ECSE-211
Design Principles and Methods

Lecture: Design 5

4 February 2019

5 lectures left.

15 Feb – MT

Teams – by end of week

Specs –

4 docs → UNDERSTOOD

→ Find a solution

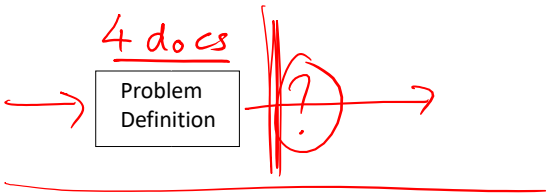
→ figure out how to implement it

Key elements – "validating"

simple models circuit, free body diag

∥ functional decomposition

The Creative Problem Solving Process For the Entire System and Each Sub-Problem



- This is the identification phase – find out what is really required. Do not go past this point until everything is clear..

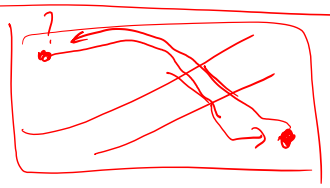
Design – Plan and Conceptualize

- Basically, the design process is similar to the scientific method with respect to a step-by-step routine but it differs in objectives and end results…
  - It encompasses the following activities, all of which must be completed.
    - 1. Define the problem to be solved
    - 2. Acquire and assemble pertinent data
    - 3. Identify solution constraints and criteria
    - 4. Develop alternative solutions
    - 5. Select a solution based on analysis of alternatives
    - 6. Communicate the results.

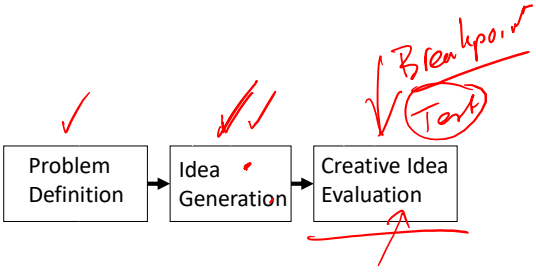
IDENTIFICATION

Generate Ideas

- This is a critical phase – everything going forwards will depend on how well this is done…
  - OK – what might work?
    - This is going to be based on your knowledge and experience
  - Let's break it into subproblems: (more ideas!)

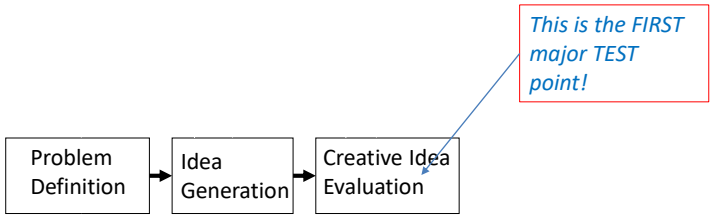


The Creative Problem Solving Process



- This is the first major breakpoint… Is it all likely to work?
- Can we come up with simple analytical models to 'test' it

The Creative Problem Solving Process



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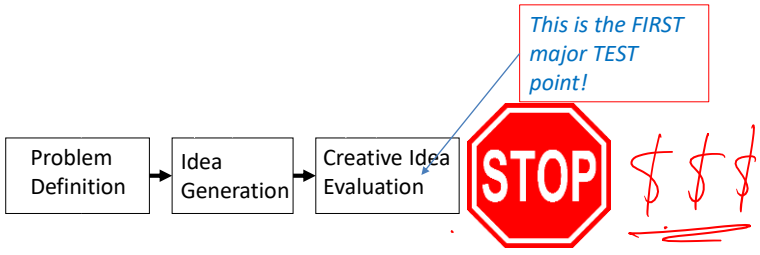

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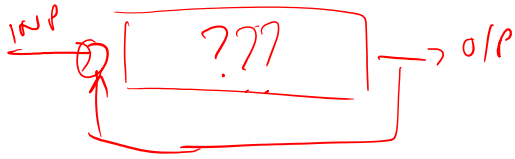
Creative Idea Evaluation

- What-If? Scenarios…
  - This is *Testing*…
  - Testing is needed to be able to decide to go on or to go back…



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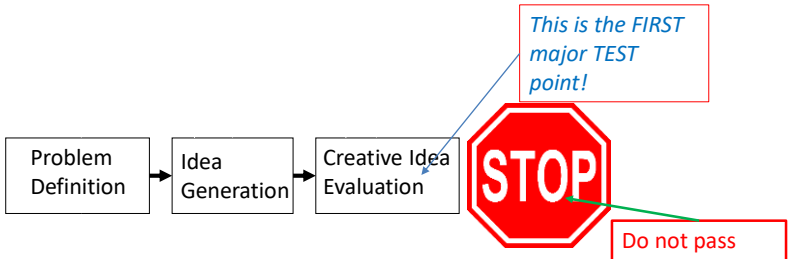

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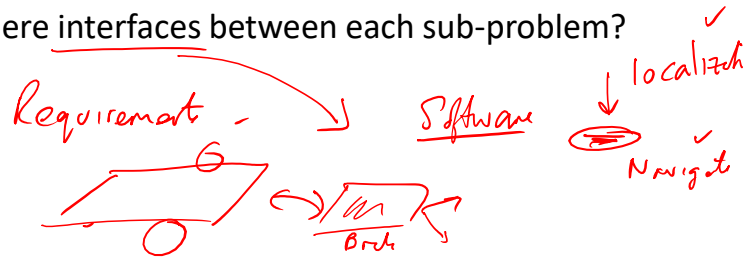
Sub-Problems?

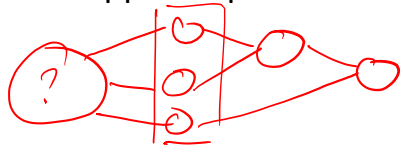
- We need a possible way of solving each one…
- Are there interfaces between each sub-problem?



- Bottom line – list all the sub-problems, list possible solutions (with sketches if necessary)

Ideas, Problems and Sub-Problems

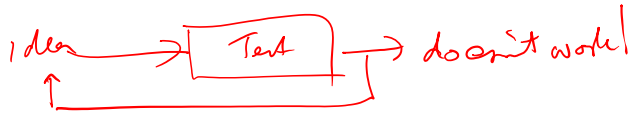
- Each Sub-Problem needs its own specification
  - A Requirements Document
    - Could be a section in the main document or completely separate
  - Each Sub-Problem undergoes a design process which must be completed before the main process can continue
  - Sub-Problem solutions can happen in parallel if they can be isolated



Design – Idea Evaluation

- Next (for the problem and each sub-problem)
  - List the known and unknown quantities separately
  - Model the problem mathematically
  - Test the accuracy of the model and the assumptions made
  - What do you do if it doesn't do what was intended?

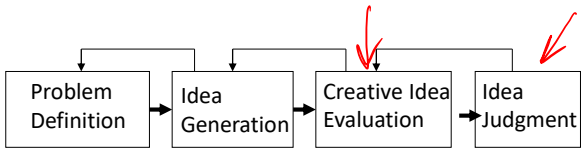
documents



Evaluation Results

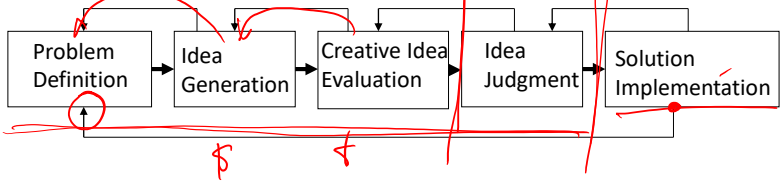
- For each main idea/concept you now have the result of an evaluation
- Now they need to be compared and a solution chosen for further development…
  - DO NOT THROW AWAY THE OTHER IDEAS AND WORK
    - File the documents in case they are needed in the future
  - *In a Design Process you need to be able to Restore a Previous State…*

The Creative Problem Solving Process



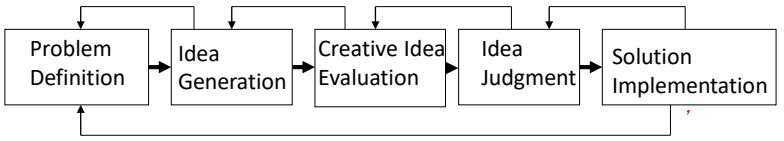
- OK – so we have several possible candidates for subproblem solutions and the complete system..
- We want a solution – delivered on time and on budget
  - which candidate idea gives us the best chance of achieving it?
- Look at the trade-offs
  - E.g.
    - Solution looks elegant but too many unknowns
    - Solution could perform the best but a time estimate suggests it cannot be done for the delivery deadline
    - Solution will need more software than can be built within the budget
    - …

The Creative Problem Solving Process



- Move to implementation
- Another series of steps
  - Construct each sub-problem solution
    - Does if meet the requirement? (TEST)
  - Integrate the sub-problems
    - Do the sub-problems "interfere"

The Creative Problem Solving Process



- OK so you've implemented it –
  - Testing of the integrated system starts…
  - These tests require significant planning
    - Real walkthroughs of all the possible scenarios