TSC Category	Precision Manufacturing Process					
TSC	Additive Manufacturing					
TSC Description	Design and apply additive manufacturing workflows to create three-dimensional objects					
TSC Proficiency Description	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
		PRE-OPR-2012-1.1	PRE-OPR-3012-1.1	PRE-OPR-4012-1.1	PRE-OPR-5012-1.1	PRE-OPR-6012-1.1
		Operate additive manufacturing (AM) equipment to produce product prototypes	Deploy additive manufacturing (AM) processes for the production of three-dimensional (3D) prototypes	Evaluate the effectiveness and sustainability of implemented additive manufacturing (AM) processes for improvements	Formulate new additive manufacturing (AM) workflows in order to streamline manufacturing processes which are in line with organisational strategies	Explore wider applications of additive manufacturing (AM) methods in the organisation by using expertise within the field to transform manufacturing workflows
Knowledge		• Principles of product, parts and/or component design and production • AM set-up and operational procedures • Infrastructures and resources required for AM processes • Material characteristics and properties • Relevant workplace safety and health (WSH) practices, guidelines and regulations • Relevant quality assurance and quality control (QA/QC) policies and procedures	• Customer requirements • Principles of precision engineering • Computer-aided design (CAD) environment and nomenclatures for AM • Processes of reverse engineering • Principles of computational analysis • Techniques to optimise AM processes and products • AM processes and general applications for metallic and non-metallic prototyping • Strengths and limitations of AM techniques • Principles of metallurgy • Applications and operational parameters of direct metal laser sintering (DMLS), selective laser sintering (SLS), selective laser melting (SLM), powder bed and inkjet head 3D printing, and/or fused	• AM characteristics, techniques and systems • Requirements of different AM processes • Factors to be considered when selecting AM solutions • Impact of AM on manufacturing operations • Methods for reviewing AM performance • Benefits and trade-offs of AM • Methods of ensuring long-term sustainability of AM	• Applications of emerging AM technologies • Impact of AM to supply chain operations • Impact of external conditions to AM implementation • Applications and operational parameters of electron beam melting (EBM), laser-aided additive manufacturing (LAAM), stereolithography (SLA), three-dimensional (3D) polymer jetting and/or fused filament fabrication	• Parameters and rules for AM • Principles of product, parts and/or component design and production • Product and process planning required for AM • Material characteristics and properties • Costing and lead-time estimation

Effective Date: April 2019, Version 1.1

			deposition modelling (FDM) machines • Post-processing of metallic and non-metallic components			
Abilities		• Interpret technical drawings and specifications in order to create stand-alone two-dimensional (2D) and three-dimensional (3D) prototypes under supervision • Apply suitable AM techniques based on product specifications and functions • Operate AM equipment • Carry out troubleshooting on AM equipment and machineries • Report anomalies in production and escalate issues for further actions	• Analyse technical drawings and specifications in order to create 3D prototypes with moving parts • Develop AM component modelling plans to meet requirements • Determine AM techniques to be applied based on product specifications and functions • Determine materials to be used based on selected AM techniques • Deploy suitable AM processes based on concept and prototyping requirements • Estimate lead-times, costs and schedules • Organise AM process sequencing to maximise efficiency • Maintain process conformance through use of relevant analysis and error checking software	• Analyse and determine material considerations of components to be manufactured • Analyse process-related issues for using direct metal laser sintering (DMLS), selective laser sintering (SLS), selective laser melting (SLM), powder bed and inkjet head, and/or three-dimensional (3D) printing for AM • Determine processes and procedures for manufacturing metallic and non-metallic components using AM • Evaluate use of reverse engineering processes for components through 3D scanning and subsequent AM • Apply optimisation techniques to improve efficiency of AM processes and product quality • Assess the impact of manufacturing process improvements	• Review methodologies for high speed metallic and liquid-based AM of components • Analyse the physical and chemical properties of components to determine appropriate AM materials and recipes • Evaluate the use of EBM, LAAM, SLA, 3D polymer jetting and/or fused filament fabrication for AM • Build business cases for implementing AM • Formulate AM processes and procedures for manufacturing components • Ensure procedures and operations are implemented according to plans and workplace safety and health (WSH) requirements • Determine post-processing procedures for manufacturing components using AM	• Evaluate the benefits and trade-offs of implementing AM to the organisation • Assess the impact and risks of AM on manufacturing operations and supply chain operations • Assess the impact and risks of external conditions on implementation of AM • Develop organisational AM application strategies in alignment with assessment results • Prepare business cases for implementing AM that satisfy business and legislative requirements • Evaluate the AM integration plans to satisfy manufacturing requirements

Effective Date: April 2019, Version 1.1