25WS62: Applied Systems Thinking Coursework CW2 (75% of total module marks)

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The coursework completed in the first part of this module (CW1) concerned the problem of water supply resilience in the UK, this coursework considers a similar problem but in more depth and with particular reference to achievement of net-zero in terms of emissions. (Rissman *et al.*, 2020) have discussed the need to harmoniasly combine technology and policy interventions in order to achieve net zero in the period 2050-2070 globally; indeed the need for an holistic approach to net zero appears to be generally accepted by governments and organisations.

The United Nations describes net zero as: '*cutting carbon emissions to a small amount of residual emissions that can be absorbed and durably stored by nature and other carbon dioxide removal measures, leaving zero in the atmosphere'* (United Nations, 2024). There are many factors that must be considered for the achievement of net zero: including international trade, agriculture, climate change and weather events, economic factors (including inflation and currency markets), policy, technology, logistics, population growth and demographics, to name a few.

In this assignment you are required to research the systems relevant to water management in the **region in which you live or from which you originate** and apply systems thinking techniques to identify and prioritise five strategic policy recommendations with respect to technology investment in the water sector to support the achievement of net zero. The recommendations should be directed towards regional government but take account of national environmental challenges and policies. For clarity, for this assignment 'regional' means a formally defined region in respect of water management or a region that for which geology and other environmental features define water sources and availability.

The problem is complex, there are many factors that can influence water supply reslinience and net zero so, through systems modelling you will identify the most significant factor (or combination of factors) to prioritise your recommendations. Furthermore, timescale is important, and so you should identify the timescale for which these recommendations are relevant (e.g. <5 years, 5-10 years, 10-20 years, >20 years).

The coursework comprises 5 tasks that must be reported within a template. It is very important to adhere to the template as it will be marked using gradescope and the quality of the feedback you receive will be diminished if you fail to use the template. Each part of the report begins on a new page and must have the correct sub-heading.

Task 1 (15% of assignment marks) – Report part 1: Background information

Carry out research into water and sewerage industry and its systems to provide background information relevant to the deduction of strategy. Provide part 1 of the report [strict maximum of 1,000 words] to be marked as follows:

- Relevance of information (5%)
- Comprehensiveness (5%)
- Quality of description (5%) this is essentially the readability and the clarity of the description.

Task 2 (10% of assignment marks) – Report part 2: Assumptions

Record your assumptions about the problem situation as a list. These are statements about the problem that help to bound it (known as delimitations that prevent the scope becoming too large). They may define theories that will be used in the analysis. They may provide clarification when information is uncertain or unknown (i.e. the assumption states information that is believed to be true but may subsequently prove to be false). Assumptions typically set the boundaries for validity of the analysis.

A list of 15-20 assumptions is expected. Prioritisation may be necessary so make sure that only assumptions that are used directly in the analysis are stated. There is no word limit, but each assumption is likely to be a single sentence.

This will be marked as follows:

- Clarity (5%): there should be no ambiguity about the assumptions
- Comprehensiveness (5%): the extent to which all aspects of the problem are covered

Task 3 (worth 25% of assignment marks in two parts) Report part 3: Method Selection

In all analytical endeavours the quality of the analysis is determined by the appropriateness of the methods to the problem being investigated. In this task you are required to determine the systems thinking methods that you will use and justify the choice objectively.

Task 3a (15% of assignment marks) Report part 3a: Criteria for Method Selection

a) Record and explain the criteria that will be used to determine the most appropriate systems thinking techniques to be used (strict maximum of 700 words). There is no fixed number of criteria but typically we might expect ten or more. (15% of assignment marks, provided as 5% for clarity and 10% for logical coherence with the problem situation)

Task 3b (10% of assignment marks) Report 3b: Method Selection

b) Review candidate methods against the criteria to select those that will be applied. Present this information in tabular form. Note that it is expected that more methods will be considered than were covered explicitly in module lectures, i.e., you are expected to research additional methods. (15% of assignment marks, provided as 5% for suitability of the table structure and 5% for quality of assessment of methods against criteria)

A word of caution: you may choose to use methods that you used in the first coursework. This is okay and no problem. But make sure that you do not simply resubmit the same work as you cannot receive marks twice for the same piece of work. If the application of the method builds on the original and is clearly different and an improvement, then that is good.

Note we would expect to see methods that model system(s) behaviour over time.

Task 4 (40% of assignment marks) – Report part 4: Application of methods and recommendations

This task concerns the application of the methods identified in task 3 and the consolidation and analysis of the results to derive a set of recommendations. The marking will take account of the quality and clarity of the writing, the competence in applying the systems thinking methods, and the coherence and logic of the conclusions based on the results. The recommendations to regional government should identify exactly five strategic policy interventions justified through logical argument. A strict maximum of 2,000 words for the whole task is applicable.

a) Report the questions you sought to address. To arrive at your conclusions (recommendations) there are key questions (5-10) that you have had to answer by applying the systems thinking methods (5% of assignment marks)
b) Report the results of systems modelling (i.e., Application of systems thinking techniques). (25% of assignment marks)
c) Make recommendations regarding policy priorities for water resilience with greenhouse gas emissions (GHG) reduction in the country/region of your choice. (10% of assignment marks)

It is plausible, perhaps even likely, that your recommendations are coincident with policy really being enacted by government. That is okay, but it is the quality of your justification that is important for

marking. Where a regional strategy already exists, you should explain alignment or disagreement of your recommendations with that strategy in this task.

Task 5 (5% of assignment marks): Report part 5: Ethics

Engineers need to consider ethics in how they approach research and development and in terms of the impact that their ideas and designs may have when instantiated in products and systems. The Royal Academy of Engineering identifies four fundamental ethical principles[1]:

1. Honesty and integrity
2. Respect for life, law, the environment and public good
3. Accuracy and rigour
4. Leadership and communication

Briefly describe any ethical matters that should be considered in reaching or implementing the recommendations in task 4. This means considering the impact and risks of implementing your recommendations. Strict maximum of 300 words. Marks will be awarded based on the suitability and quality of the explanation/argument.

To be clear, we expect you to abide by ethical practices in the way that you approach your assignment; you should only comment on your practices if you undertake tasks that are subject to the University's Ethical Review process. The focus of this section is on the ethical implications of the recommendations your make.

Report part 6 (5% of assignment marks): Statement of Quality

If you used an AI tool in the creation of this assignment, then make a statement about how you used it. If you did not use AI at all, then state 'No AI tool has been used in creation of this assignment'. You should note that search engines increasingly use sophisticated AI.

For clarity, if you present work that you claim to be your own but is not your own – whether it be generated by another human being or by AI – then your submission is plagiarised. However, the use of AI to support your research is encouraged, but don't believe everything it writes. Just be careful!

General Notes

Word limits: In any section/sub-section with a strict maximum number of words, the student should record the number of words in the section. Diagram and table captions, titles/subtitles, references, words that are part of a diagram **are not** included in the word count; words in table content **are** included in the word count. Exceeding the word limit will result in the marks for that section/sub-section being halved.

The **structure** (report parts) above must be followed.

Referencing:

- Information on references
  - References and citations | University Library - Students | Loughborough University (lboro.ac.uk)
  - You can choose style. For systems thinking, Harvard is appropriate, but not compulsory.
- Use Mendeley to organise references
  - Mendeley | University Library - Students | Loughborough University (lboro.ac.uk)

[1] Engineering Council & Royal Academy of Engineering, "Statement of Ethical Principles." RAEng., London, 2005. https://www.engc.org.uk/standards-guidance/guidance/statement-of-ethical-principles/ [accessed 05/09/22]

- Make sure you read the information about plagiarism
  - Plagiarism | Student Handbook | Loughborough University (lboro.ac.uk)
  - Submissions deemed to have been plagiarised result in disciplinary action and zero marks

Submission Deadline

Students and Apprentices should submit the coursework no later than 3PM on Wednesday 3rd December (Instance 1) or 10th December (Instance 2)

Work may be submitted up to 3 weeks before the deadline.

References

Rissman, J. *et al.* (2020) 'Technologies and policies to decarbonize global industry: Review and assessment of mitigation drivers through 2070', *Applied Energy*. Elsevier Ltd. doi: 10.1016/j.apenergy.2020.114848.

United Nations (2024) *United Nations Climate Action*. Available at: https://www.un.org/en/climatechange/net-zero-coalition (Accessed: 6 October 2024).

Marking Descriptors

The marks awarded are consistent with the indicative requirements below. Students may use these descriptors to support production of their coursework or as indicative feedback on the work that has been assessed.

Marks range	**Indicative Requirements**
80% - 100%	Outstanding: The student has fully met all the ILOs. There is evidence of excellent scholarship including the ability to critically evaluate data and methods, synthesize information and arguments, perform original and detailed analyses, and understand how to deal with complexity and uncertainty.
70% - 79%	**Pass with Distinction**: The student has met the ILOs, with evidence of comprehensive knowledge and very good understanding of current concepts and theories and their application to unseen or non-standard engineering problems. The student has demonstrated a critical approach using a wide range of evidence, analysis, reasoning and discussion. There is sustained evidence of a mature and independent approach to complex problem solving with an ability to select, justify and use innovative solution methods. There is evidence of a thorough appreciation of aspects of the subject that are uncertain, unknown or contradictory.
60%-69%	**Pass with Merit**: The student has met the ILOs, with evidence of comprehensive knowledge and good understanding of current concepts and theories and their application to seen and some unseen engineering problems. The student has demonstrated a critical approach based on application of evidence, analysis, reasoning and discussion. There is evidence of an ability to act independently to identify and define a problem and select, justify and use methods aimed at its accurate solution. There is evidence of an awareness of aspects of the subject that are uncertain, unknown or contradictory.
50%-59%	**Pass**: The student has met the ILOs, with evidence of detailed knowledge and understanding of current concepts and theories and their application to seen engineering problems. The student has demonstrated a generally critical approach using individual judgement and reasoning, but there is some limitation in the ability to conceptualise and/or apply theory and discuss findings in relation to the wider aspects of the subject. There is evidence of an ability to solve standard problems accurately through an application of acquired knowledge and skills.

Marks range	Indicative Requirements
40%-49%	**Marginal Fail**: The student has marginally failed to meet the ILOs, shown limited evidence of knowledge, and understanding of key concepts and theories and their limited application to seen engineering problems. The student has insufficient appreciation of the complexities of the subject, but the work is in the most part descriptive, rather than based on argument and logical reasoning. There is little evidence of an ability to apply learning accurately to solve a limited range of standard problems.
1%-39%	**Fail**: The student has not met all the ILOs and has only limited knowledge of key concepts and theories, with little or no recognition of the complexity of the subject. The work is largely descriptive, and analyses and discussion are minimal and/or not properly justified. Knowledge and understanding fall significantly short of the required threshold level.
0%	**Non submission**: Nothing presented by the coursework deadline.