Australian Government

Department of Education, Employment and Workplace Relations

MEM234009A Design computer-integrated manufacturing systems

Release: 1

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Modification History

New unit

Unit Descriptor

This unit of competency covers the design of a computer-integrated manufacturing (CIM) system, including control of machine and processes and the generation of manufacturing information. It includes occupational health and safety (OHS), automation safety and risk management.

Application of the Unit

This unit applies to the design of automated plant and equipment, control and data sharing systems across all forms of manufacturing and engineering. Design activities may 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 those pursuing engineering or related qualifications and careers.

Prior 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 is required.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Not applicable.

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. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.

Elements and Performance Criteria

1	Interpret the design brief or contract requirements for CIM system	1.1	Establish, in consultation with the client, the required features and extent of integration of the CIM system
		1.2	Establish technical, commercial and environmental parameters to the brief or contract
		1.3	Determine stakeholders to be consulted in design process
		1.4	Consider **OHS, 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 a range of 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 OHS 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
		3.4	Obtain sign-off on design

Required Skills and Knowledge

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

Required skills

Required skills include:

- determining features of CIM system, including OHS, regulatory and risk management requirements
- interpreting parameters to the brief or contract
- researching latest trends and techniques in CIM practices, including:
  - machine and equipment design
  - reverse engineering
  - sustainability issues and implications for machine and equipment design
  - assembly, fabrication and construction techniques
  - purchasing and inventory control systems
  - lean and other quality techniques
  - latest relevant modelling and other software
- investigating and presenting options
- investigating faults in existing designs and arriving at solutions
- selecting and using software and validation techniques
- creating design solutions to match client expectations of innovation as well as fitness for purpose
- designing for servicing, maintainability, cost, manufacturability and assembly, and ease of operation
- evaluating solutions for feasibility against design criteria, including relevant engineering and financial calculations and analysis
- communicating, negotiating and reviewing with stakeholders and client throughout process to obtain agreement on proposal and sign-off on design
- documenting design with drawings, specifications and instructions

Required knowledge

Required knowledge includes:

- current CIM design knowledge, skills and techniques, including mechanical, electrical, fluid, electronic and information technologies, sensor/transducers, controllers, interfacing and signal conditioning, networking, software, data sharing and control functions
- 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
- OHS 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
- programming and use of CIM software
- documentation, drawings, specifications, instructions required, process information and programming

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.

Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors must be satisfied that the candidate can competently and consistently: • interpret features of plant and equipment and parameters to the brief or contract • advise client based on discipline knowledge and OHS and regulatory standards • research sustainability implications and current industrial design techniques • determine OHS, regulatory and risk management requirements • investigate and measure • model and calculate using appropriate software and validation techniques • generate and evaluate a range of solutions for feasibility against design criteria • design CIM system solution • communicate, negotiate and review with stakeholders and client throughout process to obtain agreement on proposal and sign-off on design • document design with drawings, specifications and instructions.
Context of and specific resources for assessment	• This unit may be assessed on the job, a combination of both on and off the job, or off the job if suitable design and simulation facilities to test the design are available. Where assessment occurs off the job, that is, the candidate is not in productive work, 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 its 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 able not only 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.

Parameters of the brief or contract	The design brief may include the design of new equipment or fault analysis, rectification or modification to an existing design. Parameters to the design brief may include: • 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	CIM is a method of manufacturing in which the production process is controlled by computer. It may include: • computer-aided design/computer-aided manufacturing (CAD/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

Range of solutions	Range of solutions for CIM systems may include:
	• hardware options, such as:
	  • 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), e.g. touch screens
	  • wired and wireless networking systems

	• software options and systems, such as:
	  • CAD/CAM
	  • CAPP
	  • system 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

OHS, regulatory, sustainability and environmental issues	OHS, regulatory, sustainability and environmental issues may include: • OHS Acts and regulations • 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 OHS impact on employees, community and customer • state and territory regulatory requirements
Standards and codes	Standards and codes refer to all relevant Australian and international standards and codes applicable to a particular design task
Appropriate software and validation techniques	Software may be employed for: • performance analysis/modelling. Underpinning program techniques and algorithms should be understood, such as the use of FEA and numerical methods within object oriented modelling techniques Validation techniques include: • 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	Network topology refers to the arrangement of connected hardware. These include: • bus, ring, star, tree, mesh and in-line (2 way comms.)

	arrangements • wired and wireless options
Communications protocols	Communications protocols refer to the set of standardised rules for data and signal syntax, checking and error detection. Hardware and software generate 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. These include: • layered communications and networking protocols • OSI Model – Open Systems Interconnection Model – 7 layers • TCP/IP Internet Protocol Suite {Transmission Control Protocol (TCP) and the Internet Protocol (IP)} – 4 or 5 layers • IEEE 802 LAN/MAN group of standards, including IEEE 802.3 Ethernet standard, IEEE 802.11 Wireless Networking standard • interface standards, such as RS232 and RS485, Fieldbus, Modbus and DNP3.0
Automation safety	Automation safety refers to the reliance on emergency stop, failsafe design, redundancy, interlocks and data integrity. Standards apply to general plant design and use as well as the functional safety of safety-related electrical, electronic and programmable electronic control systems.

Unit Sector(s)

Engineering practice

Custom Content Section

Not applicable.