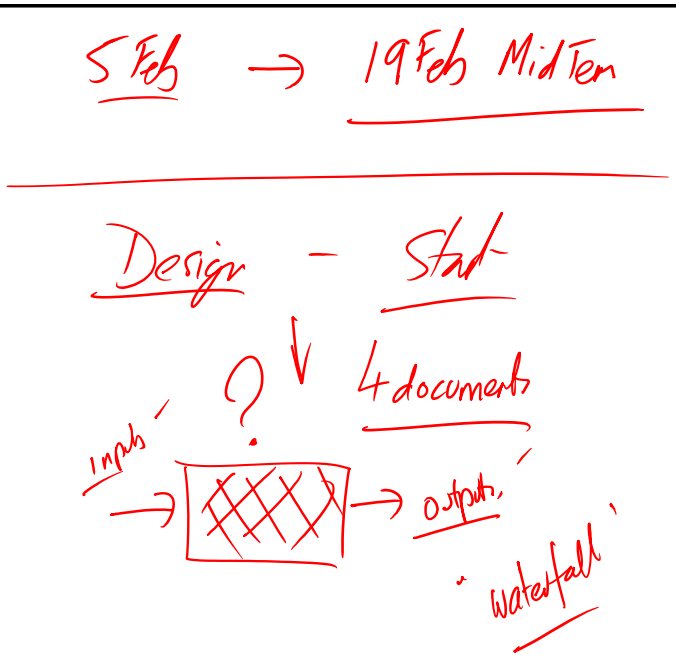
ECSE-211

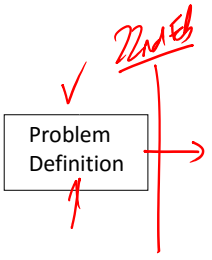
Lecture 14

5 February 2016

Design V



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..

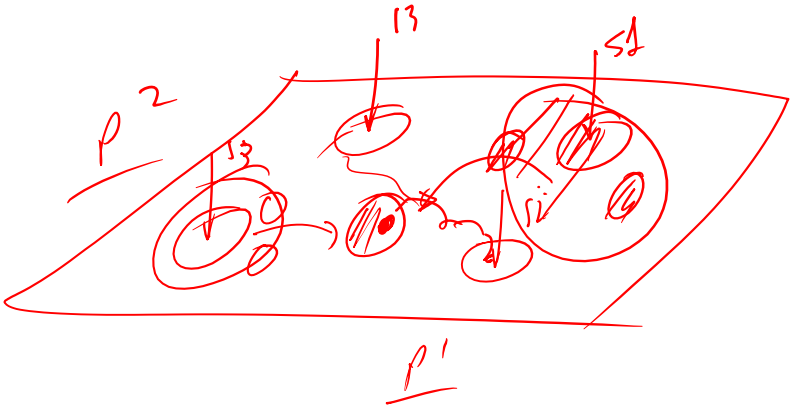
Design - Plan

- Next
  - 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?

Go back to the client

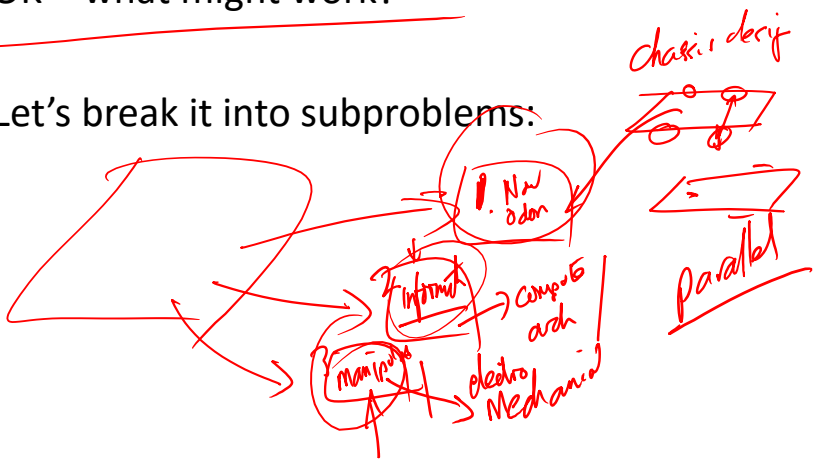
Design – Plan and Conceptualize

- 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.



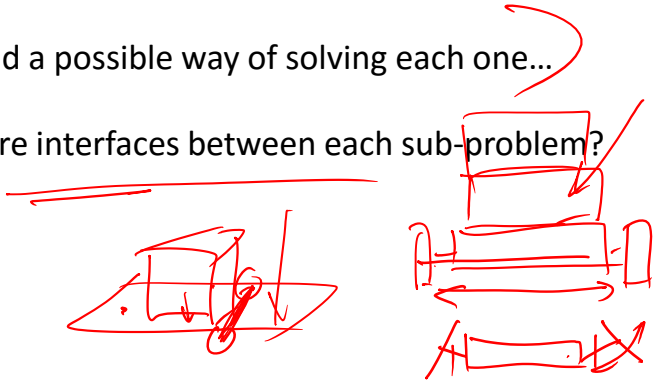
Generate Ideas

- OK – what might work?
- Let's break it into subproblems:



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)

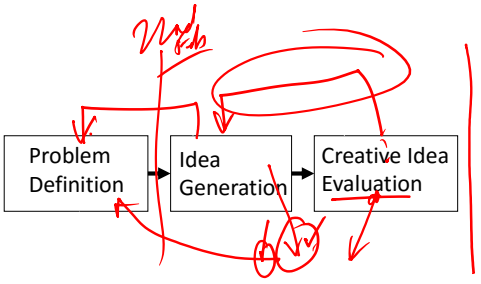
Ideas, Problems and Sub-Problems

- 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 solution can happen in parallel if they can be isolated

Design - Plan

- 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?

The Creative Problem Solving Process

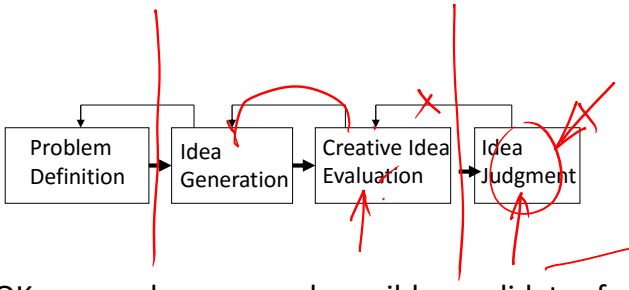


- This is the first major breakpoint… Is it all likely to work?
- Can we come up with simple analytical models to 'test' it

Creative Idea Evaluation

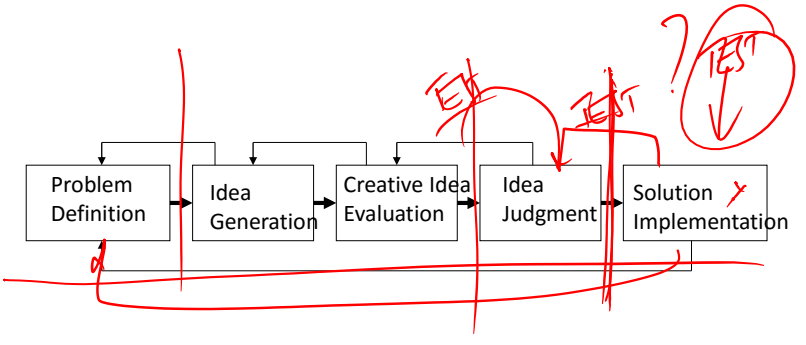
- What-If? Scenarios…
  - This is *Testing*…
  - Testing is needed to be able to decide to go on or to go back…

The Creative Problem Solving Process



- OK – so we have several possible candidates for subproblem solutions.. We want a system – which set give us the best chance of getting it?

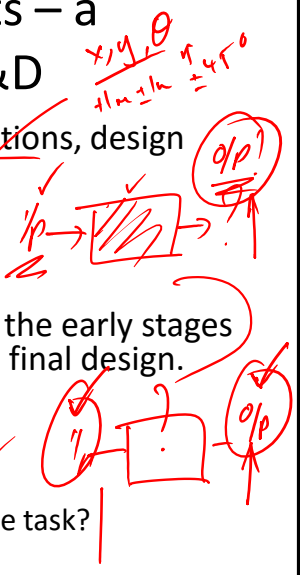
The Creative Problem Solving Process



- OK so you've implemented it – now what?

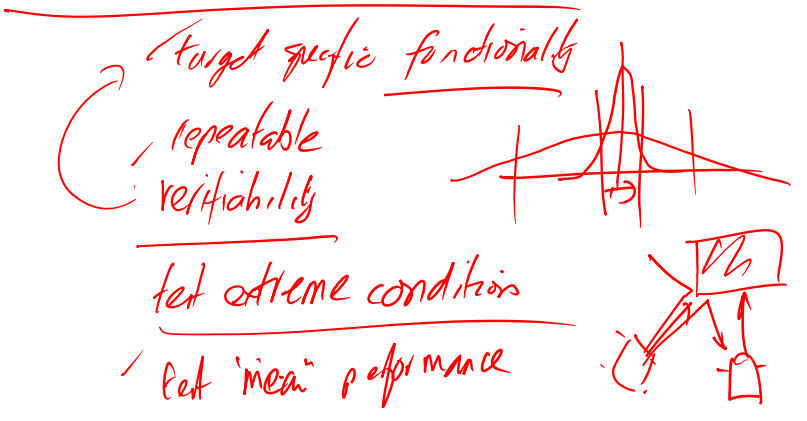
Tests and Experiments – a Continuation of R&D

- When you need to get answers to questions, design experiments
  - How well can the robot localize itself?
  - What is the error in position keeping?
    - This defines *a tolerance*
- The results of tests and experiments in the early stages of the design process will influence the final design.
- Questions to be answered?
  - How rigid can Lego be made?
  - How efficient are the motor systems?
  - How much energy will be required for the task?
  - …



Testing

- What makes a good test?



Testing

- Tests of a prototype serve to confirm the validity of the entire design
- An effective, carefully considered test plan should include the following:
  - Statement of specific purposes of the tests.
    - What decisions will the test validate?
  - Specific test objectives
    - What needs to be measured during the test?

Testing

  - A step-by-step procedure for conducting the test
    - Attention should be paid to the variables to be controlled or monitored
  - An outline of the expected results
    - A data sheet with the predicted data outcomes
    - If you don't know roughly what should happen – how do you know if it is wrong?