

## Design Requirement

### EECE401 Senior Design I

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Washington, DC

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## Before We Proceed

- Student presentations on the Sunroad Spectrum Happening

– Extra Points



- Project Description on Intel Cup 2011
- Gerard Spivey

Cornell Cup USA presented by Intel



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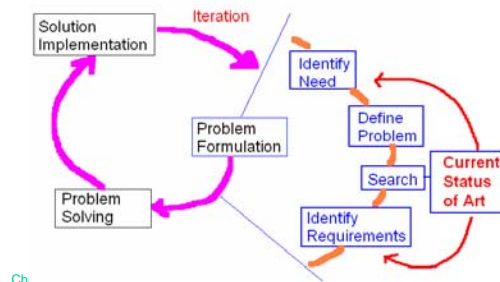
## The Next Step in Design

- We are still in the PROBLEM FORMULATION
  - Clear understanding of the PROBLEM of the project
  - Practice with the problems of Jimmy Hendrix and Eric Clapton
- Next Steps
  - The **current status** of the solution (product) to the needs and problems
  - Establish **design requirements** for the needs and the problems
    - Conversion from the **Needs** to the Design **Requirement**

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## Current Status of Art

- Study and understanding of the field knowledge around the needs and problems – core principle and technology, theory, etc
- The current status of the field related to the needs and problems -- products, patents, research and development, etc
- Other issues specific to the needs and problems



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## How to know the current status of art

- Three primary activities
  - Working with customers/users to get information
    - Interviews, Concept Maps, Observation
  - Discussing the problem with each other
    - Clarification within a group
  - Researching Information
    - Libraries and online sites
      - Be careful:
        - » Accuracy and Authority
        - » Objectivity
        - » Currency
    - Existing products
      - Benchmarking
    - Experts
      - Consulting Experts
      - Advisors

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## Homework #2

- The current status of the “Wireless Guitar Amp” product and technology ---**Title of the work must chosen by each student**
- Should answer the following questions:
  - What is the core principle or theory of the technology?
  - What kind of products are out there in the market?
  - What are their advantaged and disadvantages against the needs
  - What would improve the products and meet the needs?
- 2-person team work
- Report (**hardcopy only**) **Email submission not accepted**
  - Concise, technical, professional, WP staff writer-like report, with your own words.
  - No cover page; line 1 (title, 10 pt); line 2: space; line 3; names and IDs; line 4; Date; line5: space; line 6: First line of your first paragraph.
  - First paragraph should answer the questions, and subsequent paragraphs should explore more and expand.
  - Letter size, 1” margin all sides, 10 pt. Times New Roman font. Single space. Left justified. Max 1 page.
  - Submission Due: 1:10pm. W 14 SEP 2011

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## Design Requirement

- What is “Design Requirements” ?
  - **Technical** Guide
    - Plain English description → Technical terms
  - **Specifications**
    - Size
    - Weight
    - Current and Voltage and Power consumption
    - Reach
  - **Regulations**
    - FCC
    - FAA
    - Etc
  - It’s all down to **numbers**


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## Problem vs. Requirement (or Spec)

- A **more precise (technical) description** of the Problem (Needs):
  - should not imply a particular architecture/solution;
  - provides input to design/solution process.
- Difference between Problems (Needs) and Specification
  - Layman’s term → Technical terms
  - Aamco Commercials
  - Description → Specification (Example)



Replacement **Dell** Latitude **E5500** AC **Adapter** 90Watt 19.5V 4.62A



Replacement **Dell** Latitude **E5500** AC **Adapter** 90Watt 19.5V 4.62A

Email to a Friend  
Be the first to review this product

Availability: In stock

**\$19.99**

Qty:  [Add to Cart](#) OR [Add to Wishlist](#)  
Add to Compare

Quick Overview

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**Specification:**

Replacement **Dell** Latitude **E5500** AC **Adapter** 90Watt 19.5V 4.62A

Manufacturer: 3rd Party

Input: AC100-240V (worldwide use)

Output: DC19.5V 4.62A

Power: 90W Max

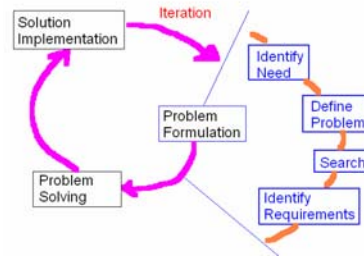
Outlet: 3-Prong

DC Connector (Barrel) size:  
Internal Diameter: 5.0mm  
External Diameter: 7.4mm  
With central smart-pin

Item Includes: AC **Adapter** and Power Cord.

## Design Requirement Identification

- Step 1:
  - Clear, unambiguous description of the problem
  - (Practice)
- Step 2: **Focus of the class**
  - Establishment of clear set of Design Requirements



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## Good Design Requirements

- Design Requirements should:
  - Be as **quantitative, measurable, and precise** as possible
  - Describe the **Need**, not the solution
  - Be **Comprehensive**
  - Be presented in an **easy to understand** format.

**Specific**  
**Measurable**

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## Requirements – Be Measurable

- If you cannot test if a “requirement” is met, then it is not a requirement
- Testable → Measurable → Quantitative
- Example:
  - 2-liter soda container
    - Bad: “must be safe”
    - Good:
  - Wireless Guitar Amplification System
    - Bad: “lower power consumption”
    - Good:
    - Bad: “Sound quality should not be changed”
    - Good:
  - PV connection to Power Grid
    - Bad: “saving electricity bill”
    - Good:

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## Requirements – Need is described

- Should not limit the range of solutions unnecessarily
- 2-liter soda container
  - Good: “container”
  - Bad: “bottle”
- Page turner for a quadriplegic
  - Bad: “Must be Bluetooth enabled”
  - Good:
- Wireless Guitar Amplification System
  - Bad: “Use Bluetooth technology”
  - Good:
  - Bad: “must have wheels to move around”
  - Good:
- Hybrid Vehicle
  - Bad: “Gasoline engine is minimally used”
  - Good:

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## Requirements – Be Comprehensive

- How to be comprehensive?
  - Include a team in the formulation of requirement
  - Keep the customers (or stakeholders) in the loop
  - Checklist
    - Spur Ideas
    - Identify gaps

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## Sample requirement items (1)

- **Aesthetics:** “70% of target guitarists indicate that the appearance of the system will encourage purchasing it” --- cf. iPad vs. Galaxy Tab
- **Cost:** “Each container must cost less than \$0.10 to manufacture given a production of 2 million per year”
- **Dimensions:** “It must fit within 10”x6”15”
- **Easy of use:** “must not require more than 1 minute to set up the system”
- **Energy Use:** “The maximum power demand must be less than 20W and lasts at least 2 hours with standard audio system emergency power source”
- **Environment:** “The system should stand more than 4 hours in temperatures ranging from 40F to 130F.”
- **Ergonomics:** “The system must be able to be lifted up with less than 10 pound force”
- **Interface with other systems:** “all connectors must fit on audio industry terminals”
- **Lifespan:** “The soda container must last for 2 years when filled with pressurized soda at 85F”

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## Sample requirement items (2)

- **Maintenance:** “Required annual maintenance should be minimized and must not exceed 10 minutes per 1 person”
- **Weight:** “The system must be less than 1 pound”
- **Noise Level:** “The noise level of the system should be less than 60dB at 2 feet from front of the device when operating”
- **Patents:** “Must not infringe on the following patents: (1), (2), etc”
- **Performance:** “Car must reach 110 mph”
- **Recycling:** “Container must be made of at least 33% post-consumer materials and must be 100% recyclable”
- **Safety:** “The system should not get in fire when dropped from 3 feet while in operation”
- **Standards:** “The EMC standards and FCC part 15 in particular must be approved”
- **Regulation:** Electric wiring must meet and satisfy 2010 NEC code

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## Sample Design Requirement

- Lane Departure Warning System



Design Requirements Form F2010.xls  
Microsoft Excel Worksheet  
36 KB

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## Summary of "Problem Formulation"

- The most important first step in design process
- Is focused on identifying the requirements of the needs and problems
- Involves activities of
  - gathering information about needs
  - know the current status of art
  - Formulate (quantify) Design Requirements
- Will be used throughout the design process as Guideline for
  - Concept development and exploration
  - Basis for testing

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## Schedule of Next 2 Weeks

- W 14 SEP 2011
  - Project Presentation (NASA's Satellite Control of Robot)
  - Design Requirement Practice
- W 21 SEP 2011
  - Project Presentation (TBD)

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