

**SKILLS FRAMEWORK FOR PRECISION ENGINEERING  
TECHNICAL SKILLS AND COMPETENCIES (TSC) REFERENCE DOCUMENT**

<b>TSC Category</b>	Manufacturing and Operations					
<b>TSC</b>	Manufacturing Technology					
<b>TSC Description</b>	Optimise manufacturing processes, utilising available and applicable technologies					
<b>TSC Proficiency Description</b>	<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>	<b>Level 4</b>	<b>Level 5</b>	<b>Level 6</b>
		<b>PRE-MPR-2033-1.1</b>	<b>PRE-MPR-3033-1.1</b>	<b>PRE-MPR-4033-1.1</b>	<b>PRE-MPR-5033-1.1</b>	
		Identify suitable manufacturing processes to manufacture precision engineering components and products to meet requirements	Evaluate traditional and non-traditional machining technologies to identify suitable applications for optimising manufacturing processes	Evaluate different systems for application in manufacturing, and solve related problems in manufacturing processes	Evaluate manufacturing process outputs and the utilisation of resources and formulate enhancements for overall value	
<b>Knowledge</b>		<ul style="list-style-type: none"> <li>Classifications of manufacturing processes</li> <li>Types and applications of machining processes and non-traditional machining (NTM) processes</li> <li>Types of machines, tooling and associated applications</li> <li>Types of grinding, abrasive bonding materials and grading of grinding wheels</li> <li>Types and characteristics of cutting tools, and their effects on machining processes</li> <li>Concepts and inter-relation across cutting speeds, feed rates and effective speeds</li> <li>Types and purposes of cutting fluids</li> <li>Types of chip formation</li> <li>Types and purposes of joints and joining processes</li> <li>Types and applications of jigs and fixtures</li> </ul>	<ul style="list-style-type: none"> <li>Types of traditional machining processes</li> <li>Principles in traditional machining</li> <li>Types of non-traditional machining (NTM) processes</li> <li>Types of energy applied in NTM</li> <li>Industry needs for NTM</li> <li>Areas of applications for NTM</li> <li>Types of laser beam machines, machining technology and applications</li> <li>Principles of ultrasonic machining (USM)</li> <li>Ultrasonic machine design and construction</li> <li>USM technology and applications</li> </ul>	<ul style="list-style-type: none"> <li>Engineering mathematics and mathematical models</li> <li>Concepts and principles of mechanical physics</li> <li>Data sampling, sampling distributions and confidence intervals</li> <li>Principles of precision engineering</li> <li>Principles of computer-aided design (CAD)</li> <li>Effects of thermodynamics, structural damping and dynamic loading</li> <li>Principles, application, types and limitations of finite element method/analysis (FEM/FEA)</li> <li>Safety factors in FEM/FEA</li> <li>Engineering optimisation methods</li> <li>Multi-disciplinary design optimisation (MDO) approach</li> </ul>	<ul style="list-style-type: none"> <li>Methods, tools and criteria for evaluating engineering processes</li> <li>Types and impact of recommendations on engineering processes</li> <li>Design trade-offs made through adopting different precision engineering principles</li> <li>Computer-aided engineering (CAE)</li> <li>Concepts and applications of 'smart factory' and networked manufacturing processes</li> <li>Concepts and applications of ultra-precision machining and micro-electromechanical systems</li> <li>Concepts of nanofabrication and molecular manipulation</li> <li>Principles of innovative thinking and change management</li> <li>Engineering ethics</li> <li>Workplace safety and health (WSH) requirements</li> </ul>	

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<p><b>Abilities</b></p>		<ul style="list-style-type: none"> <li>• Interpret engineering drawings for manufacturing engineering components and products</li> <li>• Shortlist suitable processes to produce engineering components and products based on engineering drawings</li> <li>• Evaluate the merits and limitations of manufacturing processes which meet required criteria of quantity, cost and delivery</li> <li>• Verify limitations of the selected manufacturing processes and seek suitable alternatives</li> <li>• Determine appropriate machining parameters to meet the requirements of selected manufacturing processes</li> <li>• Determine appropriate machines and tooling capable of manufacturing the engineering components and products</li> <li>• Determine appropriate jigs and fixtures to support selected manufacturing processes</li> </ul>	<ul style="list-style-type: none"> <li>• Analyse types of energy applied in NTM technology to optimise manufacturing processes</li> <li>• Review requirements for NTM processes to select most suitable technologies for application</li> <li>• Review types of NTM to select most suitable technologies for application</li> <li>• Evaluate applications of laser beam machining for suitability of application</li> <li>• Evaluate applications of USM for suitability of application</li> <li>• Apply appropriate technologies to optimise manufacturing processes</li> <li>• Evaluate effectiveness of methods adopted for selecting suitable traditional and non-traditional machining technology</li> </ul>	<ul style="list-style-type: none"> <li>• Determine behavioural characteristics of static and dynamic engineering systems</li> <li>• Evaluate the effects of mechanics on common manufacturing processes and products to determine appropriate applications</li> <li>• Apply general principles of precision engineering to meet design, precision manufacturing and quality requirements</li> <li>• Analyse and model engineering situations to solve manufacturing problems</li> <li>• Formulate engineering solutions using numerical and analytical tools</li> <li>• Apply FEM/FEA to analyse the effects of thermodynamics, structural damping and/or dynamic loading on requirements</li> <li>• Apply optimisation techniques to optimise manufacturing results</li> </ul>	<ul style="list-style-type: none"> <li>• Establish criteria for evaluating engineering processes for effectiveness and efficiency</li> <li>• Lead in the establishment of new manufacturing processes and technology</li> <li>• Recommend improvements to engineering processes to add value to company processes or quality output of products and services</li> <li>• Assess the potential impact of recommended changes on business and operational concerns</li> <li>• Evaluate the design of components, precision machines and systems for adherence to established principles</li> <li>• Review applications of ultra-precision machining to determine relevancy to application to manufacturing processes</li> <li>• Review applications of micro-electromechanical systems to determine relevancy for application to manufacturing processes</li> <li>• Evaluate the effects of incorporating CAE into manufacturing process chains to enhance overall value</li> <li>• Evaluate the effects of incorporating 'smart factory' concepts into manufacturing process</li> </ul>	
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