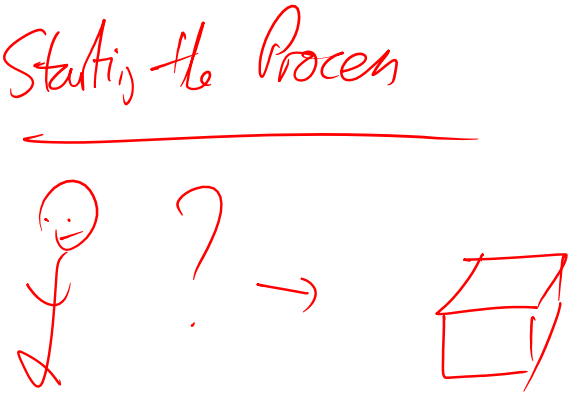
ECSE-211

Lecture 11

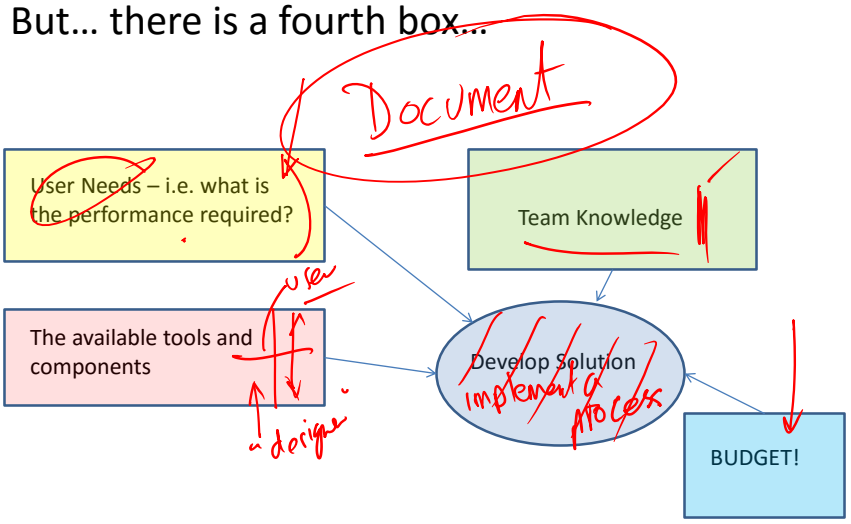
29 January 2016

Design IV



Design – Needs and Givens

- But… there is a fourth box…



The Requirements Document

- The first piece of documentation in the system
- *Defines the first box*
- When completed, this should give a complete description of the needs of the client..
  - All questions should be answered before the real design can start..

The Requirements Document

- All Documents in the process must have:
  - A title
  - The author name
  - Date
  - Version number
  - Edit history

The Requirements Document

- The goal is to understand what the user wants
  - What is the system meant to do?
    - List any performance data you have
  - What can you use to solve the design problem?
    - List any items that are explicitly specified
  - Are there tolerances on performance?
    - List them
  - Is there a deadline?
    - List it
  - …

Design 3 – How do you Start?

- Maybe the questions are based on the capabilities/resources you have…

Design 3 – How do you Start?

- Maybe the questions are based on the capabilities/resources you have…
- What tools/components do you have access to for solving the problem?
  - Identify the solution environment..
  - Note – this is not the environment the final device will operate in (that is given in the requirements)

The Solution Environment

- This is Box 2
- Determine what tools you have
  - Software?
  - Hardware?
- What building blocks/components you have
  - Capabilities of parts..
  - Software?
  - Hardware?

The Solution Environment

- Develop a set of questions
- Develop a set of answers
- Complete a document

The System Document

- The second piece of documentation
- *Fills in the second box*
- When complete, everything about the system available for implementing the solution should be known.
- In trying to complete this document initially, there will be unknowns…
  - How do you resolve these?

The System Document

- Completing the system document may identify issues with the requirements..
- This is an iterative process…
  - Ask more questions
  - Return to the Requirements Document and revise it – in consultation with the user.

Design 3 – How do you Start?

- Maybe the questions are based on the human capabilities/resources you have…

Design 3 – How do you Start?

- Maybe the questions are based on the capabilities/resources you have…
- What is the team capable of? What is your knowledge/capability base?
  - Create an inventory of capabilities – these may constrain your solution…
  - Document what you can do:
    - E.g. John has worked with Mindstorms before – he knows how to program it
    - E.g. Mary has been involved in a robotics project before McGill

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Create a document – Write it down – who has expertise in what?

Capabilities Document

- This is the third document
- *Fills in the third box*
- This is the knowledge/skill base of the team
  - Who can program?
  - Who understands mechanics?
  - Who understands systems?
  - Who can manage?
  - …..

Design 3 – How do you Start?

- Maybe the questions are based on the budget you have…
  - The budget involves time
  - The budget involves available systems
  - *The budget involves money!*

The Constraints Document

- This is the fourth document
- *It fills in box four*
- Defines the constraints imposed by budget
  - Time available – i.e. people times hours times salary
  - Systems available – i.e. component provided, components which might be acquired
- This document may also affect the requirements document – it may need revising.

Now What?

- Are the documents complete?

Now What?

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  - If we believe they are at this point, what do we do with them?

Design – What's Next?

- So you have fully understood the project, you have researched the unknowns and now have the knowledge base which allows you to understand the user requirements and system constraints… What should be done next?

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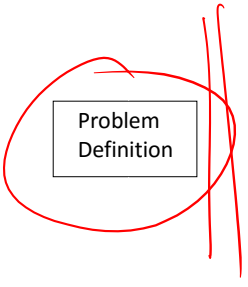
- So you have fully understood the project, you have researched the unknowns and now have the knowledge base which allows you to understand the user requirements and system constraints… What should be done next?
  - *Plan a solution and look for ways of getting there*
  - Define and sketch the system which might satisfy the requirements of the problem
  - Identify the key elements before applying the appropriate physical laws
    - In EE draw a circuit diagram
    - In Mechanics, sketch a free-body diagram
    - Create a Functional Diagram?

Design Process

- From a first idea
  - Identify the possible components
  - Create sub-problems
    - Each subproblem becomes a design problem
  - Nested set of design problems to be solved
    - The solution process for each one may be different

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?