



Australian Government

MEM234009 Design computer-integrated manufacturing systems

Release: 1

MEM234009 Design computer-integrated manufacturing systems

Modification History

Release 1. Supersedes and is equivalent to MEM234009A Design computer-integrated manufacturing systems.

Application

This unit of competency defines the skills and knowledge required to design a computer-integrated manufacturing (CIM) system, including control of machine and processes and the generation of manufacturing information. It includes consideration of work health and safety (WHS), automation safety and risk management.

The unit applies to the design of automated plant and equipment, control and data sharing systems across all forms of manufacturing and engineering. Design activities can also include reverse engineering and design rectification or modifications of an existing design. It is suitable for automated manufacturing system designers and maintenance personnel, and for those pursuing engineering or related qualifications and careers.

Individuals completing this work either already have or are developing skills and experience in the application of computing technology, mathematics, scientific principles and techniques, electrical principles and techniques, programming of computers and controllers, methods, processes and mechanical construction techniques, manufacturing plant and processes, and evaluation of CIM systems.

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

Nil

Competency Field

Engineering science

Elements and Performance Criteria

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
1. Interpret the design brief or contract requirements for CIM system	1.1 Establish the required features and extent of integration of the CIM system in consultation with the client 1.2 Establish technical, commercial and environmental parameters of

Elements	Performance Criteria
<i>Elements describe the essential outcomes.</i>	<i>Performance criteria describe the performance needed to demonstrate achievement of the element.</i>
	the brief or contract 1.3 Determine stakeholders to be consulted in design process 1.4 Consider WHS, regulatory requirements and enterprise procedures relevant to the brief 1.5 Provide preliminary advice to the client on feasibility of the CIM project
2. Prepare concept proposal	2.1 Carry out initial investigations and measurements 2.2 Carry out required modelling and calculations using appropriate software and validation techniques 2.3 Generate solutions that include consideration of data requirements, hardware requirements, system integration, network topology, communication protocols and automation safety, using appropriate innovation and creativity 2.4 Check feasibility and evaluate solutions against design criteria, ensuring conformity to standards and codes, technical, economic and WHS requirements 2.5 Determine social and sustainability implications of solutions 2.6 Review concept proposals with client and identify preferred solution
3. Design CIM system	3.1 Develop CIM design that includes results of feasibility study, consideration of expert opinion, initial calculations and modelling and the use of judgment and discretion 3.2 Provide documentation, drawings, specifications and instructions 3.3 Consult with client and stakeholders to obtain sign-off on design

Foundation Skills

This section describes those language, literacy, numeracy and employment skills that are essential to performance.

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

This field allows for different work environments and conditions that may affect performance.

Essential operating conditions that may be present (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) are included.	
Parameters of the brief or contract include:	• design of new equipment or fault analysis, rectification or modification to an existing design • design cost and system capital cost • maintainability and product life cycle cost • durability, function, performance and aesthetics • energy and environmental sustainability and social issues • equipment availability and worksite restrictions • other special features and limits in the design brief.
CIM includes:	• computer-aided design (CAD) and computer-aided manufacturing (CAM) • computer-aided process planning (CAPP) • computer numerical control (CNC) machine tools • direct numerical control (DNC) machine tools • flexible machining systems (FMS) • automated storage and retrieval systems (ASRS) • automated guided vehicles (AGV) • use of robotics and automated conveyance • computerised scheduling • production and inventory control • a business system integrated by a common database.
Solutions include:	• hardware options including: • processing machinery • transfer devices, robots, conveyors, and other automated pick and place devices • materials handling equipment • AGVs • programmable logic controllers (PLCs) • remote terminal units (RTUs) • human, machine interfaces (HMIs) and touch screens • wired and wireless networking systems • software options and systems including: • CAD/CAM • CAPP • supervisory control and data acquisition (SCADA) • distributed control systems (DCS) • ASRS • enterprise resource planning (ERP) • quality assurance (QA) and quality control (QC) systems • local area network (LAN) and wide area network (WAN)

	network communications.
WHS, regulatory, sustainability and environmental issues include:	• WHS acts, regulations and relevant standards • industry codes of practice • risk assessments • registration requirements • safe work practices • 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 • state and territory regulatory requirements.
Appropriate software and validation techniques include:	• performance analysis and/or modelling requiring understanding of underpinning program techniques and algorithms, the use of FEA and numerical methods within object-oriented modelling techniques • comparison of traditional solutions for simple design problems with software solutions to the same design problems • review of previously implemented design challenges which were completed using the software.
Network topology includes:	• bus, ring, star, tree, mesh and in-line (two-way comms.) arrangements • wired and wireless options.
Communications protocols include:	• the set of standardised rules for data and signal syntax, checking and error detection. • hardware and software generated data in accordance with a protocol that allows generators and receivers to understand or translate the data as information, control signals integrity and error checks including: • layered communications and networking protocols • OSI Model – Open Systems Interconnection Model – seven layers • TCP/IP Internet Protocol Suite {Transmission Control Protocol (TCP) and the Internet Protocol (IP)} – four or five layers • IEEE 802 LAN/MAN group of standards, including IEEE 802.3 Ethernet standard, IEEE 802.11 Wireless Networking standard • interface standards, including RS232 and RS485, Fieldbus, Modbus and DNP3.0.
Automation safety includes:	• emergency stop • failsafe design

	• redundancy • interlocks • data integrity.
Design parameters requiring research include:	• sustainability implications • current industrial design techniques including machine and equipment design • reverse engineering • assembly • fabrication and construction techniques • purchasing and inventory control systems • lean and quality techniques • software.

Unit Mapping Information

Release 1. Supersedes and is equivalent to MEM234009A Design computer-integrated manufacturing systems.

Links

Companion Volume Implementation Guides are available on VETNet -

<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b7050d37-5fd0-4740-8f7d-3b7a49c10bb2>

Assessment Requirements for MEM234009 Design computer-integrated manufacturing systems

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include:

- interpreting features of plant and equipment and parameters of the brief or contract
- advising client based on discipline knowledge and work health and safety (WHS) and regulatory standards
- researching design parameters
- determining WHS, regulatory and risk management requirements
- investigating and measuring to confirm the parameters for required design
- investigating faults in existing designs propose solutions
- modelling and calculating using appropriate software and validation techniques
- generating and evaluating solutions for feasibility against design criteria
- designing computer-integrated manufacturing (CIM) system solution on at least two occasions
- communicating, negotiating and reviewing with stakeholders and client throughout the process to obtain agreement on proposal and sign-off on design
- documenting design with drawings, specifications and instructions.

Note: Where a volume and/or frequency is not specified, demonstration must be provided at least once.

Knowledge Evidence

Evidence required to demonstrate the required knowledge for this unit must be relevant to and satisfy the requirements of the elements and performance criteria and include knowledge of:

- current CIM design skills and techniques including:
 - mechanical, electrical, fluid, electronic and information technologies
 - sensor and transducers
 - controllers
 - interfacing and signal conditioning
 - networking, software
 - data sharing and control functions
- brief or contract parameters

- techniques for:
 - continuous improvement
 - problem-solving and decision-making
 - root cause analysis (RCA) or failure mode and effects analysis (FMEA) or design review based on failure mode (DRBFM), and Pareto analysis
- features and capability of plant, equipment, controllers, software, network and communication systems
- automation safety considerations
- WHS and regulatory requirements, codes of practice, standards, risk management and registration requirements
- engineering design software options
- contemporary engineering design methods
- software options for control and data sharing
- hardware options and capabilities to suit processes and products
- CIM communication protocols
- programming and use of CIM software
- documentation, drawings, specifications, instructions, process information and programming required for design.

Assessment Conditions

- Assessors must:
 - have vocational competency in designing computer-integrated manufacturing systems at least to the level being assessed with relevant industry knowledge and experience
 - satisfy the assessor requirements in the Standards for Registered Training Organisations 2015 or its replacement and comply with the National Vocational Education and Training Regulator Act 2011, its replacement or equivalent legislation covering VET regulation in a non-referring state/territory as the case requires.
- Where possible assessment must occur in operational workplace situations. Where this is not possible or where personal safety or environmental damage are limiting factors, assessment must occur in a sufficiently rigorous simulated environment that reflects realistic operational workplace conditions that cover all aspects of workplace performance, including environment, task skills, task management skills, contingency management skills and job role environment skills.
- Conditions for assessment must include access to all tools, equipment, materials and documentation required including relevant workplace procedures, product and manufacturing specifications.
- Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.
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