<table>
<thead>
<tr>
<th>TSC Category</th>
<th>Technology Application Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSC</td>
<td>Robotic and Automation Technology Application</td>
</tr>
<tr>
<td>TSC Description</td>
<td>Integrate robotic and automation technologies in manufacturing workflows, including process operations, maintenance, logistics and plant surveillance, to enhance productivity and precision and reduce reliance on manual tasks</td>
</tr>
</tbody>
</table>

### TSC Proficiency Description

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>ECM-TEM-2003-1.1</td>
</tr>
<tr>
<td>Level 2</td>
<td>ECM-TEM-3003-1.1</td>
</tr>
<tr>
<td>Level 3</td>
<td>ECM-TEM-4003-1.1</td>
</tr>
<tr>
<td>Level 4</td>
<td>ECM-TEM-5003-1.1</td>
</tr>
<tr>
<td>Level 5</td>
<td>ECM-TEM-6003-1.1</td>
</tr>
</tbody>
</table>

- **Level 1:** Apply procedural knowledge of robotic and automation technologies to execute manufacturing tasks.
- **Level 2:** Interpret workflow plans and manufacturers' recommendations for the use of automatic technologies and systems.
- **Level 3:** Review performance of robotic and automation technologies to assess improvements on the manufacturing workflow and products.
- **Level 4:** Formulate new manufacturing processes that adopt robotic and automation technologies to enhance operational efficiency.
- **Level 5:** Explore wide applications of robotic and automation technologies of manufacturing in the organisation to transform manufacturing processes.
- **Level 6:** Formulate new manufacturing processes that adopt robotic and automation technologies to enhance operational efficiency.

### Knowledge

- **Types of robotic and automation technologies and their process control systems utilised in manufacturing tasks**
- **Methods of operating robotic systems for manufacturing tasks**
- **Procedures of safe machinery operation**
- **Types of sensors and actuators**
- **Procedures for installing actuators and sensors**
- **Organisational manufacturing workflows**
- **Principles of robotic and automation technologies**
- **Procedures for setting up and inspecting robotic systems and automation technologies**
- **Approaches to oversee manufacturing tasks that use robotic systems and automation technologies**
- **Principles of process control algorithms**
- **Types and applications of control loop components and controllers**
- **Range of applications for robotic and automation technologies**
- **Methods of evaluating resources and skills to carry out manufacturing tasks using robotic and automation technologies**
- **Principles of electro-pneumatics**
- **Types of logic control programmes**
- **Concepts pertaining to performance specifications and analyses**
- **Best practices in robotics and automation**
- **Components of a robot**
- **Principles of path and trajectory planning**
- **Types of robot programming languages**
- **Organisational products and processes**
- **Organisational quality and Workplace Safety and Health (WSH) guidelines**
- **Methods of developing detailed operating procedures for robotics and automation technologies**
- **Methods to influence the adoption of new technologies**
- **Impact of robotics and automation on manufacturing operations**
- **Benefits and trade-offs of advanced robotics and automation**
- **Financial costs of introducing robotics and automation to manufacturing processes**
- **Automation cost-benefit analysis methods**
- **Methodology of return on investment analyses**
- **Methods of conducting Research and Development**

©SkillsFuture Singapore
Effective Date: October 2017, Version 1.1
### Abilities

- Operate robotics and automation technologies by following manufacturers’ instructions and operating procedures
- Follow safety procedures when operating robotics and automation technologies
- Identify and report any issues with robotics and automation technologies
- Install sensors and actuators for process control in specified locations

- Evaluate the feasibility of robotics and automation systems for manufacturing processes
- Apply optimisation techniques to improve automated processes' efficiency and product quality
- Determine range of application, resources, skill requirements and production feasibility for robotics and automation technologies
- Synthesise innovation developments in the energy and chemicals industry
- Anticipate macro trends and their impact on speed, processes or automation requirements in the energy and chemicals industry
- Evaluate the benefits and trade-offs of implementing robotics and automation to the business
- Assess the costs and returns on investment of automating production processes
- Develop robotics and automation application strategies
- Analyse alternative approaches to robotics and automation to enhance manufacturing precision and productivity
- Identify potential opportunities to improve robotics and automation approaches in the organisation
- Prepare business cases for implementing robotics and automation to satisfy business and legislative requirements

<table>
<thead>
<tr>
<th>Development (R&amp;D) in robotics and automation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robotics and automation legislative requirements</td>
</tr>
<tr>
<td>Principles of change management</td>
</tr>
</tbody>
</table>

- Oversee use of robotics and automation technologies
- Diagnose faults in the use of robotics and automation technologies for manufacturing processes and suggest solutions
- Interpret and extract relevant process parameters from given specifications
- Apply corrective actions for automatic and manual shut-down during critical and emergency situations
- Review and incorporate feedback on the operation of robotics and automation technologies into updated operating procedures

- Evaluate various automation technologies and robotic systems to compare strengths and limitations of automation technologies
- Evaluate the feasibility of robotics and automation systems for manufacturing processes
- Formulate processes and procedures for manufacturing components using robotics and automation
- Drive automation technology and robotic systems into day-to-day operations
- Ensure procedures and operations are implemented according to plan and WSH requirements
- Refine parameters of robotics and automation processes to improve operational efficiency
- Determine post-processing procedures for manufacturing components using robotics and automation

- Implement advanced optical metrology to the business
- Assess improvements to products and manufacturing processes
- Evaluate the benefits and trade-offs of implementing advanced optical metrology to the business
- Review and incorporate feedback on the operation of robotics and automation technologies into updated operating procedures

- Synthesise innovation developments in the energy and chemicals industry
- Anticipate macro trends and their impact on speed, processes or automation requirements in the energy and chemicals industry
- Evaluate the benefits and trade-offs of implementing robotics and automation to the business
- Assess the costs and returns on investment of automating production processes
- Develop robotics and automation application strategies
- Analyse alternative approaches to robotics and automation to enhance manufacturing precision and productivity
- Identify potential opportunities to improve robotics and automation approaches in the organisation
- Prepare business cases for implementing robotics and automation to satisfy business and legislative requirements