> • Having the knowledge and implementation understanding of lean manufacturing methodologies, technique and tools. • Be able to adopt and use new or existing information technology to analyze, select and critically evaluate digital information in order to investigate and solve work-related problems and develop a collaborative knowledge body while engaging in organizational practices within a specific organisational context.

	<ul style="list-style-type: none"> • Be able to create valuable insight and utilized it into creation of new value in applications and solutions. • Be able to understand visual data output and making decision based on the data. • Be able to understand open communication protocols, open collaboration concept and approach, network protocol and configuration CPS (network architecture). • Be able to understand and control of machine to machine communication.
Manager	<ul style="list-style-type: none"> • Be able to define the organisation functional need and priorities. • Be able to assess and analyse potential contribution of technology to future organisation. • Be able to understand the value creation of the technology adopted. • Be able to integrate cultural sensitivity and relevance, problem-based learning, and advance technology with real-world application. • Be able to create valuable insight and utilized it into creation of new value in applications and solutions. • Having the ability to analyse data and the use of tools for understanding the business.

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