THIS GUIDE IS TO BE READ IN CONJUNCTION WITH THE QUICK GUIDE TO LIFECYCLE

Pedagogical advantages

Engineering work, from individual discreet design changes to mega-projects, is conducted within a lifecycle. It is important that students understand the concept of a lifecycle to add context to their projects, their role within it, and particularly, the lasting influence they have for all subsequent lifecycle phases. An understanding of the lifecycle assists with making decisions and plans for the long-term benefit of the project rather than the short-term needs of the individual (or, in industry: a select company or group of people). It also informs them on what to expect and ask of people who have worked on prior phases in the lifecycle of an engineering project or design change.

Educating students in the lifecycle illustrates that engineers can work in all lifecycle phases of a project and that engineering has wider application than detail design.

The differences between an engineer and a designer include:

- Engineers are typically involved in a wider set of lifecycle activities
- Designers are typically involved during design phases, especially detail design
- Engineers specify what designers design

Assessment

Many assessments could be given in the context of the engineering lifecycle, whether it be developing concepts and a requirement specification for a defined problem, or performing detail design, calculations or lab tests against a specification. Posing assignment material in the guise of client briefs or requirements specifications prepares students for the types of problems and documents they will experience in industry.

Large projects which cover multiple phases of the engineering lifecycle are better for teaching and assessing students in the lifecycle approach. Such projects should begin with a project brief, include validation of a built design, and consider the operation and disposal of the design. Final-year honours projects or other large projects are ideal.

Students should be given the opportunity to develop requirements based on a project brief and technical standards and generate concept options. These should be reviewed by an educator for interim assessment and feedback that the students can incorporate into the detail design. The design documentation should be verified against the requirements and be reviewed for assessment before the design is built. Once built the design should be tested for further verification and validation.

Where possible, consideration should also be given to the subsequent lifecycle phases including operation and end-of-life. Assessment should be based on adherence and implementation of the engineering lifecycle and its deliverables, rather than the success of the project itself. That is, a thorough validation that reveals failures or short-comings with the design may be superior to a narrow validation that passes all criteria.

Implementation

To be successful, an engineering project or design change will have an associated process defining the individual lifecycle phases, their deliverables and any reviews or assessment points between them.

The basis of this process should be provided by the educator but can be customised by a project team to suit the nature and schedule of the project. The lifecycle diagram illustrated on the Quick Guide to Lifecycle provides a starting point. The process should clearly define each lifecycle phase, the activities and deliverables related to that phase.

Once the engineering process is defined and agreed, then the project team execute the project in accordance with the process, performing each of the defined activities and creating each of the necessary deliverables.

Project deliverables likely include:

- Project brief
- Requirements specification
- Concepts
- Hazard register
- Design documents
- Verification procedure
- Verification results
- Validation procedure
- Validation results

It is not necessary to create a single, unified report for the project, as the outcomes are described by the collection of deliverables.

Indicative assessment

Students are given an authentic complex design and engineer project brief and technical specifications from a client. This will be used to develop and document the engineering process, a project brief to tell back to the client what is expected to be done, concept solutions for the client's problem, the requirement specifications and the design for the proposed solution. For each lifecycle phase of the project, students will identify the key deliverable documents and points for review, testing/evaluation, verification and validation.

Note: Assessment of the lifecycle developed and implemented is not dependent on the functionality of the design or engineering output. That should be assessed separately. For:

- Hazard Register - Refer Hazard Identification Implementation Guide
- Verification Procedure - Refer Design Verification Implementation Guide
- Verification Results - Refer Design Verification Implementation Guide
- Validation Procedure - Refer Design Validation Implementation Guide
- Validation Results - Refer Design Validation Implementation Guide
- Project Plan - Refer to Project Planning Implementation Guide

Sample instructions

With support from your supervisor, and for a given authentic complex design and engineer project brief and technical specifications, your team will develop a proposed engineering process describing:

- each lifecycle phase to be addressed by the project
- the key deliverable documents, and
- the points within the lifecycle subject to review.

Once the engineering process is approved by the supervisor, the team will be responsible for executing and delivering the project in accordance with the process.

Indicative Rubric

	Not Satisfactory	*Satisfactory*	*Very Good - meets Satisfactory criteria plus…*
Engineering Process	☐ No process submitted	☐ Engineering process describes each lifecycle phase and the required deliverables for each phase ☐ Engineering process describes the points within the lifecycle that will be subject to review	☐ Engineering process describes the individual roles for each lifecycle phase
Project Brief	☐ No project brief submitted	☐ Project brief describes, in non-technical terminology, the problem needed to be solved by the project	☐ Project brief describes the boundaries and interfaces of the problem, describing who will interact with it and how it interfaces with other systems.
Concepts	☐ No concepts submitted ☐ No concept evaluation submitted	☐ Concept solutions to the project brief are presented ☐ Concept solutions are evaluated for appropriateness	☐ The relationship between the concept solutions and the project brief and technical specifications are clearly articulated
Requirements Specification	☐ No requirement specification submitted	☐ Requirements specification describes the requirements of the project brief in technical terms ☐ Requirements specification describes the technical standards upon which the solution should be based ☐ Each requirement has a unique identifier	☐ Requirements specification describes the requirements related to environmental impact ☐ Requirements specification describes the requirements related to each phase of the lifecycle
Design Documents	☐ No design documents submitted	☐ Design models, drawings, calculations, code or other documents describe the design in sufficient detail for it to be built	☐ Design documents have revision control ☐ Design documents are reviewed and approved by peers

Frequently asked questions

1. *What is a requirement specification?*

A requirement specification converts a Project Brief or "Need Statement" into a systematic breakdown of unique engineering requirements, each individually traceable to a criterion, and thorough in both breadth and depth. Each requirement might be a: user need, legal need, standards need, industry practice need, public need, etc.

Requirements are phrased using 'should' or 'shall' to impose a need that must be met by the design.

2. *How does a requirement specification differ from a project scope or a design specification?*

A requirement specification defines 'what' the design needs to be. It is a technical document describing the design without regard for project schedules, budgets or resources.

A project scope defines the content of the project – the goals, activities and deliverables needed to deliver the project.

A design specification explains 'how' the design meets the requirements, linking design details back to the requirements.

For a small or simple design change, these could be fulfilled by one document.

3. *What is meant by the Project Brief for the client/sponsor?*

A Project Brief for a client/sponsor is a briefing paper or executive summary used to summarise the key elements of the Project Scope documentation. The Project Brief is an opportunity for the sponsor/client to confirm that the plan meets their expectations and specifications. It needs to be in non-technical language that the client will understand.

Tips for writing the Project Brief:

- Aim for no more than 2 pages and ideally one page in length.
- Use tables, flowcharts and dot points to clearly and succinctly present information
- Include:
  - A brief reiteration of the project requirements provided by the sponsor/client
  - Deliverables – what is the expected output of the project
  - Timeframes – start, finish, key deadlines and milestones
  - What is not included in the project
  - Any underpinning assumptions that impact on the project plans and execution
  - Significant and likely risks and how these will be addressed, including safety issues
  - Who will be involved in the project and their responsibilities

Further Reading & References

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