Requirements Specifications

Solving the client’s problem.

Client: “Make me one of these, please!”

Image taken from Cycle Finish website, http://www.cyclefinish.net/motorcycle/tank-and-plastic-repair.html, Redwood City, CA, (16 Sep 2008)

Reference

- Much of what you see here is adapted from:

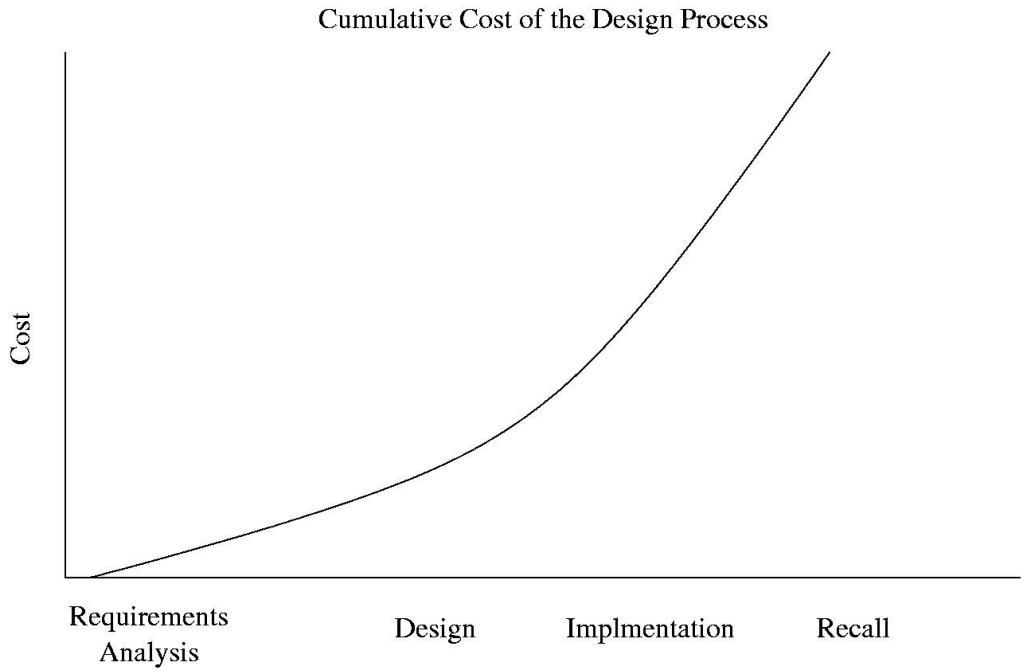
  Salt, J.E. and Rothery, R., “Design for Electrical and Computer Engineers”, John Wiley and Sons, 2002. ISBN 0-471-39146-8

Where are we?

- This is one of the first design stages.
- Since it forms the foundation of all activities that follow, it is terribly important.

Motivation

This is also a *financially* important stage since failure to do it right may make or break a company.



Three Steps

- Assess the needs of the client.
- Specify the design requirements.
- Assess the Hazards

- Solutions are not considered.
- Iteration between the first two steps is required.
- Seek to understand the client’s problem.
- This process requires a great deal of patience, interpersonal skills, and experience.

1. Needs Assessment: Real-World Factors

- Financial Limitations
- Legal/Regulatory Restrictions
- Existence of Other Designs
- Expertise Available
- Consistency with Legacy Products
- Consistency with Firm’s Practices

1. Needs Assessment: Detail

- In the end, Salt and Rothery suggest that the problem statement derived from the needs assessment have the following qualities:
  - It is **Nontechnical** in nature
  - It is **Nonquantifiable**: rarely are values ever included
  - It is **Complete**
  - It is **Specifiable**: each aspect should lead to a quantifiable measure

1. Needs Assessment: Question the Customer

Depends on the knowledge level of the customer.

- Questions that Define the Design Problem:

  What is the problem? Why is there a problem? What is my role in solving the problem? How will I know when we are done?

- Questions to determine the budget and schedule:

  When is the solution required? Cost constraints? Expected production costs and volumes?

- Questions about reliability and maintenance:

  Consequences of failure – even once? What resources are available for maintenance?

- Questions of contract:

  How is completion defined? How will it be evaluated? Payment method? Is the work legal?

1. Needs Assessment: Further Steps

- Help the client differentiate between *wants* and *needs*.

  More features = more time = more expensive.
- Explore project *boundaries*: this involves characterizing the real-world aspects of the design.
- Perform an *Input/Output Analysis*: a top-level block diagram can help identify key parameters.

Needs Assessment: Further Stages (continued)

- *Preview the User Interface(s)*: brings the end-objective to mind.
- *Survey the Attributes of Other (Similar) Designs*: gives rise to a myriad of questions that have a nice reference point.

eg) Is the package to be

smaller than design X?

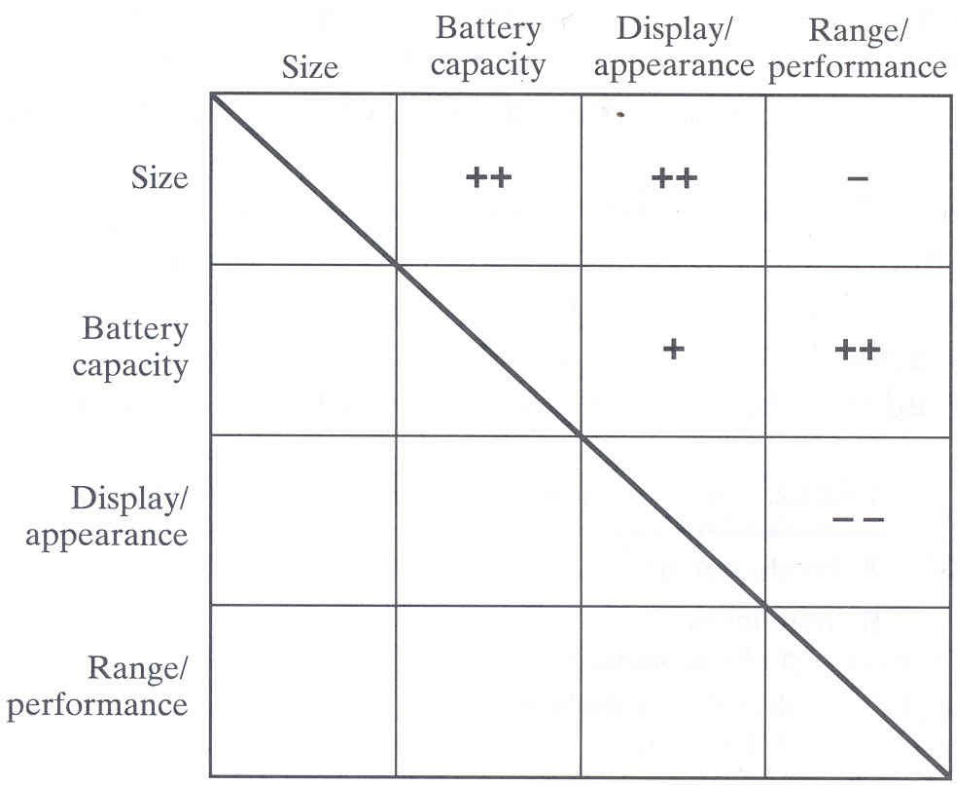
1. Needs Assessment: Further Stages (continued)

- *Identify Conflicting Needs*: design trade-offs become the focus, including the classic “time vs. cost vs. quality”.
  - It is helpful to develop a correlation matrix to identify how the features of the design are linked.

(see next page)

Sample Correlation Matrix

(Taken from Salt and Rothery)



1. Needs Assessment: Further Stages (continued)

- Prepare a *Draft User Manual*: brings to light many details that may have been missed.
  - Product Overview
  - Installation
  - Initial Setup
  - Operations
  - Maintenance

2. Requirements Specifications

- Once the Needs Assessment is complete, translate into the **Requirements Specifications** Document.
- Recall that this process is iterative.
- The translation from needs into a specification is one-to-one. If there are problems, then the need may need to be revisited.

2. Requirements Specifications: Translating Needs

- Some tools will help the translation from needs to specifications:
  - Searching out expert sources. **Research!**
  - Analyze similar designs. **Research!**
  - Conduct tests or experiments. **Research!**

2. Requirement Specifications: Interface Points

- How the user interacts with the product can sometimes be summarized by figures showing the conceived physical design.
- How the device interfaces with other systems, including mechanical systems, also receives attention here:
  - Power source? From the wall? Via a transformer? Network connected? Nature of data traffic?
- Again, recall that the entire point of this document is to ensure that what the customer needs is what the customer will get!

2. Requirements Specifications: Excessive Requirements

- Having too many specifications can complicate the design (and increase cost).
- Watch out for:
  - Specification of needless features and functionality: “feature creep”.
  - Specifications that are too stringent.

2. Requirements Specification: The Document

A typical Requirements Specification Document is structured as follows:

- Overview
- Statement of the Problem
- Operational Description (via draft user's manual)
- Requirements Specification
- Design Deliverables
- Preliminary System Test Plan
- Implementation Considerations (Service/Maintenance and/or Manufacture)

Attachments could include:

- Studies
- Relevant Codes and Standards

2. Requirements Specification: The Document (continued)

- For the purposes of this course, the expected Requirements Specification submission is not quite so ambitious.
- In the end, you have two clients no matter how you look at it:
  - The customer.
  - The course.

  Based upon what you are asked to submit for the Requirements Specifications, your advisor will attempt to steer implementation in a manner that will see all projects roughly equal in length and difficulty. This steering continues through subsequent design stages, too!

3. Hazard Assessment

- Sometimes pursuing a project means working with potentially dangerous technology or in a potentially dangerous environment.
    - Environment (working at a height, around equipment, around any other hazards, etc.)
    - Chemicals (acids, bases, nanomaterials, carcinogens, etc.)
    - Mechanical Systems (whirling blades, gears, etc.)
    - Radiation (UV light, microwaves, etc.)
    - Electrical (excessive voltage, current)

3. Hazard Assessment (continued)

- It is important to ensure that everyone involved in the project knows:
  - about the hazards
  - how to safely handle all hazards
  - how to act in an emergency situation arising out of any of these hazards

3. Hazard Assessment (continued)

- You will know the most about what hazards are associated with your project: please inform your instructor about them!
- Please research and learn safe-work procedures related to these hazards, and provide your instructor with evidence of this training!

Summary

- Hopefully you have understood that it is of paramount importance to solve the customer's (client's) *needs* and not their *wants*.
- Helping the client figure out what the core needs are can be challenging, to say the least.
- During the design process, there is a constant need to appropriately balance design tradeoffs.
- By way of the Requirements Specifications, you are beginning to arm yourself with documentation that can be referred to in the event of a dispute.