Australian Government

MSS405052A Design an experiment

Release 2

INDUSTRY SKILLS COUNCILS
Creating Australia's Future

MSS405052A Design an experiment

Modification History

Release 2 - Prerequisite unit code corrected - MSS404052A
Release 1 - New unit, superseding MSACMT652A Design an experiment* - Equivalent
* New prerequisite *MSS404052A Apply statistics to operational processes* superseding MSACMT452A Apply statistics to processes in manufacturing

Unit Descriptor

This unit of competency covers the skills and knowledge required to design experiments. The design of experiments is generally undertaken as part of black-belt six sigma but may also be undertaken independently.

Application of the Unit

This unit applies to a technical expert who is required to design and implement experiments aimed at making breakthrough improvements in the process. They will work with other members of the process team in doing this.
This unit primarily requires the application of skills associated with problem solving, initiative and enterprise, and planning and organising skills in order to identify, implement and evaluate an experiment. Communication skills associated with gathering, interpreting and documenting information are required.
Where this unit forms part of a suite of six sigma then the following units will also be relevant:

- *MSS403010A Facilitate change in an organisation implementing competitive systems and practices*
- *MSS403051A Mistake proof an operational process*
- *MSS404081A Undertake proactive maintenance analyses*
- *MSS405002A Analyse and map a value stream*
- *MSS405011A Manage people relationships*
- *MSS405050A Determine and improve process capability*
- MSS405053A Manage application of six sigma for process control and improvement
- *MSAPMSUP390A Use structured problem solving tools.*
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Licensing/Regulatory Information

Not applicable.

Pre-Requisites

MSS404052A Apply statistics to operational processes

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	Choose an improvement project	1.1	Review a process/value stream map
		1.2	Identify areas in need of improvement
		1.3	Select a process/value stream area for analysis and improvement
		1.4	Determine the objective of the experiment in consultation with relevant stakeholders
2	Design the experiment	2.1	Select appropriate factorial design
		2.2	Estimate signal to noise ratio
		2.3	Determine required number of runs and factorial fraction
		2.4	Determine resolution
		2.5	Design a sequential series of experiments
		2.6	Calculate resource requirement for this design
		2.7	Determine whether resource requirements are practical

			in consultation with relevant stakeholders
		2.8	Modify experiment, if required, to match available resources
		2.9	Determine/develop required metrics
3	Conduct the experiment	3.1	Conduct first run of experiment
		3.2	Replicate in random order for required number of runs
		3.3	Block out known sources of variation
		3.4	Conduct other experiments in series
		3.5	Record data/have data recorded
4	Analyse and confirm the experimental results	4.1	Identify aliases/confounding of variables/results
		4.2	Analyse data using statistics pack or similar
		4.3	Interpret analysed data in line with objectives
		4.4	Identify confidence level of analysed data
		4.5	Design experiment to confirm correlations identified
		4.6	Conduct confirming experiment
		4.7	Analyse data from confirming experiment
		4.8	Confirm results (or conduct further experiments)

Required Skills and Knowledge

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

Required skills

Required skills include:

- analysing existing statistics and other data for relevance to the experiment
- determining where additional data is required and developing strategies for acquisition
- undertaking self-directed problem solving and decision-making
- solving problems
- communicating complex issues and techniques to stakeholders
- documenting procedures and results
- producing a range of charts and generating and validating required data for inclusion
- using statistics packs

Required knowledge

Required knowledge includes:

- charting, such as:
  - Pareto charts
  - main effects plots
  - scatter plots
  - interaction plots
  - contour plots
  - response surface plots
- statistical principles and analysis, such as:
  - analysis of means (ANOM)
  - prediction equations
  - analysis of variance (ANOVA)/one-way ANOVA
  - desirability function
  - hit a target
  - advanced graphical data analysis
  - multi-variate planning
  - variation trees and funneling
  - hypothesis testing
  - central limit theorem
  - statistical analysis roadmap

  - analysis for means and t-test
  - correlation and regression
- factorial analysis principles and methods, such as:
  - multi-variate analysis
  - Taguchi S/N ratios
  - 2/3 level factorial
  - Taguchi L8
  - 2/4-1 half fraction
  - Plackett-Burman 8-run
  - full factorial
- acceptance criteria/confidence levels

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	A person who demonstrates competency in this unit must be able to provide evidence of their ability to: • design an experiment relevant to improvement strategies and targets of the organisation • conduct an experiment • confirm results, including conduct of confirming experiments.
Context of and specific resources for assessment	Assessment of performance must be undertaken in a workplace using or implementing one or more competitive systems and practices. Access may be required to: • workplace procedures and plans relevant to work area • specifications and documentation relating to planned, currently being implemented, or implemented changes to work processes and procedures relevant to the assessee • documentation and information in relation to production, waste, overheads and hazard control/management • reports from supervisors/managers • case studies and scenarios to assess responses to contingencies.

Method of assessment	A holistic approach should be taken to the assessment. Competence in this unit may be assessed by using a combination of the following to generate evidence: • demonstration in the workplace • workplace projects • suitable simulation • case studies/scenarios (particularly for assessment of contingencies, improvement scenarios, and so on) • targeted questioning • reports from supervisors, peers and colleagues (third-party reports) • portfolio of evidence. In all cases it is expected that practical assessment will be combined with targeted questioning to assess underpinning knowledge. Where applicable, reasonable adjustment must be made to work environments and training situations to accommodate ethnicity, age, gender, demographics and disability.
Guidance information for assessment	Assessment processes and techniques must be culturally appropriate and appropriate to the oracy, 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.

Competitive systems and practices	Competitive systems and practices may include, but are not limited to: • lean operations • agile operations • preventative and predictive maintenance approaches • monitoring and data gathering systems, such as Systems Control and Data Acquisition (SCADA) software, Enterprise Resource Planning (ERP)

	systems, Materials Resource Planning (MRP) and proprietary systems • statistical process control systems, including six sigma and three sigma • Just in Time (JIT), kanban and other pull-related operations control systems • supply, value, and demand chain monitoring and analysis • 5S • continuous improvement (kaizen) • breakthrough improvement (kaizen blitz) • cause/effect diagrams • overall equipment effectiveness (OEE) • takt time • process mapping • problem solving • run charts • standard procedures • current reality tree Competitive systems and practices should be interpreted so as to take into account: • the stage of implementation of competitive systems and practices • the size of the enterprise • the work organisation, culture, regulatory environment and the industry sector
Improvement	Improvement includes: • an improvement in performance of an area/section or the whole enterprise as measured in terms of customer features/benefits
Objective of the experiment	Objective of the experiment may include: • screen factors to find the critical few • optimise a few critical factors • solve process problems • reduce waste • increase reliability
Factorial design	Factorial design may include: • 2/3 level factorial • Taguchi L8 • 2/4-1 half fraction • Plackett-Burman 8-run

	• full factorial
Signal-to-noise ratio	Signal-to-noise ratio may be estimated from: • previous experiment design experience • previous process capability studies • statistical process control data • estimated from other sources
Resolution	Resolution is typically: • Resolution III design: A design where main factor effects are confounded with two factor and higher order interactions • Resolution IV design: A design where main effects are confounded with three factor and higher order interactions and all two factor interactions are confounded with two factor interactions and higher order interactions • Resolution V design: A design where main effects are confounded with four factor and higher order interactions and two factor interactions are confounded with three factor interactions and higher order interactions
Sequential series of experiments	A typical series of experiments consists of: • a screening design (fractional factorial) to identify the significant factors • a full factorial or response surface design to fully characterise or model the effects • confirmation runs to verify results
Required metrics	Required metrics may include: • quantitative measures normally associated with the process • other quantitative measures relevant to the experiment • ranking systems for normally qualitative measures, such as defectives
Statistics pack	Typical statistics packs include: • minitab • JMP • spreadsheets, such as Excel, particularly with specific add-ons, such as Sigma XL, Analyse It or other add-ons

Unit Sector(s)

Unit sector Competitive systems and practices

Custom Content Section

Not applicable.