Australian Government

Department of Education, Employment and Workplace Relations

MEM234012A Design integrated maintenance management systems

Release: 1

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Modification History

New unit

Unit Descriptor

This unit of competency covers the skills required for the systematic design of integrated maintenance processes to complement engineering and business objectives through the maximisation of plant utilisation. It includes consideration of quality aspects, design for reliability and maintainability, and the generation of system data which is analysed and used to aid continuous improvement processes.

Application of the Unit

This unit applies to the design of integrated maintenance systems for existing plant and for new plant and processes in all areas of manufacturing and engineering. Design activities may also include reverse engineering, and design rectification or modifications of an existing design. It is suitable for maintenance personnel and system designers involved in engineering, manufacturing and related asset maintenance systems, and those pursuing engineering or related qualifications and careers.

Prior or concurrent experience in evaluation of maintenance systems, mathematics, mechanical, electrical, fluid, thermal, production methods and processes, materials handling and automated systems, repair techniques, occupational health and safety (OHS) and risk management is required.

This unit applies where substantial engineering-related skills are required to design the maintenance management system.
Where the emphasis is on competitive manufacturing related skills, such as lean manufacturing, reliability centred maintenance (RCM), proactive or total productive maintenance (TPM), and the engineering support is provided by other personnel, then the unit MSACMT681A Develop a proactive maintenance strategy should be considered.

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 client brief or contract requirements	1.1	Determine required features of the integrated maintenance management system
		1.2	Interpret parameters to the brief or contract
		1.3	Determine stakeholders to be consulted in design process
		1.4	Research current maintenance systems and management techniques relevant to brief or contract, including lean systems maintenance, systems thinking, continuous improvement, and constraint and contingency management
		1.5	Assess OHS regulatory, sustainability or environmental issues relevant to contract or brief
		1.6	Seek appropriate technical and professional assistance as required
		1.7	Provide initial advice on feasibility based on specified or anticipated operations, including expectations for equipment availability and budget for maintenance
2	Prepare concept proposal	2.1	Establish integrated maintenance management system options for plant and plant support services
		2.2	Establish facilities and service maintenance response system options

		2.3	Categorise maintainable assets
		2.4	Establish data collection, storage, analysis and system feedback requirements
		2.5	Establish personnel participation and development requirements.
		2.6	Carry out required modelling and calculations using appropriate software and validation techniques
		2.7	Generate a range of solutions to the design brief ensuring conformity with OHS requirements
		2.8	Determine social and sustainability implications of solutions
		2.9	Review concept proposals with client to identify most appropriate solution
3	Design and handover integrated maintenance management system	3.1	Develop integrated maintenance management system design
		3.2	Provide documentation, diagrams, specifications and instructions
		3.3	Consult with client and stakeholders on features and operation of final design
		3.4	Obtain sign-off on design
		3.5	Monitor implementation with stakeholders and make any necessary adjustments to design

Required Skills and Knowledge

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

Required skills

Required skills include:

- designing maintenance system proposals that are properly integrated with engineering and business objectives
- categorising maintainable assets
- determining maintainable features of plant and equipment and parameters to the brief or contract
- determining OHS, regulatory, risk management and sustainability requirements
- advising clients based on discipline knowledge and OHS and regulatory standards
- establishing maintenance management system options for plant and plant support services, facilities and service maintenance response system options, data collection, storage, analysis and system feedback requirements, and personnel participation and development requirements
- investigating faults in existing designs and proposing solutions
- analysing financial costs and management implications of maintenance management systems, including life cycle cost and break-even
- modelling and calculating using appropriate software and validation techniques
- generating and evaluating a range of solutions for feasibility against design criteria
- planning for staffing requirements and training to operate maintenance management system
- 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 maintenance management techniques and systems
- options and trends in performance analysis, modelling and simulation software
- design techniques for reliability, maintainability and life cycle costing
- maintenance system options, such as corrective, preventative, predictive (condition monitoring), precision, RCM, proactive or TPM
- economic, social and environmental implications of maintenance management systems
- OHS and regulatory requirements, codes of practice, standards, risk management and registration requirements
- technical and professional support services required to comply with license, legal and

indemnity requirements
- processes for investigation, such as developing options, modelling and calculating, generating a range of solutions, completing feasibility and evaluation studies and preparing proposals
- maintainable features of assets
- asset importance, such as risk to operations, critical plant, semi-critical and remainder of plant
- strategies for critical assets to maintain reliability, such as back-up assets, storing spares and use of redundant monitoring
- maintenance activities, online and break-down, such as manual and instrumented monitoring, adjustments, lubrications, lubricant testing, alignments, balancing, machining, fabricating, assembling and mounting, and reporting results
- management of spares inventory recognising cost and criticality of assets
- 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
  - theory of constraints (TOC)
- integrated maintenance data systems, including analysis, collection, handling, storage, scheduling, recording and reporting
- maintenance and operational system control documents, such as flowcharts, schedule and report templates, network specifications, data analysis and feedback procedures
- monitoring options, such as manual and sensor/transducer options

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: • design a maintenance system proposal integrated with engineering and business objectives • interpret maintainable features of plant and equipment and parameters to the brief or contract • advise client on maintenance system options • research current maintenance management techniques and systems • establish maintenance management system options • categorise maintainable assets

	• determine sustainability and OHS, regulatory and risk management requirements • model and calculate using appropriate software and validation techniques • generate and evaluate a range of solutions for feasibility against design criteria • 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	• Full assessment of this unit would normally need to be undertaken on the job in the context of a commercial design project and software. Assessment of some elements of the maintenance system design process may be possible off the job providing full plant simulation facilities and software are available that reflect 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.

Integrated maintenance management systems	Integrated maintenance management systems usually combine management, financial, engineering and other practices for cost-effective maintenance of assets such as plant, equipment and facilities. These systems involve the design for reliability and maintainability, manufacture, installation, commissioning and eventual write-off and replacement of the assets. Data is collected and analysed to assess the reliability, life cycle costs and productivity of the assets against the design criteria. Reliability relates to the productivity of assets, that is, the maintenance of service or product output (quantities) and its quality within cost parameters. Systems may also include consideration of: • maintenance priority • maintenance activity audit • monitoring and testing • maintenance system data • facilities and service maintenance response systems • maintainability
Parameters to the brief	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: • determination of the degree of innovation and creativity expected by the client • design process limits and budgets • product cost limits and budgets • performance specifications • equipment availability, capacities and restrictions • specified administrative, communication and approval procedures • other special features and limits in the design brief

Maintenance systems	Maintenance systems may include: • break-down maintenance • preventive maintenance • predictive maintenance (On-condition) • precision maintenance • proactive maintenance • reliability centred maintenance • total productive maintenance
Lean systems maintenance	Lean maintenance systems aim at maximising machine and process uptime, minimising waste and costs, maintaining quality and delivery and customer service. Maintenance processes and procedures are subject to continuous improvement and are set to complement engineering business objectives. Processes covered under the lean systems maintenance reference include: • process improvement • problem solving and decision making • RCA, FMEA or DRBFM • application of TOC
Systems thinking	Systems thinking: • is the process of developing solutions within the context of an entire system • recognises that an improvement in one subsystem can adversely affect another subsystem
Continuous improvement	Continuous improvement implementation may relate to: • plant, products, processes, systems or services, including design, development, implementation or manufacture, commissioning, operation or delivery and maintenance
Constraints and contingencies	Contingencies are unplanned events that may require a maintenance system response. Examples may include: • breakdowns • loss of services • sudden increases or decreases in production • regulatory change Constraints are limitations on possible

	maintenance system solutions. These may be technical or physical constraints, such as: • lack of spare parts • delays in supply • shortage of skilled workers • limits to site access or logistical limitations • financial, regulatory or internal procedures constraints
OHS, regulatory requirements and enterprise procedures	OHS, regulatory requirements and enterprise procedures may include: • OHS Acts and regulations • relevant standards • industry codes of practice • risk assessments • registration requirements • safe work practices • state and territory regulatory requirements applying to electrical work

Appropriate technical and professional assistance	Appropriate technical and professional assistance may include:
	• technical support and advice relating to elements which have intrinsic dangers, for example:
	  • 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

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 OHS impact on employees, community and customer
Data collection, storage and analysis	Manual methods or maintenance management software may be employed for: • management of asset data, maintenance inventory, maintaining essential documentation (e.g. material safety data sheets (MSDS), work permits and databases) • planning, data recording and analysis • generation of documents, such as work orders, inventory reorders, and reports for process improvement or design feedback Software options include: • computer maintenance management (CMM) • computer-aided process planning (CAPP) • system control and data acquisition (SCADA)/distributed control systems (DCS) • automated storage and retrieval systems (ASRS) • enterprise resource planning (ERP) • quality assurance (QA) and quality control (QC) systems software
Personnel participation and development requirements	Personnel, participation and development requirements in the maintenance system include the determination of labour requirements and functions for: • autonomous and supervised maintenance-related activities, such as monitoring, adjustment, lubrication, disassembly, repair or replacement of parts, balancing and assembly • installation, alignment and recommissioning in accordance with standard procedures • participation in process improvement, including: • measuring performance against benchmarks, such as life cycle costs, time between failures (TBF), and overall

	equipment effectiveness (OEE), as appropriate to individual job functions in design or operations
	• data management, generation, recording, analysing, storing and use of software
	• required training, including:
	  • training for systems participation
	  • technical training

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

Unit Sector(s)

Engineering practice

Custom Content Section

Not applicable.