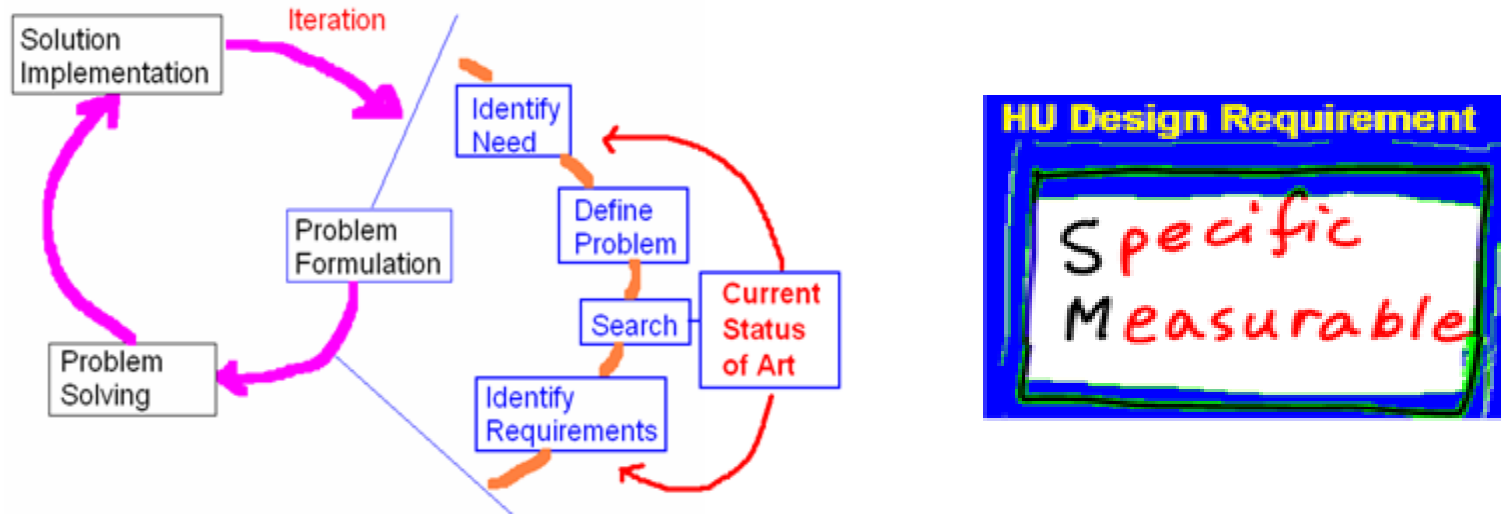


Design Requirements



EECE401 Senior Design I

www.mwftr.com/SD1819.html

Recall: Problem Formulation Process

- Comprehensive Problem Statement:
 - Customer demands,
 - **Specific Needs** from the problems
 - Why they are not met/Solved,
 - Many different angles,
 - Cause, not symptoms

Recall: Our exercise on Problems Statements

Exercise : Crowded Dorm Room

Needs:

- 1) Crowded rooms hinders privacy & limits comfortable living conditions
- 2) Crowded rooms affects personal/quiet time which influences class performance
- 3) Crowded rooms are unsanitary living conditions which decreases morale and affects happiness
- 4) Crowded rooms increases the chances of conflict
- 5) Crowded rooms can negatively affect daily productivity.
- 6) Crowded rooms increases clutter and chances of injury.



- Team Activity 1
- Living habits
 - Sleeping schedule
 - Organization of property
 - The desire for privacy
 - Space for everyone's belongings
 - safety hazard
 - Heightened chance of personal tensions

Recall: Team Activity for Problems Statement

Team Activity Assignment

- Discuss this problem in your team's weekly meeting
 - Complete the activity
 - Submit the Problem Statement which includes all 6
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 2018-2019 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) proble

Problem Statement Form
for VIP and Design Class

Date: _____

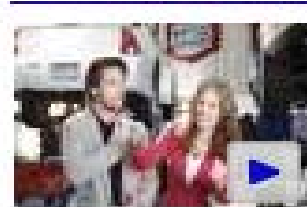
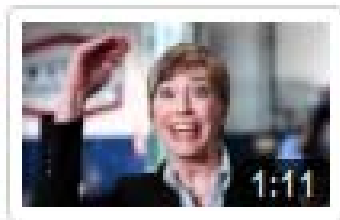
Team Name		
Team Project Title		
Team Advisor		
Team Assistant		
Team Members	Senior Design Class Students	
	Other Students	
Team Project's Long Term Goal		
Team Project's 2017-2018 Academic Year Goal		
Problem Statement	Dissatisfied Situations	Itemize:
	Needs from the Situations	Itemize:
	1-Sentence Problem/Need Statement	A complete sentence:

Next Step

- Next Step
 - From the problem statement, we establish **design requirements** for the needs and the problems
 - **Conversion** from the **Needs** to the **Design Requirement**
- Design Requirements
 - A **more precise (technical) description** of the Problem (Needs):
 - should not imply a particular solution;
 - provides **input (engineering term for “customer needs”)** to concept design/solution process.

Problem vs. Requirement (or “Spec”)

- Conversion from Problems (“Needs”) to Design Requirement (“Specification” or “Spec”)
 - Layman’s term → Technical terms
- Aamco Commercials



Problem vs. Requirement (or “Spec”)

- Layman’s term → Technical terms
- 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: [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 Connector (Barrel) size:
Internal Diameter: 5.0mm
External Diameter: 7.4mm
With central smart-pin

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

Design Requirement - Details

- 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 and Standards: Radiation, Noise, etc
 - Constraints (economical, socio-cultural, etc)

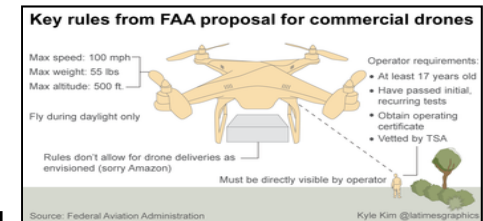
Design Requirement - Example

- **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 International 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.



Problem Statements to Design 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 maintaining their comfort and security for everyone.



- Efficiently?
- Maintaining comfort?
- Maintaining security?



Conversion of Problem Statement to Design Requirements

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 maintaining their comfort and security for everyone.

HU Design Requirement

Specific
Measurable

- 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.

Requirements – Be Measurable

- If you cannot test if a “requirement” is met or not, then it is not a requirement
- Testable → Measurable → Quantitative
- Example:
 - Terminator
 - Bad: “It plays tic-tac-toe on a checker board”
 - Good:
 - Slate8
 - Bad: “Sign is converted and displayed in text”
 - Good:
 - eTrike
 - Bad: “eTrike should run long without recharge”
 - Good:



Requirements – Need is described

- **Should not limit the range of possible solutions unnecessarily**
- **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

Design Requirements

- Efficiently?
- Maintaining comfort?
- Maintaining security?

- Above 3 are just a sample of more diverse items for Design Requirement
- More design requirement items (next page)

Design 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”

Design 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”

Design 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”

Design 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.

Talking about Socio-Cultural Constraints

- “Socially Responsible Design”
- **Socio-Cultural Constraints:** Customer Cultural Preference-based requirements on material, design, Fengshui, for example.

#BUSINESS NEWS JULY 19, 2017 / 7:14 PM /



Ford's 'golden noses' seek edge in slowing China car market

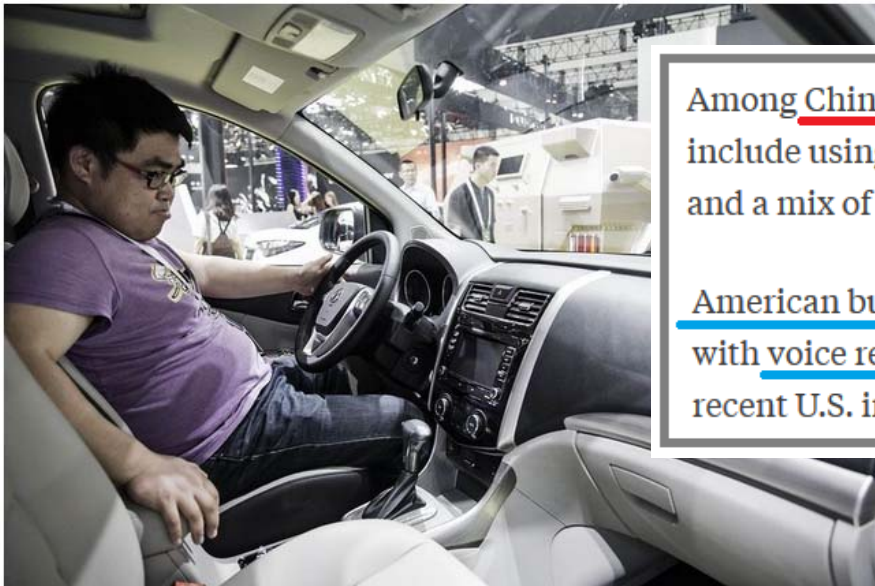
- **Guess what Ford Seeks?**



Talking about Socio-Cultural Constraints



Chinese Consumers Hate That New-Car Smell



Among China's motorists, popular ways of getting rid of that new car smell include using bags of activated carbon, lemon, grapefruit or orange peels, and a mix of water with vinegar.

American buyers, on the other hand, have been consistent in taking issue with voice recognition, Bluetooth and connectivity systems in J.D. Power's recent U.S. initial quality surveys,

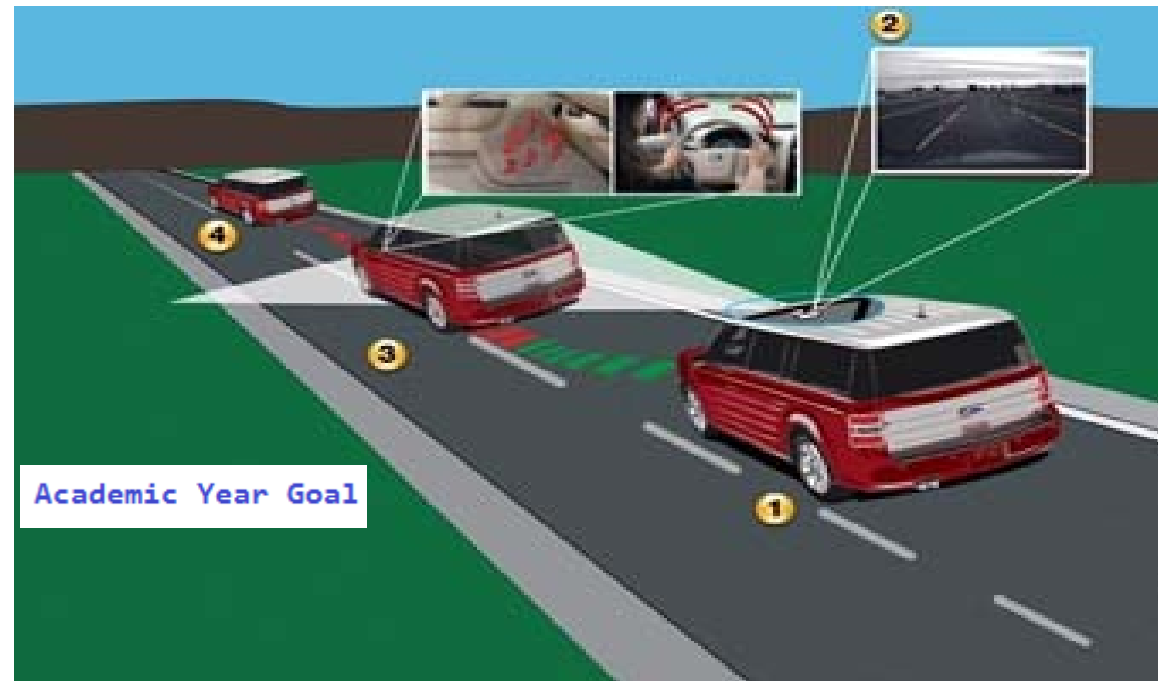
A visitor sits in the driver's seat of a Dongfeng S500 electric car at the Beijing International Automotive Exhibition. New car smell is deemed unpleasant in China, where formaldehyde pollution of interior air have worried people. *Photographer: Qilai Shen/Bloomberg*

Now, Design Requirements for your team project

- Start from Problem Statement of the Team Project Design Requirements
- Team meeting/activity this week
- Check the Design Req Items and More
- Must include Socio-Cultural Constraints
- Refer to the Sample Design Req

Sample Design Requirement

- Team **Summit**
- Log Term Goal: **Autopilot Car**
- Academic Year Goal: **Lane Departure Warning System Implementation**



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), Funny 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

<p>Performance</p>	<p>The LDWS should:</p> <ul style="list-style-type: none"> • 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 	<p>Federal Motor Carrier Safety Administration</p>
<p>Cost</p>	<p>The LDWS design:</p> <ul style="list-style-type: none"> • Must cost less than \$490 to install the device in a vehicle • Must not incur maintenance costs of more than 	
<p>Safety</p>	<ul style="list-style-type: none"> • 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 	<p>National Highway Transport Safety</p>

Sample Design Requirement

<p>Compliance</p>	<p>LDWS should meet the electrical requirements as stated in most recent version of the following SAE standards:</p> <ul style="list-style-type: none"> • 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)” 	<p>SAE International</p>
<p>Driver-Vehicle Interface</p>	<p>The LDWS interface should:</p> <ul style="list-style-type: none"> • 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	<p>LDWS should meet the environmental requirements as stated in the most recent version of the following SAE standard:</p> <ul style="list-style-type: none"> • SAE Standard J1455, "Joint SAE/ Technology and Maintenance Council (TMC) Recommended Environmental Practices for Electronic Equipment Design". 	SAE International
Intellectual Property	<ul style="list-style-type: none"> • 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	
Socio-Cultural Constraints	Alert method (audio/visual and vibration) should be culture-responsive for global acceptance	

Design Requirements – Team Assignment

- Project Design Requirements
- Team meeting/activity
- Use **Excel file format**
 - **Form:**
www.mwftr.com/SD1819/Design_Requirements_FORM.xls
 - **Sample:**
www.mwftr.com/SD1819/Design_Requirements_SAMPLE.xls
- Be comprehensive
- Submission required
 - Due **M 10/8/2018**

