

Tools for Engineering Design 2 Upgrading Project (Weeks 9 & 10)

The aim of the Upgrading Project

The UPGRADING PROJECT is an exercise in understanding drivers and constraints, design development, and communication.

The project is about developing the School of Engineering site at The King's Buildings (more information below). As for the Masterplanning project you need to develop three concepts and make a recommendation. The project can be split into three stages, each of which is described further below:

- (1) Before thinking of any design solutions, sub-divided into
 - (a) understanding the problem;
 - (b) stakeholder identification; and
 - (c) deciding how to judge if a design is good.
- (2) Optioneering
- (3) Recording and communicating your design

We have deliberately chosen a design project that is neither mechanical or civil engineering based, but that is accessible to both disciplines. The design tools we are developing here are relevant to any engineering design process.

(1) Before thinking of any design solutions – problem definition

The problem definition stage is extremely important, but often over-looked. We often rush into creating design ideas before fully understanding the brief, so in this project there is an emphasis is on the project definition.

(a) Problem definition *(before thinking of any design solutions)*

One of the key tools in engineering design is being able to understand not just the explicit details given in a project brief from a client, but the underlying motivations, drivers, and concerns of all of the stakeholders. This is so that during the development phase of project, you as the engineer, can add as much value as possible to the design solutions you create.

When you are assessing a brief you need to consider:

- What has the client asked for, and what might they want you to deliver?
- If you need more information, ask the client. You will sometimes find that you need to design without all of the information you might like, but always ask for clarification.
- Whether you are clear what the client is wanting. Ask the client if you are unsure; there is no such thing as a stupid question when you are asking for clarity.

(b) Stakeholder identification *(still before thinking of any design solutions)*

Who are the stakeholders?

For example:

- client;
- contractor;
- users;
- local residents;
- local authority planning department;
- health and safety executive;

- etc.

What will these stakeholders want to see from the project, and what will they be concerned about? You can ask yourselves “*what would I want if I was stakeholder xxx*”, which is a very useful tool for understanding the design problem.

(c) How will you judge whether a design is good or not? (*still before thinking of any design solutions*)

How will you judge whether a design is good or not; how will judge whether one design is better than another?

- List the criteria that a design will be judged on. For example, these might include cost, aesthetics, safety, usability.
- Decide which criteria are most important, and apply a weighting to define their relative importance.

There is more information on this approach in the *Judgment Matrix* video on Learn, and you will have met something similar if you were here for 1st year. Note how we define the judgement criteria and their weightings before starting to think of design solutions.

(2) Optioneering

Now you are ready to start your design. During the early phases of design, you will come up with several distinct options which you will need to judge and discuss so that you can ensure the correct direction of your design given the various explicit and implicit design drivers.

When you design during these early stages you need to consider:

1. Common sense options
2. Technical feasibility.
 - Are you sure it works? Does it meet the client needs?
3. Buildability
 - Can it be safely built with normal practices? Does it deal with access constraints etc?
4. Operability
 - Do the people that have to use it understand how it works, or need extra training?
5. Environment
6. Cost
7. Safety
8. Other categories of your choice (which should follow from your judgment matrix).

(3) Recording and communicating your design

There are usually two outputs from a design:

- The design options and recommendation, communicated primarily through drawings. This would often also include a report, although we are not asking for a report in TED2.
- A record of the design and decision process, such as the stakeholder analysis. Note that this should be separate to the proposed design options.

The Upgrading Project

The upgrading project lasts for two weeks and it is your job as the design team to make recommendations to the client, who has produced a brief explaining the project. It is also your job as a design team to document your design process and thinking so that the client, colleagues and other stakeholders can understand how you reached your design recommendations. There are three deliverables from the project:

1. Stakeholder identification (20%)
 - Understand the parties involved and how they might be affected by the Upgrading Project
 - **Action:** Produce a list of potential stakeholders (maximum one side of A3) and their potential concerns
2. Define options for client (60%)
 - Three options, from your understanding of the problem and stakeholders/
 - **Action:** Show the three options using a maximum of six sides of A3, suitably labelled and annotated.
3. Design recommendation (20%)
 - List potential drivers and assess each option against these to determine the most appropriate design solution.
 - **Action:** Produce a scored options matrix spreadsheet with justification of the scores and weightings given.

Deadline for submission = 1pm, Monday Week 11. (3rd April).

Suggested timetable for the two weeks

Week 9 – before the TED2 session on Friday morning (now on Friday morn

- Problem definition (including reading the brief)
- List stakeholders and their concerns
- Decide how you will judge your design
- Consider a site visit
- Identify any further information you need, ready to ask about this on Friday morning.

Week 9 – TED2 session on Friday morning

- Ask the client for clarification about the brief.
- Design development

Week 10

- Design development and design recommendation

The Project

Title: *Providing semi-temporary facilities for the School of Engineering prior to the major refurbishment of Kings' Buildings campus*

Client: *Ben Finnegan, Estates Department, on behalf of the School of Engineering, University of Edinburgh*
[NB – Ben Finnegan is a fictional person. You can only contact him through the Learn discussion boards or the tutors in the Friday TED2 sessions].

Engineering has been taught in one form or another since 1673 and the Regius Chair of Engineering was founded in 1868. Since then the School has grown from strength to strength with over 1,800 students studying both undergraduate and postgraduate courses. The number of academic staff has grown from around 100 to 150 over the past five years, and this is expected to continue to grow. The school's professional services staff and research staff and 500 postgraduate students have also grown during this period.

There is a long-term plan to construct completely new engineering buildings at the other side of the King's Buildings campus (part of the grand masterplan for the site); however, delivery of these new buildings will take 10-15 years. The school is currently located in some of the lowest grade buildings in the university, and has outgrown its current space. It requires additional high quality space on a semi-temporary basis. In particular, the school requires:

- space for teaching;
- space for our engineering community to meet;
- additional office space for our teaching organisation and student support teams;
- upgrades to improve the environmental performance of its buildings.

Brief:

The School of Engineering has been given permission by the University's Estates Department to construct semi-permanent buildings within the marked areas on **Error! Reference source not found.** below. There are a number of caveats that go along with this permission including:

- No building can be greater than 5 storeys.
- As many of the existing trees and scrubland need to be protected.
- The Sanderson Building and Hudson Beare LT2 are protected buildings.
- Teaching in the current buildings must continue as there is no alternative room to relocate current and future classes.
- Safe access for students and staff to the differing facilities must be ensured throughout the construction process.
- Ventilation of spaces must be considered due to the potential continuing importance of the pandemic.
- Parking during construction can be truncated but will need to be reinstated when the new buildings are occupied.
- Spaces outside the site identified in Figure 1 are not available for this project.

The School of Engineering require (for normal operation after Covid restrictions end):

- A new 450 seat lecture theatre.
- Four project work rooms (50, 100, 100, 200 student capacity).
- A new manufacturing space for student projects (for 20 students at a time, using appropriate equipment).
- A space that acts as the heart of the engineering community.
- A replacement teaching organisation and student support office, that has increased space for a team that is 50% bigger. The new space should be able to remain open even if physical distancing is reintroduced due to Covid-19.
- Bicycle storage for 100 bicycles.

The new design needs to integrate well with the current structures (see Figure 2) that remain in your designs, and yet be distinct enough so as to be seen as new additional facilities. The design ethos for the school of engineering is built on sustainability and technology and they desire that these new semi-temporary structures reflect these ideas in their design.



Figure 1: Location of the School of Engineering development site
 Latest mapping available from digimap.edina.ac.uk
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Figure 2: Aerial view of site – May 2020

What should the design options and drawings show?

The client has asked to see outline design options that are sufficient to show the differences between the three different concepts, where they will be located, and their key features. It does not require detailed plans.

For example, Figure 3 is one of several images in the development of Cameron Toll. Note how this image shows the hotel and cinema locations in relation to the existing buildings, but it does not present details such as rooms or layouts inside the new buildings. Further examples of outline drawings can be found in the Cameron Toll masterplan, but please note that the client does not require such an extensive consultation document for the current project.

https://www.camerontoll.co.uk/wp-content/uploads/2022/02/Updated_Cameron-Toll_A1-V4-and-A3s.pdf



Figure 3: Extract from Cameron Toll Masterplan

https://www.camerontoll.co.uk/wp-content/uploads/2022/02/Updated_Cameron-Toll_A1-V4-and-A3s.pdf

You should use the drawing frames provided on the Learn site.

Detailed Ordnance Survey digital mapping can be downloaded from OS Roam, on www.digimap.edina.ac.uk.

Upgrading project assessment criteria

Component	Weighting	Pass (D)	Excellent (A3)	Professional (A1)
Stakeholder analysis	20%	Some thought given to basic set of stakeholders and their concerns – analysis conveys this – predominantly text presentation.	Exemplary analysis that could be used as an example in future teaching with minor alteration. Pictorial or graphical representation of analysis is excellent.	Exemplary analysis that could be used as an example in future teaching without alteration. Pictorial or graphical representation of analysis is excellent.
Drawings and design options	60%	At least three options and drawings present, relevant to options and correctly formatted all of which appear technically feasible.	Exemplary drawings which could be used in future teaching with some minor alterations.	Exemplary drawings which could be used in future teaching without alteration.
Option scoring and recommendation	20%	Recommendation made with use of scoring matrix but lack of detail on specific scores.	Recommendation made with use of scoring matrix considering stakeholders' needs with detail on specific scores and discussion of potential design modifications.	Exemplary set of scored options considering stakeholder needs, and modifications, which could be used as examples in future teaching