



Australian Government

MEM23126A Evaluate industrial robotic applications

Release: 1

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Modification History

Release 1 (MEM05v9).

Unit Descriptor

This unit of competency covers the evaluation of industrial and mobile robotic applications, including loading and positioning capability, accuracy, repeatability, communications requirements, networks and protocols, and effectiveness of integration into automation systems. It includes evaluation of standard industrial robot types as well as mobile robots and other automated elements.

Application of the Unit

This unit applies to the use of industrial and mobile robotic devices or systems for commercial, industrial, machine and process automation in engineering and related applications.

It is suitable for people working as automation or robotics technicians or paraprofessionals and draftspersons, and those pursuing related technical qualifications and careers.

Licensing/Regulatory Information

Not applicable.

Pre-Requisites

MEM23004A	Apply technical mathematics
MEM23111A	Select electrical equipment and components for engineering applications
MEM23112A	Investigate electrical and electronic controllers in engineering applications
MEM23116A	Evaluate programmable logic controller and related control system component applications
MEM23117A	Evaluate microcontroller applications

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

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| 1 | Establish scope of robotics evaluation | 1.1 Determine parameters and context of robotics applications to be evaluated |
| | | 1.2 Identify stakeholders to be consulted on evaluation |
| | | 1.3 Identify software requirements used in the robotic applications |
| | | 1.4 Identify relevant compliance requirements of work health and safety (WHS) and regulatory requirements, codes of practice, standards and risk assessment requirements for robotic applications with particular emphasis on automation safety |
| | | 1.5 Ensure appropriate support, including licensed electrical, technical and professional assistance, is available |
| | | 1.6 Investigate sustainability implications of robotic applications |
| 2 | Confirm existing features of robotics applications | 2.1 Review features and functions of robotic applications and classify industrial robotic devices |
| | | 2.2 Review robots and robotic elements |
| | | 2.3 Identify robotic principles and techniques required to evaluate and optimise the processes |
| | | 2.4 Identify appropriate analysis techniques, software and software validation techniques |

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| 3 | Evaluate robotic applications | 3.1 | Assess robotic hardware, sensors/transducers, signal conditioning, controllers, power interfaces, actuators and interface with the end effectors |
| | | 3.2 | Assess motion analysis, load capability, accuracy, precision and repeatability |
| | | 3.3 | Assess system integration, networks, data sharing, control and human machine interfaces |
| | | 3.4 | Assess software and programming techniques for controllers, distributed control system (DCS), system control and data acquisition (SCADA) and system simulation |
| | | 3.5 | Assess compliance of robot and system with WHS and regulatory requirements, codes of practice, standards and risk management requirements |
| | | 3.6 | Apply mock-up and prototyping techniques for robot and subsystem testing |
| | | 3.7 | Assess sustainability implications of robotic application |
| 4 | Report results | 4.1 | Record results of evaluation |
| | | 4.2 | Provide documentation, such as calculations, specifications, diagrams, computer programs and files, and mock-ups or prototypes |

Required Skills and Knowledge

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

Required skills

Required skills include:

- identifying, reviewing and classifying features and functions of robotic applications and robotic devices, including relevant robotic principles and techniques, analysis techniques and software
- ensuring safe electrical working practice, including use of licensed personnel, where required
- identifying WHS and regulatory requirements, and risk management compliance with particular emphasis on automation safety
- investigating sustainability implications of robotic applications
- determining safety, condition, efficiency and functionality of robotics and associated applications, including:
 - controller functions and programming
 - network and system interfacing
 - compliance with WHS and regulatory requirements
 - automation safety
 - robotic hardware
 - sensors/transducers
 - signal conditioning
 - controllers
 - power interfaces
 - actuators and end effectors
- evaluating robotic motion, including:
 - load capability
 - accuracy
 - repeatability
 - efficiency
- determining efficiency and effectiveness of robotic interfacing, including:
 - system integration and networks
 - data sharing
 - control and human machine interfaces
 - software and programming
 - SCADA or DCS and system simulation
- applying mock-up, prototyping and virtual techniques for robot and subsystem testing
- reporting and documenting results of evaluation, including calculations, specifications,

diagrams, computer programs and files, and mock-ups or prototypes

Required knowledge

Required knowledge includes:

- compliance requirements of WHS and regulatory requirements, codes of practice, standards and risk management requirements for robotic applications
- classifications and applications of industrial robotic devices or systems
- features, mechanisms and components of robots
- advantages and disadvantages of different types of actuators for engineering applications
- types of actuator power interfaces
- end effectors and their applications
- robot sensors, such as:
 - contact, proximity and interrupted beam
 - distance sensing
 - pressure and temperature
 - relative and absolute encoders
 - vision and smart cameras
- sensor interface/transducer signal conditioning techniques and analog to digital converter (ADC)
- online and offline programming methods
- mechanical, fluid power, electrical, electronic, programming, communications and networking principles and techniques related to robotics
- the role of kinematic and kinetic analysis of robot mechanisms
- analysis of motions, loads, accuracy, precision and repeatability
- situations requiring licensed trade, technical or professional assistance (e.g. actuator power interfacing)
- interfaces for sensors and actuators, such as the use of signal conditioning techniques and ADC, power interfacing and digital to analog converter (DAC), and pulse-width modulation (PWM)
- programming techniques for motion control and load handling with specialist input, such as vision systems, proximity and distance measurement inputs, and variable velocity control which may be implemented using packaged routines
- automation safety in systems and programs, including appropriate use of emergency stop, failsafe design, redundancy, interlocks, guarding and data integrity
- system integration of sensing, control, end effectors and actuators, data requirements, network topology and communication protocols required
- software for simulation, motion analysis, control, DAC and SCADA
- sustainability implications of industrial robotics

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 industrial robotic applications and integration into automation systems. This includes working individually and as part of a team in accordance with organisational procedures.
Critical aspects for assessment and evidence required to demonstrate competency in this unit	Assessors must be satisfied that the candidate can competently and consistently: • identify WHS, regulatory and risk management requirements, and compliance with particular emphasis on automation safety • investigate sustainability implications of robotic applications • identify, review and classify features and functions of robotic applications and robotic devices, robotic principles and techniques, analysis techniques and software • evaluate robotic hardware • evaluate robotic motion, load capability, accuracy, precision and repeatability • evaluate system integration, networking, data sharing, control and human machine interfaces, software and programming • apply mock-up, prototyping and virtual techniques for robot and subsystem testing • 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.

Robotic device or system	Robots are mechanical, programmable self-controlling machines used widely in engineering and related applications where location, work environment, costs, accuracy, quality, repeatability and reliability dictate their use in preference to human or other machines. The robot may be networked so as to serve an automated environment
Industrial robotic	Industrial robotic applications vary widely. Examples include:

applications	• palletising and depalletising robots • welding and cutting robots • packaging robots • transfer robots • interactive remote surgery robots • interactive nuclear fuel cell robots
Mobile robotic applications	Mobile robotic applications may include: • military robots, including land mine detection and improvised explosive demolition • police bomb detection robots • automated guidance vehicles
Review features and functions of robotic applications	Features and functions may be assessed by analysis of specifications and drawings, 'reverse engineering' of robotic applications and performance analysis using simulation and dynamic performance software. The review may include motion control but does not require validation of dynamic stability which is included in other units and dependant on solution of differential equations
Sensor and actuator interfacing techniques	Sensor and actuator interfacing techniques include the use of: • signal conditioning techniques and ADC, power interfacing and DAC and PWM
Controller programming techniques for motion control and load handling	Controller programming techniques may include the use of various motion pathway methods, including: • 'teach' mode or coordinate and path programming • use of variable velocity algorithms • provision for input variables, such as contact, proximity, measured distance or load and vision, pressure and temperature, and open and closed loop actuator control
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

Analysis	Analysis may include: • static and dynamic analysis of loads • the stresses and deformations resulting • graphical and mathematical methods and software options
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
Standards and codes	Standards and codes refer to all relevant Australian and international standards and codes applicable to a particular robotic application
Automation safety	Automation safety refers to the reliance on emergency stop, failsafe design, redundancy, interlocks, guarding 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
Appropriate technical and professional assistance	Appropriate technical and professional assistance may include: • licensed electrical tradespersons • 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

Unit Sector(s)

Competency field

Unit sector

Custom Content Section

Not applicable.