



Australian Government

MEM23132A Evaluate rapid manufacturing processes

Release 1

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Modification History

Release 1 (MEM05v9).

Unit Descriptor

This unit of competency covers evaluation of rapid manufacturing based on additive, spray deposition and casting processes and includes evaluating the processes for their applicability, market competitiveness and sustainability. The unit requires consideration of product manufacturability, materials, systems and processes maintainability, plant and tooling requirements.

Application of the Unit

This unit applies technical evaluations of rapid manufacturing processes. It is suitable for people working as technicians, designers and draftspersons, and those pursuing manufacturing engineering or related technical qualifications and careers.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

MEM23004A Apply technical mathematics

Employability Skills Information

This unit contains employability skills.

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.

Performance criteria describe the performance needed to demonstrate achievement of the element.

Elements and Performance Criteria

1	Establish scope of rapid manufacturing processes and application	1.1	Identify technologies, including software, used or proposed in rapid manufacturing application
		1.2	Confirm stakeholders to be consulted as part of evaluation
		1.3	Confirm that appropriate support, including technical and professional assistance, is available
		1.4	Identify market context for rapid manufacturing product
		1.5	Determine relevant work health and safety (WHS) and regulatory requirements, standards, codes of practice, risk management and organisational procedures
2	Identify principles and techniques required for evaluation of rapid manufacturing application	2.1	Determine principles and techniques required to evaluate and optimise the rapid manufacturing application
		2.2	Select appropriate analysis and development software and software validation techniques
3	Evaluate rapid manufacturing processes	3.1	Assess WHS and regulatory compliance requirements and risk management practices of rapid manufacturing processes
		3.2	Assess effectiveness of software used for product design, rapid manufacturing process control and process optimisation
		3.3	Review suitability of facilities, services, plant and

- tooling for rapid manufacturing processes
- 3.4 Assess products and rapid manufacturing processes for sustainability
- 3.5 Assess materials against specifications in design and suitability for rapid manufacturing processes
- 3.6 Assess process for appropriate degree of automation and other technical efficiency aspects
- 3.7 Review rapid manufacturing application for competitiveness, including supply chain performance, costs, break-even and comparative performance of alternative manufacturing methods
- 3.8 Review labour and skill requirements
- 3.9 Apply systems thinking, continuous improvement, problem solving and decision making, and constraint and contingency management
- 4 Report results
 - 4.1 Record results of evaluation
 - 4.2 Provide documentation, such as drawings, calculations, product and process analysis, and computer-aided design (CAD) files

Required Skills and Knowledge

This section describes the skills and knowledge required for this unit.

Required skills

Required skills include:

- determining technologies, parameters and context of rapid manufacturing applications
- investigating sustainability implications of rapid manufacturing processes and associated products
- reviewing features and functions of rapid manufacturing processes, including assessing:
 - compliance of rapid manufactured product with design specifications
 - suitability of materials and equipment used in a rapid manufacturing process
 - efficiency of selected rapid manufacturing processes against other manufacturing processes, including cost-benefit analysis of alternative methods of rapid manufacturing, where applicable
 - integration of rapid manufacturing processes with manufacturing practice systems, such as lean manufacturing
 - skill and training requirements of the applicable rapid manufacturing processes
- identifying and evaluating rapid manufacturing control systems and software
- selecting and using appropriate analysis techniques and software for evaluation of rapid manufacturing processes
- identifying relevant WHS, regulatory and risk management compliance requirements for rapid manufacturing applications
- assessing software, facilities, services, plant and tooling, and materials for suitability to rapid manufacturing applications
- applying systems thinking, continuous improvement, and constraint and contingency management to evaluation of rapid manufacturing processes
- reporting and documenting results of scoping, principles and techniques identification and evaluation of systems, layouts, programs and flow charts

Required knowledge

Required knowledge includes:

- range, features and applications of rapid manufacturing processes, including:
 - digitisers and reverse engineering processes
 - selective laser sintering (SLS)
 - fused deposition modeling (FDM)
 - stereolithography (SLA)

- laminated object manufacturing (LOM)
- electron beam melting (EBM)
- 3-D printing (3-DP)
- solid freeform fabrication
- sprayed metal deposition
- direct metal deposition (DMD)
- casting (patternless and rapid pattern processes)
- vacuum forming
- sources of support, including technical and professional assistance
- sustainability implications of rapid manufacturing processes
- WHS, regulatory and risk management requirements relevant to rapid manufacturing applications
- relationship between process and product in rapid manufacturing technologies, for example:
 - using printing or SLA processes in low strength paper or plastic applications
 - higher component strength applications in plastics or sintered metals
 - applications using tool steels, brass, stainless steel, carbon steel and aluminum alloy, such as metal spray deposition or lost wax for cast products
- materials for additive 'printing' processes
- materials for sprayed metal deposition
- materials for rapid casting
- other materials (e.g. thermoplastics for vacuum forming)
- labour and skills requirements for rapid manufacturing processes
- systems thinking, continuous improvement, and constraint and contingency management
- CAD functions, features and techniques related to rapid manufacturing, including relevant file formats

Evidence Guide

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.

Overview of assessment	A person who demonstrates competency in this unit must be able to evaluate rapid manufacturing applications for safety, economy and fitness for purpose.
Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors must be satisfied that the candidate can competently and consistently: • review technologies, including software, used in rapid manufacturing applications • evaluate rapid manufacturing processes for efficiency and

	cost-benefit against alternative manufacturing techniques • select appropriate analysis principles and techniques and software • identify and assess compliance against relevant WHS and regulatory requirements, risk management and organisational procedures • report and document results.
Context of and specific resources for assessment	• This unit may be assessed on the job, off the job or a combination of both on and off the job. Where assessment occurs off the job, then a simulated working environment must be used where the range of conditions reflects realistic workplace situations. • The competencies covered by this unit would be demonstrated by an individual working alone or as part of a team. • Where applicable, reasonable adjustment must be made to work environments and training situations to accommodate ethnicity, age, gender, demographics and disability. • Access must be provided to appropriate learning and/or assessment support when required. Where applicable, physical resources should include equipment modified for people with disabilities.
Method of assessment	• Assessment must satisfy the endorsed Assessment Guidelines of the MEM05 Metal and Engineering Training Package. • Assessment methods must confirm consistency and accuracy of performance (over time and in a range of workplace relevant contexts) together with application of underpinning knowledge. • Assessment methods must be by direct observation of tasks and include questioning on underpinning knowledge to ensure correct interpretation and application. • Assessment may be applied under project-related conditions (real or simulated) and require evidence of process. • Assessment must confirm a reasonable inference that competency is not only able to be satisfied under the particular circumstance, but is able to be transferred to other circumstances. • Assessment may be in conjunction with assessment of other units of competency where required.
Guidance information for assessment	Assessment processes and techniques must be culturally appropriate and appropriate to the language and literacy capacity of the candidate and the work being performed.

Range Statement

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

Rapid manufacturing applications	Rapid manufacturing applications can be found in most industries with the selection of a rapid manufacturing process depending on the suitability of the product and materials for available rapid manufacturing equipment and cost-benefit analysis against traditional manufacturing alternatives. Examples of rapid manufactured items may include: • medical and biomedical prosthetics and implants • custom musical instruments • jewellery • consumer products • toys • any small to medium quantity item, particularly involving high set-up cost associated with using alternative or traditional methods
Context of manufacturing processes	The context of manufacturing operations includes consideration of: • global competitive markets • product and process sustainability • lean systems • product manufacturability • system maintainability • facilities, services, plant and tooling requirements • supply chains • material and product flow • transfer operations • process control • labour requirements and skills distribution • information flow • systems thinking, continuous improvement, and constraint and contingency management • WHS and regulatory requirements and risk management
Appropriate technical and professional assistance	Appropriate technical and professional assistance may include: • technical support and advice relating to elements which have intrinsic dangers, such as: • high pressure

	- energised fluid vessels - high temperatures and heat energy capacity - wiring with high current control voltages above extra low voltage - professional support for technologies, such as: - specialist electric motor drives and controllers - specialist materials, plastics, metal alloys and nano materials - special processes, foundry, alloy welding, heat treatment, sealing and fastening
WHS, regulatory requirements and enterprise procedures	WHS, regulatory requirements and enterprise procedures may include: - WHS Acts and regulations - relevant standards - codes of practice from Australian and overseas engineering and technical associations and societies - risk assessments - registration requirements - safe work practices - state and territory regulatory requirements applying to electrical work
Standards and codes	Standards and codes refer to all relevant Australian and international standards and codes applicable to a particular rapid manufacturing process
Sustainability	Sustainability is used to mean the entire sustainable performance of the organisation/plant, including: - meeting all regulatory requirements - conforming to all industry covenants, protocols and best practice guides - minimising ecological and environmental footprint of process, plant and product - maximising economic benefit of process plant and product to the organisation and the community - minimising the negative WHS impact on employees, community and customer
Systems thinking	Systems thinking refers to the conduct of engineering work in a manner that demonstrates knowledge of how the interaction of different technical systems on equipment, machinery or structures, as well as the skills and techniques of personnel, combine to perform or support engineering-related operations, processes or projects. It embraces determining or establishing how the function of each technical system or component, as well as the skills and techniques of personnel, effects or potentially may effect, outcomes. Systems

	should be interpreted broadly within the context of the organisation and depending on the project or operation can include equipment, related facilities, material, software, internal services and personnel, and other organisations in the value chain
Continuous improvement implementation	Continuous improvement implementation may relate to plant, products, processes, systems or services, including design, development, implementation or manufacture, commissioning, operation or delivery and maintenance. Improvement processes may include techniques, such as: • balanced scorecard • current and future state mapping • measuring performance against benchmarks • process improvement, problem solving and decision making • data management, generation, recording, analysing, storing and use of software • training for improvement systems participation • technical training
Manage constraints and contingencies	Contingencies arising during operations or improvement projects are responded to in the context of constraints. Contingencies may threaten operations or improvement projects and planning for contingencies may be essential to maintain resources, skilled labour and schedules. Each contingency will have constraints on possible solutions. These may be: • financial, organisational, procedural or cultural • physical constraints, such as limits to resources, limits to site access or logistical limitations
Process competitiveness	Competitive or lean processes uses cost, capacity and responsiveness, quality, reliability and waste minimisation as drivers of the process and measures for process improvement. Lean manufacturing is the response of many organisations to local, regional, national and global market competitiveness
Automation	Automation options range from manual operations with manual information generation, handling, analysis and storage to islands of automation, supported by manual interfaces with some electronic information processing, to systems with major automation and networked data handling
Labour requirements and skills distribution	Globally competitive manufacturing processes require well trained employees for flexibility of deployment options and minimisation of labour waste. Continuous improvement requires continuous training to match skills to process improvements and developments. Modern manufacturing processes require proactive maintenance participation

	and skills development
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Unit Sector(s)

Competency field

Unit sector Engineering science

Custom Content Section

Not applicable.