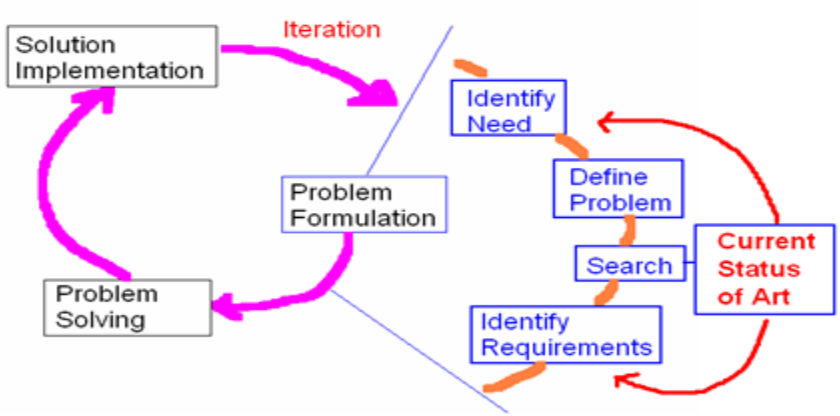
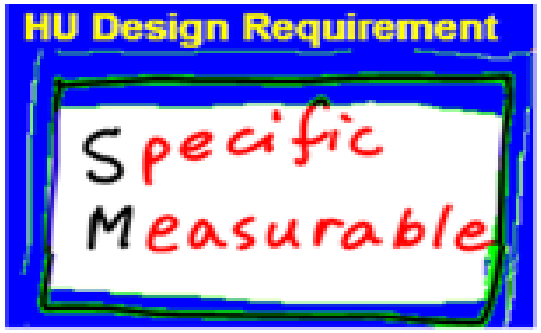
Design Requirements



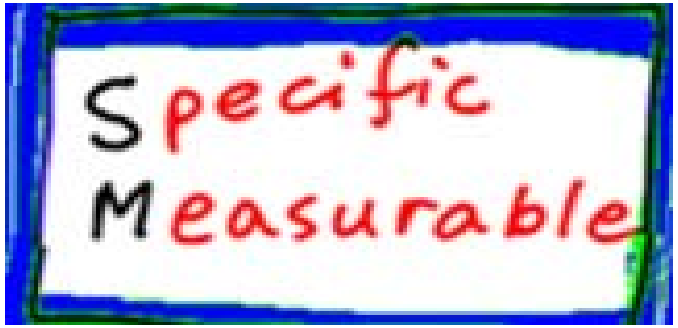


EECE401 Senior Design I

www.mwftr.com/SD1718.html

Problem Formulation

- Idea Generation Help for Problem Statement:
  - Customer,
  - Problems
  - Specific Needs from the problems
  - Why they are not met/Solved,

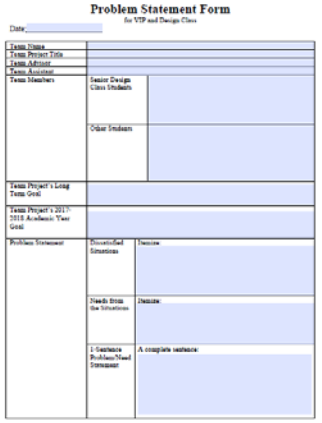


Team Activity 1: What is your team's Problem/Need Statement?

Team Activity Assignment

- Discuss this problem in your team's 1st weekly meeting
- Complete the activity
- Submit the Problem Statement which includes all 6 items listed below

1. **Team Name/Team Project Title:**
2. **Team Members:**
3. **Team Members of Senior Design Class:**
4. **Project's Long-Term Goal:**
5. **Project's 2017-2018 Academic Year Goal:**
6. **Problem statement**
   a. Dissatisfied situations – list them all
   b. Describe the Needs specifically and quantitatively
   c. Final summary for 1-sentence (or 1-paragraph) problem/need statement

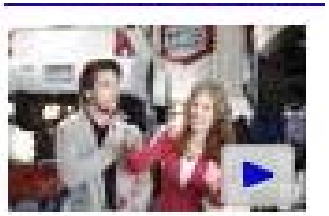


Next Step

- Next Step
  - Once we are confident that the needs, with the current solution/product, cannot be met, we take up the problem, and establish **design requirements** for the needs and the problems
    - **Conversion** from the **Needs** to the Design **Requirement**

Problem vs. Requirement (or “Spec”)

- A more precise (technical) description of the Problem (Needs):
  - should not imply a particular architecture/solution;
  - provides **input (engineering termed “customer needs”)** to concept design/solution process.
- Conversion from Problems (“Needs”) to Design Requirement (“Specification” or “Spec”)
  - Layman’s term → Technical terms
  - Aamco Commercials
  - Description → **Specification** (Example)



Replacement Dell Latitude E6500 AC Adapter 90Watt 19.5V 4.62A

Replacement Dell Latitude E6500 AC Adapter 90Watt 19.5V 4.62A

Email to a Friend
Be the first to review this product

Availability: In stock

$19.99

Qty: 1 Add to Cart OR Add to Wishlist
Add to Compare

Quick Overview

Specification:

Replacement Dell Latitude E6500 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 Connecter (Barrel) size:
Internal Diameter: 5.0mm
External Diameter: 7.4mm
With central smart-pin

Item Includes: AC Adapter and Power Cord.

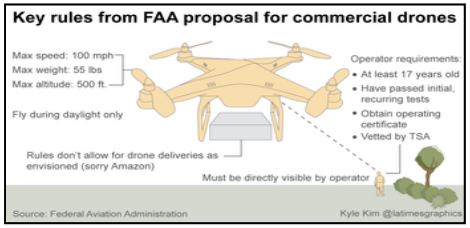
Design Requirement

- What is “Design Requirements” ?
  - Technical Guide
  - Plain **English description** of problem statement→ **Technical terms for concept design**
  - **Express in quantity and in number**
  - **Should include**
    - **Specifications**
    - **Compliance to Regulations: Radiation, Noise, etc**
    - **Constraints (economical, socio-cultural, etc)**

Design Requirement

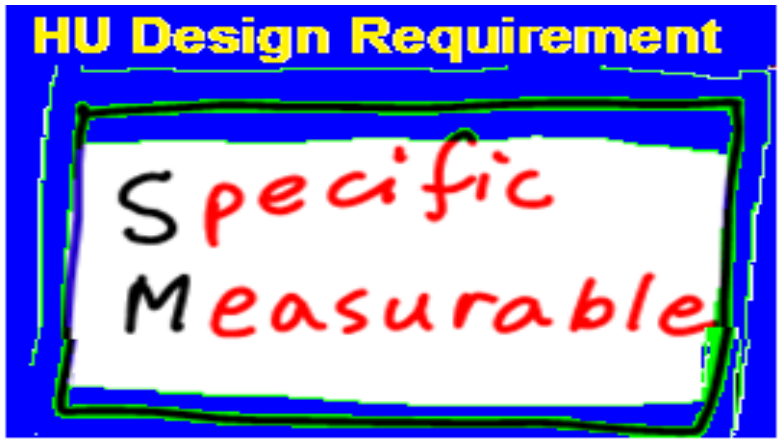
- **Specifications**
  - Size
  - Weight
  - Current and Voltage and Power consumption
  - Response Time

- **Compliance to Regulations**
  - FCC: Electronic devices
    - Part 15 of Title 47 “Low-power, non-licensed transmitters”
    - (Ex) 47 CFR 15.103 “Digital devices oscillating below 1.705 MHz) etc etc”
    - FCC ID --- traceability to FCC compliance
  - FAA: Aircraft devices
  - FDA: Medical devices
    - (EX) 510(k) Clearance to Market [FDA 21 CFR Part 820]
    - (EX) ISO 13485 Medical Device Quality requirement in Internatio market
  - Others



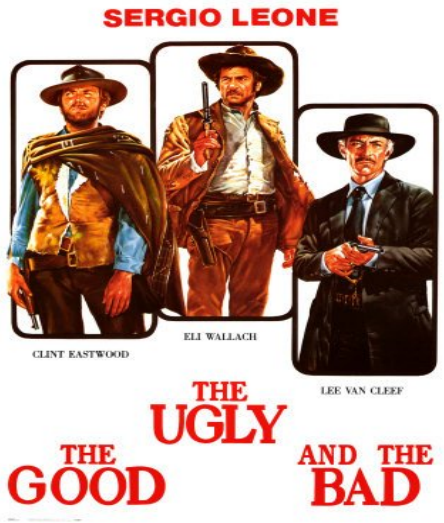
Good Design Requirements

- 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.
  - **"SM" Requirement**



Requirements – Be Measurable

- **If you cannot <u>test if</u> a "requirement" is met or not, then it is not a requirement**
- Testable → Measurable → Quantitative
- Example:
  - DOPES
    - Bad: "Attach Sensors to the PCB Board"
    - Good:
  - Slate8
    - Bad: "Sign is quickly converted and displayed in text"
    - Good:
  - Trike
    - Bad: "Trike Should run long without pedaling"
    - Good:



Requirements – Need is described

- **Should not limit the <u>range of possible solutions</u> unnecessarily**
- Ex. Safer and Stronger 2-liter soda holder
  - Bad: “bottle”
  - Good: “container”
- Ex. Wireless Guitar Amplification System
  - Bad: “Use Bluetooth technology”
  - Good:
  - Bad: “must have wheels to move around”
  - Good:
- Ex. Slate8
  - Bad: “Use Wired Communication System to avoid interference between Sign Robot and Display/Audio”
  - Good:

Requirements – Be Comprehensive

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

Practice for GOOD Requirements

- Remember this?

- And these good problem statements ?

There are six females living in a small dorm room and they would like our help in figuring out how to pack their belongings in the room as efficiently as possible. while maintaing their comfort and security for everyone.

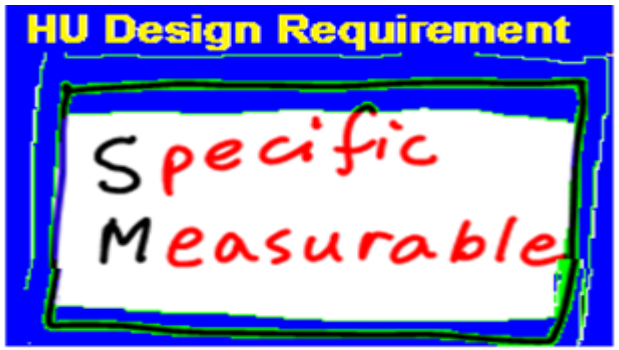
The fundamental problem is to find the most efficient way to use a given space as our living quarters while maintaing comfort, organization, and moveable space.

Practice for GOOD Requirements

- **Conversion to quantifiable requirement**

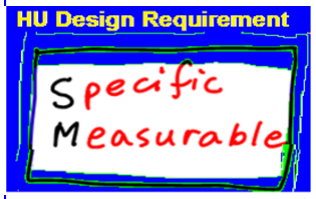
There are six females living in a small dorm room and they would like our help in figuring out how to pack their belongings in the room as efficiently as possible. while maintaing thier comfort and security for everyone.

- Efficiently?
- Maintaining comfort?
- Maintaining security?



Practice for GOOD Requirements - Example

There are six females living in a small dorm room and they would like our help in figuring out how to pack their belongings in the room as efficiently as possible. while maintaing their comfort and security for everyone



- Efficiently?
  - One's belongings are to be placed within 1 meter of her bed/desk.
- Maintaining comfort?
  - Each person has own space of radius 2 meters with no clutters
- Maintaining security?
  - All occupants under emergency should be able to evacuate within 10 seconds.
  - No belongs are to be placed within 1 meter from the front door.

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”

Sample requirement items (2)

- **Environment**: “The system should stand more than 4 hours in temperatures ranging from 40°F to 130°F.
- **Ergonomics**: “The system must be able to be lifted up with less than 10 pound force”
- **Interface with other systems**: “all connectors must fit to industry audio cabling standard 3.5 mm TRS minijack”
- **Lifespan:** “The soda container must last for 2 years when filled with pressurized soda at 85°F”

Sample requirement items (3)

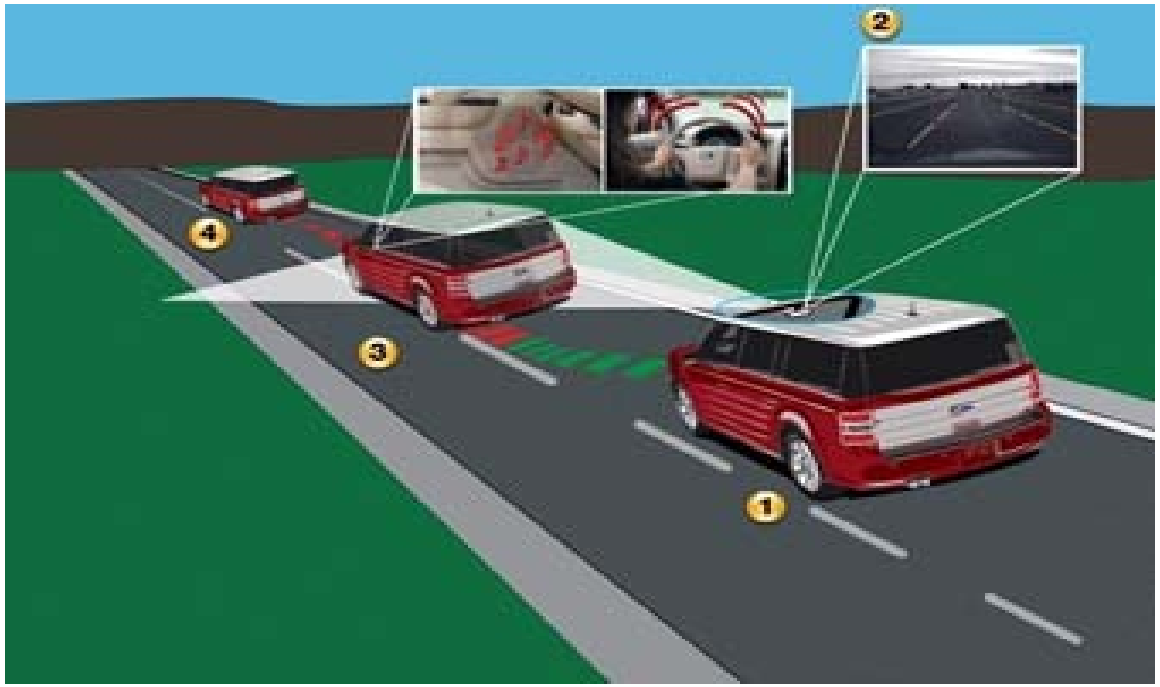
- **Maintenance**: “Required annual maintenance should be minimized and must not exceed 10 minutes per 1 person”
- **Weight:** “The system must be less than 1 pound”
- **Noise Level:** “The noise level of the system should be less than 60dB at 2 feet from front of the device when operating”
- **Intellectual Property:** “Must not infringe on the following utility and design 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”

Sample requirement items (4)

- **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 complied”
- **Regulation**: Electric wiring must meet and satisfy 2010 NEC code
- **Socio-Cultural Constraints**: Customer Cultural Preference-based requirements on material, design, Fengshui, for example.

Sample Design Requirement

- Lane Departure Warning System



Sample Design Requirement

Design Requirement		
Date:	10/4/2017	
Design Project Title:	Auto-Pilot Car	
Team Name:	Summit	
Team Advisor	Dr. Grand Master	
Team Assistant	Derrick Dale	
Project's Long Term Goal	Development of a driverless car	
Project's 2017-2018 Academic Year Goal	Development of a Lane Departure Warning System	
Team Members (Design Class)	Adam Lucky (EE), Otis Titilope (CpE), Funmy Milos (EE), Mark Marlon (CpE)	
Team Members (Others)	Ashley Wells (EE, SP), Caleb Trask (EE, Jr), Charles Hamilton (CS, Fr), Niyi Naifu (CpE, Sp), Immanuel Daniel (EE, Fr), Tracy Adams (ME, Fr)	
Requirements	**Descriptions**	**Source**
Background (NEED)	1500 fatalities in recent years from about 100,000 crashes in which driver drowsiness was a factor. LDWS reduce the number and severity of	
Objective (Problem)	Should issue a warning signal if car crosses or deviates towards lane boundaries.	

Sample Design Requirement

Performance	The LDWS should: • Perform a self-test that checks all major system sensors and components, operate within 30 seconds of starting the vehicle, and relay the results of the self-test to the driver indicating whether the system is operational. • Be able to track lane boundaries and issue warnings within ±0.1 meter (±4 inches) from the warning thresholds. • Issue warnings, detect vehicle position relative to virtual lane boundaries, and track virtual lane boundaries when the vehicle is traveling at or above a speed of 37 mph. • Issue directional warning within 1 second if car departs from current lane, specifying the direction of drift/lane departure • Not issue warning if the turn signal is activated and the car is moving at a speed less than 45mph	Federal Motor Carrier Safety Administration
Cost	The LDWS design: • Must cost less than $490 to install the device in a vehicle • Must not incur maintenance costs of more than	
Safety	• The LDWS must adhere to all NHTSA safety standards (crash avoidance, simplicity of use, etc) and not interfere with any of them • If warning signal is audible, it should not be	National Highway Transport Safety

Sample Design Requirement

Compliance	LDWS should meet the electrical requirements as stated in most recent version of the following SAE standards: • SAE Standard J1455, "Joint SAE/ TMC Recommended Environmental Practices for Electronic Equipment Design (Heavy-Duty Trucks)" • SAE Standard J1113, "Electromagnetic Compatibility Measurement Procedures and Limits for Vehicle Components (Except Aircraft) (60 Hz to 18 GHz)"	SAE International
Driver-Vehicle Interface	The LDWS interface should: • Consist of audio sources of at least 1.5MW, indicator lights no brighter than 80candela, vibrational devices (3600 RPM), and controls for operation by the driver. • Issue an audible and/or tactile warning when the vehicle crosses the warning threshold. • Include a visual indicator to indicate when the system is not tracking the vehicle's position in the lane. This status may be indicated by an instrument panel warning light or an indicator that is integral to LDWS. • Use a visual indicator to indicate that the system is operational and ready to function. This status may be indicated by an instrument panel warning light or an indicator that is integral to LDWS. • Use a visual or audible indicator to indicate a system failure or malfunction. This status may be indicated by an instrument panel warning	

Sample Design Requirement

Energy, Power, and Environment	LDWS should meet the environmental requirements as stated in the most recent version of the following SAE standard: • SAE Standard J1455, "Joint SAE/ Technology and Maintenance Council (TMC) Recommended Environmental Practices for Electronic Equipment Design".	SAE International
Intellectual Property	• Must not infringe Ford Motor's Patent and Design patents US 1234568.	USPTO
Size and Weight	The total system should amount to no more than 10 lbs	
Deliverables	A prototype which evaluates the desired functions and performances	

Design Requirements – Team Assignment

- Project Design Requirements
- Team meeting/activity
- Use Excel file format (if possible)
- Be comprehensive
- Submission required

Submission: Design Requirement

- **Submission Due/List**
  - **W 10/4/2017:**
    1. Problem Statement
    2. Team Contract
    3. Design Requirement