



Australian Government

Department of Education, Employment and Workplace Relations

MSACMT652A Design an experiment

Revision Number: 1

MSACMT652A Design an experiment

Modification History

Not applicable.

Unit Descriptor

Unit descriptor	This unit covers the knowledge and skills associated with the design of experiments (DoE). DoE is generally undertaken as part of black belt six sigma' but may also be undertaken independently.
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Application of the Unit

Application of the unit	In a typical scenario, a technical expert will 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 on six sigma then the following will also be relevant: • <i>MSACMT650A Determine and improve process capability</i> • <i>MSACMT653A Apply six sigma to process control and improvement</i> • <i>MSACMC410A Lead change in a manufacturing environment and/or</i> • <i>MSACMC611A Manage people relationships</i> • <i>MSAPMSUP390A Use structured problem solving tools</i> • <i>MSACMS601A Analyse and map a value chain</i> • <i>MSACMT451A Mistake proof a production process</i> • <i>MSACMT481A Undertake proactive maintenance analyses</i>
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Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Prerequisite units	<i>MSACMT452A</i>	<i>Apply statistics to processes in manufacturing</i>
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Employability Skills Information

Employability skills	This unit contains employability skills.
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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.
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Elements and Performance Criteria

ELEMENT	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 this resource requirements is 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 experiences 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 objective(s) 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

REQUIRED SKILLS AND KNOWLEDGE

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

Required skills

- analysis
- problem solving
- communication
- documenting
- calculations
- use of statistics packs

Required knowledge

- Charting such as Pareto Charts, Main Effects Plots, Scatter Plots, Interaction Plots, Contour Plots, Response Surface Plots
- Statistical principles and analysis such as ANOM, Prediction Equations, ANOVA/ One-way ANOVA, Desirability Function, Hit a Target, Advanced Graphical Data Analysis, Multi-Vari 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

EVIDENCE GUIDE

The Evidence Guide describes the underpinning knowledge and skills that must be demonstrated to prove competence. It is essential for assessment and must be read in conjunction with the performance criteria, the range statement and the assessment guidelines of the relevant training package.

Overview of assessment requirements	Assessment should confirm that the person can undertake DoE projects in a work situation.
What are the specific resource requirements for this unit?	Access to an organisation using design of experiment or access to an organisation where DoE could be conducted.
In what context should assessment occur?	Assessment will need to occur in an organisation implementing DoE or through project based assessment.
Are there any other units which could or should be assessed with this unit or which relate directly to this unit?	This unit could be assessed concurrently with other units dealing with six sigma type work and/or change management. These are: • <i>MSACMT650A Determine and improve process capability</i> • <i>MSACMT653A Apply six sigma to process control and improvement</i> • <i>MSACMC410A Lead change in a manufacturing environment and/or</i> • <i>MSACMC611A Manage people relationships</i> • <i>MSAPMSUP390A Use structured problem solving tools</i> • <i>MSACMS601A Analyse and map a value chain</i> • <i>MSACMT451A Mistake proof a production process</i> • <i>MSACMT481A Undertake proactive maintenance analyses</i> The prerequisite unit <i>MCMT452A Apply statistics to processes in manufacturing</i> should where possible be assessed concurrently with this unit
What method of assessment should apply?	Assessors must be satisfied that the person can consistently perform the unit as a whole, as defined by the Elements, Performance Criteria, skills and knowledge. A holistic approach should be taken to the assessment.

EVIDENCE GUIDE

	Assessors should gather sufficient, fair, valid, reliable, authentic and current evidence from a range of sources. Sources of evidence may include direct observation, reports from supervisors, peers and colleagues, project work, samples, organisation records and questioning. Assessment should not require language, literacy or numeracy skills beyond those required for the unit. The assessee will have access to all techniques, procedures, information, resources and aids which would normally be available in the workplace. The method of assessment should be discussed and agreed with the assessee prior to the commencement of the assessment.
What evidence is required for demonstration of consistent performance?	Generally one significant DoE project should generate sufficient evidence.

Range Statement

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.

Objective of the experiment	Purpose may include: • screen factors to find the critical few • optimise a few critical factors • solve process problem(s) • 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 DoE experience • previous process capability studies • statistical process control data • estimated from other sources
Resolution	Resolution is typically: • Resolution III DOE: A design where main factor effects are confounded with two factor and higher order interactions. • Resolution IV DOE: 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 DOE: 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.

RANGE STATEMENT	
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 characterize 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 Many statistical packages are suitable. It is desirable that they include residual analysis capability.

Unit Sector(s)

Unit Sector	CM Tools
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Co-requisite units

Co-requisite units	
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Functional area

Functional Area	
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