Defining Engineering Problems

Product/Project Development Approach

Client Statement → Problem Definition → Conceptual Designs → Preliminary Design → Detailed Design → Design Communication → End Product

Project Implementation
Problem Definition

- Input: Client’s problem statement
- Tasks: (what needs to be done):
  1. Establish preliminary user requirements
  2. Clarify/complete user requirements
  3. Rank requirements
  4. Establish constraints
- Output: (Outcome of tasks)
  1. Prepare project/problem definition document
  2. Deliverables

Establish Preliminary User Requirements (i.e. From client statement)

- Usually based on a brief verbal statement (by client)
  - May have a hidden implied solution based on the clients knowledge (or lack of knowledge) about the problem
  - May have hidden agenda (i.e. what is client’s real objective?)
  - May have unrealistic expectations
- e.g. Design of a new heating system for an existing building that houses Duke Energy
  - Duke Energy (i.e. client) wants use of natural gas since it is more efficient
Clarify User Requirements

- Clarify user requirements
- Need to ask
  - What should the product/project outcome do?
    - e.g. heat building
  - What features are needed?
    - e.g. Heat yes, but air conditioning?
    - **What is missing from clients statement?**
      - Remember, the client is not the expert (you are)
      - Low cost/high efficiency?
      - Independent control/automation?
      - In parallel, ask:
        - Why is this needed? Is it really needed?
        - Start thinking about how is this going to be done?

Rank Requirements

- Setting Priorities
  - Rank the importance of the requirements
  - Where design efforts should focus
    - How much effort needs to be devoted to meet a requirement. What requirement can you ‘trade-off’
    - e.g. individual control of the temperature may not be needed if the temperature control is automated
Rank Importance of Requirements

- Ranking:
  - Pair-wise comparison (rapid/easy)
  - Based on personal opinions (and therefore biased)

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<th>Requirements</th>
<th>Cool Building</th>
<th>Heat Building</th>
<th>Automated Control</th>
<th>Independent Control</th>
<th>Score</th>
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Identify Constraints

**Constraints**: Restrictions on an aspect of the design

- Typically stated as a binary choice
- Restricts design space
  - e.g. costs less than $X
  - e.g. uses natural gas
Establishing Deliverables

- What the client will get
  - what will the delivered product/project do/be.
  - Provide estimate of delivery time.
  - Provide an overview of team of expertise that will be assembled to complete the product/project
  - Possibly too early at this stage, but if you can, provide an estimate of resources needed