ES2631 Critique and Communication of Thinking and Design
AY2025-2026 Semester 1
Assignment 1
Team Oral Presentation on Engineering Conceptual Design Project (30%)

Context

In the early weeks of the semester, through e-lectures, independent and tutorial session activities as well as class discussions, you will be introduced to an engineering reasoning framework that we use in this course. Although there are a number of conceptual frameworks for thinking and reasoning (Elder & Paul, 2020; Ennis, 1996, 2004; Halpern, 2014; Stanovich, Toplak & West, 2008), the **Engineering Reasoning Framework** (Paul, Niewoehner & Elder, 2019) has been specifically adapted for the Engineering discipline. Constant use of the framework helps engineering and design students and professionals cultivate important intellectual traits and dispositions which facilitate critical thought within and beyond the technical domain.

Task

In this first assignment, we place the spotlight on **elements of thought** (Paul, Niewoehner and Elder, 2019) through an exercise that involves identifying a problem within a specific context and proposing an engineering design solution that addresses the problem by taking into consideration the needs and affordances of the context. The intent is not to produce a novel engineering design but to articulate the **reasoning** behind a problem and propose a solution based on the creative use or adaptation of existing technology. The proposed solution can be new or significantly improve upon an existing solution. It should be appropriate for the context. In other words, the focus is on the thinking and reasoning undergirding the articulation of a problem and a corresponding possible solution.

This semester, your focus *must* be Singapore specific. Your topic could relate to a specific demographic or community in Singapore. The problem or need must be identified via an exploration of existing ways of addressing it and their limitations. In other words, you must show where the problem exists, whom it affects and how, why existing approaches are inadequate and why it is worth solving. Your proposed solution must be technological, i.e., use principles, theories, models, concepts, frameworks and methodologies specific to engineering. Simply proposing an AI-based solution without a proper understanding of its workings and sufficient consideration of specific mechanisms, concepts, challenges and pitfalls is not acceptable. Likewise, a proposal solely focused on the development of some software such as an App would not qualify as an Engineering solution unless it also has a hardware component.

To facilitate your team discussion and project presentation, we suggest the following steps to take and points to note:

1) Review the elements of thought:
    - Purpose (of this project in relation to the question at issue; based on an understanding of existing approaches to addressing the question within the context and their limitations)
    - Question at issue (or problem, in the context of this assignment)

- Information (facts/data/evidence pertaining to the problem, context and your design solution – these are derived from primary and secondary sources)
- Inferences (conclusions derived from data and evidence)
- Concepts (theories and engineering design principles that underlie your solution)
- Assumptions (ideas that are taken for granted in relation to the problem or your solution)
- Implications (or consequences of adopting or not adopting your solution)
- Points of view (different perspectives related to the problem or design of the solution)

2) Establish your contextual focus and identify a specific problem pertaining to it. As mentioned above, you could focus on a problem that affects Singapore generally or one that pertains to a specific community, population or sector within the country. Use relevant and credible secondary sources to contextualise the problem.

3) Articulate "why" it is a problem, i.e.,
   - What exactly is the gap or concern that needs to be addressed? Whom does the problem affect?
   - What are some existing solutions and why are they not effective? This is important to consider so that your proposed design can improve upon or creatively rethink what has already been tried.
   - What evidence or sources have been interrogated to reach the conclusion that it is a problem (e.g., first-hand observations, gaps or needs in the real world and relevant literature)?

4) Provide justifications or make a case for your *engineering or technological* solution, i.e.,
   - What inferences or assumptions have been made?
   - What are the different points of view and how have they been taken into consideration?
   - What concepts, theories or principles *of engineering and/or design* have been applied?
   - What are the potential implications of the proposed solution?

5) Sources should be carefully selected and acknowledged in your presentation. Refer to the lecture and handout on **Source Types, Selection, Integration and Attribution** (week 3) for details on how to do so, in order to ensure that your evidence is credible and compelling and to avoid plagiarism. Other than as a search engine and as a final proofreading tool, AI in any form **should not** be used for any other aspect of developing and presenting your assignment.

6) In your presentation, cover all the relevant and necessary elements as is appropriate but **highlight three elements of thought** for detailed discussion. The team critiquing your presentation in Assignment 2 will focus on these three elements.

Presentation and Submission Guidelines

In groups of three, make an *9-10-minute presentation*. The presentation will be followed by a *7-minute* Q&A session in which all team members must participate.

1) In 2-member teams, each member can speak for up to 5 mins., in 3-member teams, each speaker gets a little over 3 minutes.
2) The Q&A is assessed individually and based on both the quality of questions and responses. Team members are urged to take turns asking and answering questions.
3) Each presentation and Q&A session are to be recorded. This could be facilitated via a mobile phone, with the recording serving as a reference for Assignment 2, for which you will individually analyse another team's oral presentation. The recording should not be more than 500MB (avoid using 4K recording) and is to be uploaded to MS Teams or any other platform your tutor instructs you to use.
4) Your final slides must include a **list of references** in APA format and a **generative AI use declaration**. **If you used AI, please provide details regarding the tool used, prompt and output and how you used the output in the assignment.** Use **in-text citations** on individual slides, where appropriate, to show what your sources are and how you have used them to think through the problem and your proposed solution.
5) The presentation slides must be uploaded to the designated Teams folder *before* your presentation and the video recording uploaded on the same day after your presentation.

Assessment criteria

The team project presentation will be assessed on the effectiveness of its rationale and the team's application of the framework. Assessment will be based on the following criteria:

- Critical Thought and Reasoning (40%) [Assessed on a group basis]
    - The presentation explicitly and competently demonstrates understanding of the task requirements:
        - All content is categorised accurately based on the Engineering Reasoning Framework
        - The problem and context are well established using appropriate evidence.
        - The purpose of the project is clear and relevant.
        - The solution fits the context, is well developed, based on relevant concepts and supported by facts and data.
    - The presenters engage the audience effectively and the project arouses audience interest and curiosity.
    - The presenters use relevant and credible sources and other evidence critically and effectively i.e., contextualizing, synthesizing, critiquing, comparing and contrasting, for identification of problem and making a case for solution(s).
    - All sources are credible, timely, relevant and properly cited in APA style throughout the presentation.
    - An AI use declaration is included. If AI was used, details are provided in the recommended format.
- Delivery skills (30%) [Assessed on an individual basis]
    - Few language errors and which do not interfere with the audience's comprehension.
    - Few hesitations and no awkward pauses.

    - Projects confidence and calmness.
    - Clear and accurate pronunciation.
    - Well projected voice with suitable modulation in volume and pitch.
    - Presentation is natural and does not sound scripted – not reading from notes.
    - Upright, open posture with natural and appropriate body movement.
    - Good body position in relation to the projected image.
- Visual aids (20%) [Assessed on a group basis]
    - Successful integration of images/graphics/multimedia and text, demonstrating teamwork.
    - Slides are very well presented in terms of size, alignment, contrast and proximity of components, demonstrating teamwork.
    - Sufficient detail to convey one key point per slide.
    - Excellent transition with presenter leading the slides.
    - Logical progression of slides resulting in a presentation that flows smoothly.
- Q&A (10%) [Assessed on an individual basis]
    - Team members take turns to answer questions and effectively build on one another's responses.
    - Responses are thoughtful, clear and relevant. They further develop, clarify or justify ideas and perspectives discussed during the presentation.
    - Each student also engages other presenting teams by asking relevant questions and/or offering useful suggestions. The questions and suggestions should allow another team to clarify ideas, rethink or build on aspects of their project.

Work Schedule

Please seek approval for your proposed project early so that you will have sufficient time to work on it. Here is a suggested work schedule:

Teaching Week	Activity
Week 2	• Form a group. Give your names to your tutor. • Based on the given themes, identify a problem and explore possible engineering solutions. • Seek approval from your tutor on your project focus (problem to be addressed and possible solutions).
Weeks 3 and 4	• Select and outline one engineering solution. • Develop the engineering solution. • Prepare for the presentation: develop and organize the content, and prepare the visual aids.
Week 4 OR 5	• Attend a group conference with your tutor. • Revise your solution design, as appropriate. • Prepare for the presentation: finalise the visual aids and practice.

Week 6	• Assignment 1: Present your project.

References

Elder, L. & Paul, R. (2020). *Critical Thinking: Tools for Taking Charge of Your Learning and Your Life.* 3rd Edition. Rowman & Littlefield.

Ennis, Robert H. (1996). *Critical Thinking*. Prentice-Hall.

— (2004). Applying soundness standards to qualified reasoning. *Informal Logic*, *24* (1): 23-39.

Halpern, D. F. (2014). *Thought and Knowledge: An Introduction to Critical Thinking.* Psychology Press.

Paul, R., Niewoehner, R. & Elder, L. (2019). *The Thinker's Guide to Engineering Reasoning: Based on Critical Thinking Concepts and Tools* (2nd ed). Rowman & Littlefield.

United Nations (n.d.) The 17 goals. https://sdgs.un.org/goals

West, R. F., Toplak, M. E., & Stanovich, K. E. (2008). Heuristics and biases as measures of critical thinking: Associations with cognitive ability and thinking dispositions. *Journal of Educational Psychology, 100*(4), 930–941.

Appendix

(Paul et al, 2019, pages 14-15)

You may also refer to pp. 31-39 for a more detailed explanation of each element and its application to Engineering research.

Please be selective in your use of the questions below, as they may not all be relevant to your conceptual design project.

Analyzing a Design Using the Elements of Thought

Engineering purpose	What is the purpose of this design? What are the market opportunities or mission requirements? Who defines market opportunities/mission requirements? Who is the customer?
Question at hand	What system/product/process will best satisfy the customer's performance, cost, and schedule requirements? How does the customer define "value"? Is a new design or new technology required? Can an existing design be adapted? How important is time-to-market?
Point of view	A design and manufacturing point of view is typically presumed. What other points of view deserve consideration? Stockholders? Component vendors/suppliers? Marketing/sales? Customers? Maintenance/repair/parts? Regulators? Community affairs? Politicians? Environmentalists?
Assumptions	What environmental or operating conditions are assumed? What programmatic, financial, market or technical risks have been considered acceptable to date? What market/economic/competitive environment is assumed? What safety/environmental assumptions are we making? Are these assumptions acceptable? What maturity level or maturation timeline is assumed for emerging technologies? What happens if we change or discard an assumption? What criteria have historically been assumed in defining a "best" or "optimum" solution? What assumptions have been made on the availability of materials? What manufacturing capability was assumed? What workforce skills or attributes have been assumed?

Analyzing a Design Using the Elements of Thought (cont'd)

Engineering information	What is the source of supporting information (handbook, archival literature, experimentation, corporate knowledge, building codes, government regulation)?
	What information do we lack? How can we get it? Analysis? Simulation? Component testing? Prototypes?
	What experiments should be conducted?
	Have we considered all relevant sources?
	What legacy solutions, shortcomings, or problems should be studied and evaluated?
	Is the available information sufficient? Do we need more data? What is the best way to collect it?
	Have analytical or experimental results been confirmed?
	What insights and experiences can the shop floor provide?
Concepts	What concepts or theories are applicable to this problem?
	Are there competing models?
	What emerging theory might provide insight?
	What available technologies or theories are appropriate?
	What emerging technologies might soon be applicable?
Inferences	What is the set of viable candidate solutions?
	Why were other candidate solutions rejected?
	Is there another way to interpret the information?
	Is the conclusion practicable and affordable?
Implications	What are some important implications of the data we have gathered?
	What are the most important market implications of the technology?
	What are the most important implications of a key technology not maturing on time?
	How important is after-market sustainability?
	Is there a path for future design evolution and upgrade?
	Are there disposal/end-of-service-life issues we need to consider?
	What are the most important implications of product failure?
	What design features if changed, profoundly affect other design features?
	What design features are insensitive to other changes?
	What potential benefits do by-products offer?
	Should social reaction and change management issues be addressed?