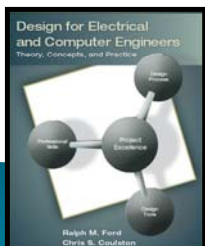


## Chapter 2 – Project Selection and Needs Identification




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## Big Picture of Chapter



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## Chapter 2 – Learning Objectives



By the end of this chapter, you should:

- ▶ Have an understanding of the types of projects electrical and computer engineers undertake.
- ▶ Understand and be able to apply sound criteria for project selection.
- ▶ Know how to determine, document, and rank end-user needs.
- ▶ Be aware of resources for conducting research surveys.
- ▶ Have selected a project concept and developed a problem statement.

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## 2.1 Types of Design Projects

Creative Design

Variant Design

Routine Design

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## Engineering Projects

- ▶ Systems Engineering & Integration
  - Large-scale, many people
- ▶ Testing.
  - Does system meet requirements?
- ▶ Experimental Design
  - Design experiment or apparatus
- ▶ Analysis
  - Correct problem, i.e. FMEA

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## Engineering Research Projects

Discover or create something new.

- ▶ Technology evaluation.
- ▶ Applied Research.
- ▶ Fundamental Research

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## 2.2 Sources of Project Ideas

- ▶ Industry sponsorship
- ▶ Engineers without Borders
- ▶ [www.FreeRandD.com](http://www.FreeRandD.com)
- ▶ Campus and local community
- ▶ Brainstorming

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## 2.3 Project Selection

Questions to ask (Heilmeier). Electrical Engineer and CEO of Bellcore.

- ▶ What are you trying to do? Articulate your goals using absolutely no jargon.
- ▶ How is it done today, and what are the limitations of current practice?
- ▶ What is new in your approach, and why do you think it will be successful?
- ▶ Who cares? If you are successful, what difference will it make?
- ▶ What are the risks and payoffs?
- ▶ How much will it cost? How long will it take?
- ▶ What are the midterm and final exams' to check for success?

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## Use of Analytical Hierarchy Process

See Appendix B – Complete description of AHP

1. Determine selection criteria
2. Determine the criteria weightings
3. Identify and rate alternatives relative to criteria
4. Compute scores
5. Review the decision

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## 2.4 Four Step Needs ID Process

1. Gather raw data.
2. Translate to marketing requirements.
3. Organize the needs into a hierarchy.
4. Rank the Needs
5. Review the outcomes

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## A Problem Statement

*"Design a mechanical arm to pick apples from a tree."*

Is this a good problem statement?  
What is a better one?

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## A Problem Statement, cont'd

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## Another Problem Statement

*The traffic at the front of campus is too congested. I would like you to design a new traffic lane for the northbound traffic exiting at the intersection at the front of the college.*

Is this a good problem statement?  
What is a better one?

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## The "Design Space"

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## Step 1: Gather Raw Data

Some methods are:

- ▶ Interviews (see questions in the book).
- ▶ Focus Groups
- ▶ Observation – i.e IDEO shopping cart & heart device
- ▶ See questions in book
- ▶ Technology push-pull
- ▶ Trends

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## Step 2: Translate Needs to Marketing Requirement

### Marketing Requirements

- ▶ Statement of Customer Needs in language of customer.
- ▶ What the product should do, NOT how it should be achieved.
- ▶ Short, action-oriented phrases
- ▶ Example – “The system should have high quality audio.”

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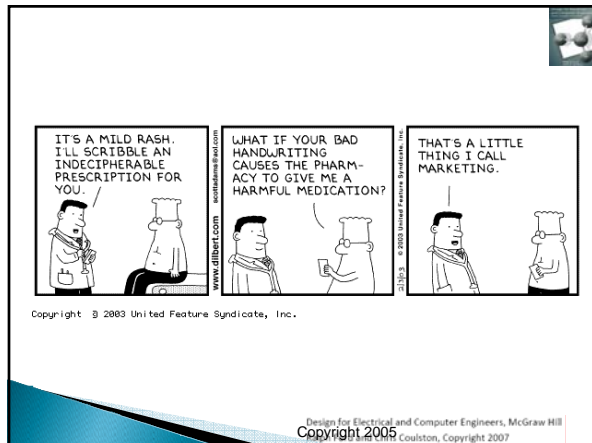
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## Example: Marketing Requirements

### Example

In IDEO Video, the guy said, “these carts have been clocked going 35 mph”, what is the marketing requirement that goes with this statement?

Answer(s):

- ▶ Cart should not move in wind.
- ▶ Cart should not exceed XX mph.

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## Example: Marketing Requirements

### Example

Customer says: "The current system is bulky and hard to hold". The marketing requirement for this is?

Answer – "The system should be easy to hold with hand"

### Example

Customer says "The system should be safe."

Answer – "The system should be safe."

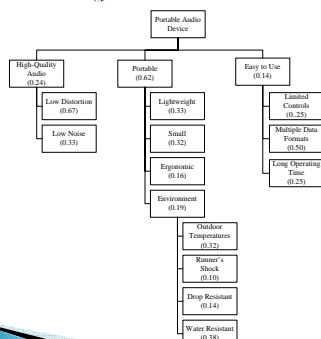
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## Step 3: Organize the Needs into a Hierarchy

- Organize needs by **functional similarity**, not by importance!
- What is **functional similarity**?

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## Tool: Objective Tree



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## Step 4: Rank the Needs

- Rank the needs to determine the relative importance of each of the needs.
- Systematically compare each need to all other needs.
- Who should do this?

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## Tool: Pairwise Comparison Matrix

	High-Quality Audio	Portable	Easy-to-Use	Score
High-Quality Audio				
Portable				
Easy-to-Use				

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## Step 5: Review the Outcomes

- This is just a process that embodies a good practice.
- It is ultimately for making decisions about what is important to the end-user.
- In the end ask yourself – “Does this make sense?” If not, you should make it so that it does or determine why not.

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## Let Review: Needs ID Process

1. Gather Raw Data (Customers, end-users)
2. Translate into Marketing Requirements.
3. Organize need into Hierarchy (Functional Similarity)
4. Rank Needs (Pairwise comparison – at each level)
5. Review the outcomes

**YES** – you will apply this to your design project!

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## 2.5 Research Survey

- ▶ **You** need to become the experts on the problem and state-of-the-art in this area.
- ▶ If you don't, then you re-invent the wheel
- ▶ If you don't, then you don't look too smart.

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## Objectives of the Research Survey

- ▶ What is the basic theory behind the concept?
- ▶ How is it currently being done?
- ▶ What are the limitations of the current designs or technology?
- ▶ What are the similarities/differences between your concept and current systems?
- ▶ Are there existing or patented systems that are relevant to the design?

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## Research Resources

See the book

- Internet resources
- Electrical and computer engineering type.
- Government resources
- Journal and conference papers.

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## 2.6 Needs and Objectives Statements

The need statement should

- ▶ Briefly and clearly state the need to be met
- ▶ Do not provide a solution to the problem
- ▶ Provide supporting statistics or anecdotes
- ▶ Describe current limitations
- ▶ Describe any supporting processes.

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## Example – Need Statement

According to AppleInsider, approximately 10.3 million people owned iPods at the end of 2004 and many of the owners used them while operating their automobiles. The National Highway Traffic Safety Administration estimates that driver distraction is a contributing cause of 20 to 30 percent of all motor vehicle crashes – or 1.2 million accidents per year. One research study has estimated that driver inattention may cause as many as 10,000 deaths each year and approximately \$40 billion in damages. iPods can present a distraction to drivers that is similar to cell phones in that the driver's attention is divided between controlling the steering wheel, watching the road, and navigating controls on the iPod. A system is needed to allow users to navigate among the music selections of their iPod without distracting their attention from the road.

*From the iPod Hands-Free Device Design Report by Al-Busaidi, Bellavia, and Roseborough [Alb07].*

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## Objective Statement

The objective statement should

- ▶ Summarize what is being proposed to meet the need
- ▶ Provide some preliminary design objectives
- ▶ Provide a preliminary description of the technical solution, avoiding a detailed description of the implementation.

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## Example – Objective Statement

The objective of this project is to design and prototype a device that will make the iPod safer to use while driving an automobile, by allowing hands-free control of the iPod. The device will interact with the user using spoken English commands. The user will be able to issue simple voice commands to the device to control the operation of the iPod. In turn, the device will communicate information verbally, such as song titles that are displayed on the iPod screen, to the user.

*From the iPod Hands-Free Device Design Report by Al-Busaidi, Bellavia, and Roseborough [Alb07].*

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## Project Application: The Problem Statement

Problem Statement Contents

- ▶ Need
- ▶ Objective
- ▶ Background (Research Survey)
- ▶ Marketing Requirements
- ▶ Objective Tree

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## 2.8 Summary

- ▶ Apply sound project selection criteria.
- ▶ Determine the true user needs.
- ▶ Outcomes of the needs elicitation process.
  - Marketing requirements
  - Objective Tree
  - Ranking of the needs
- ▶ Conduct research survey
- ▶ Problem Statement
  - Needs
  - Objectives

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