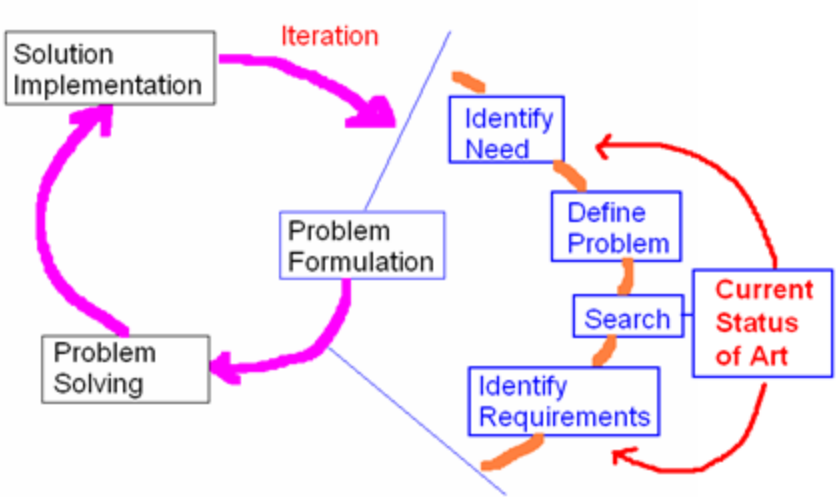
Design Requirements



EECE401 Senior Design I

www.mwftr.com/SD1516.html

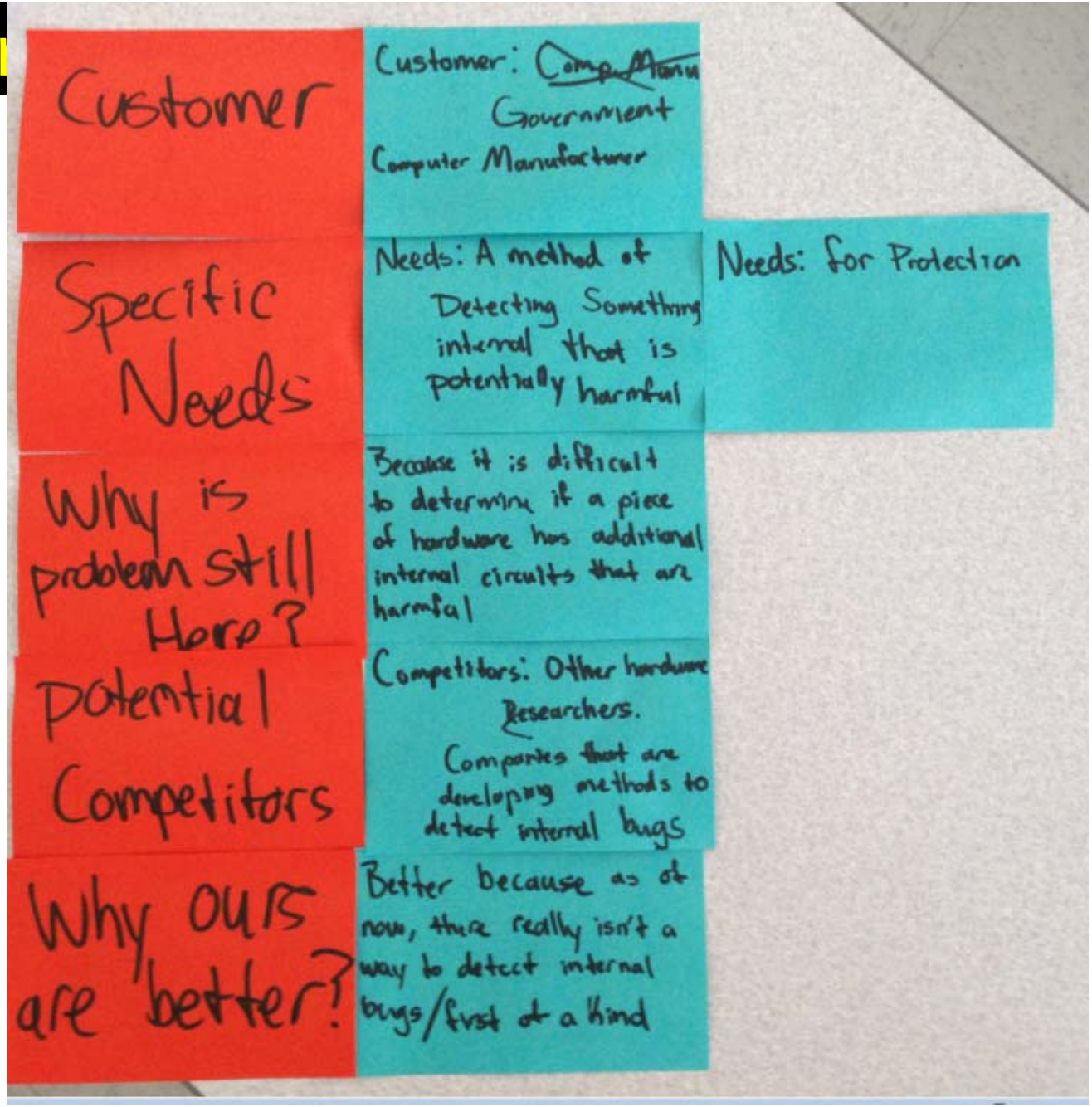
Before We Proceed

- Idea Generation Help for Problem Statement:
  - Customer,
  - Specific Needs,
  - Why they are not met/Solved,
  - Competitors
  - Advantage of yours

Before We Pr

- 1 Customer,
- 2 Specific Needs,
- 3 Why they are not met/Solved,
- 4 Competitors.
- 5 Advantage of yours

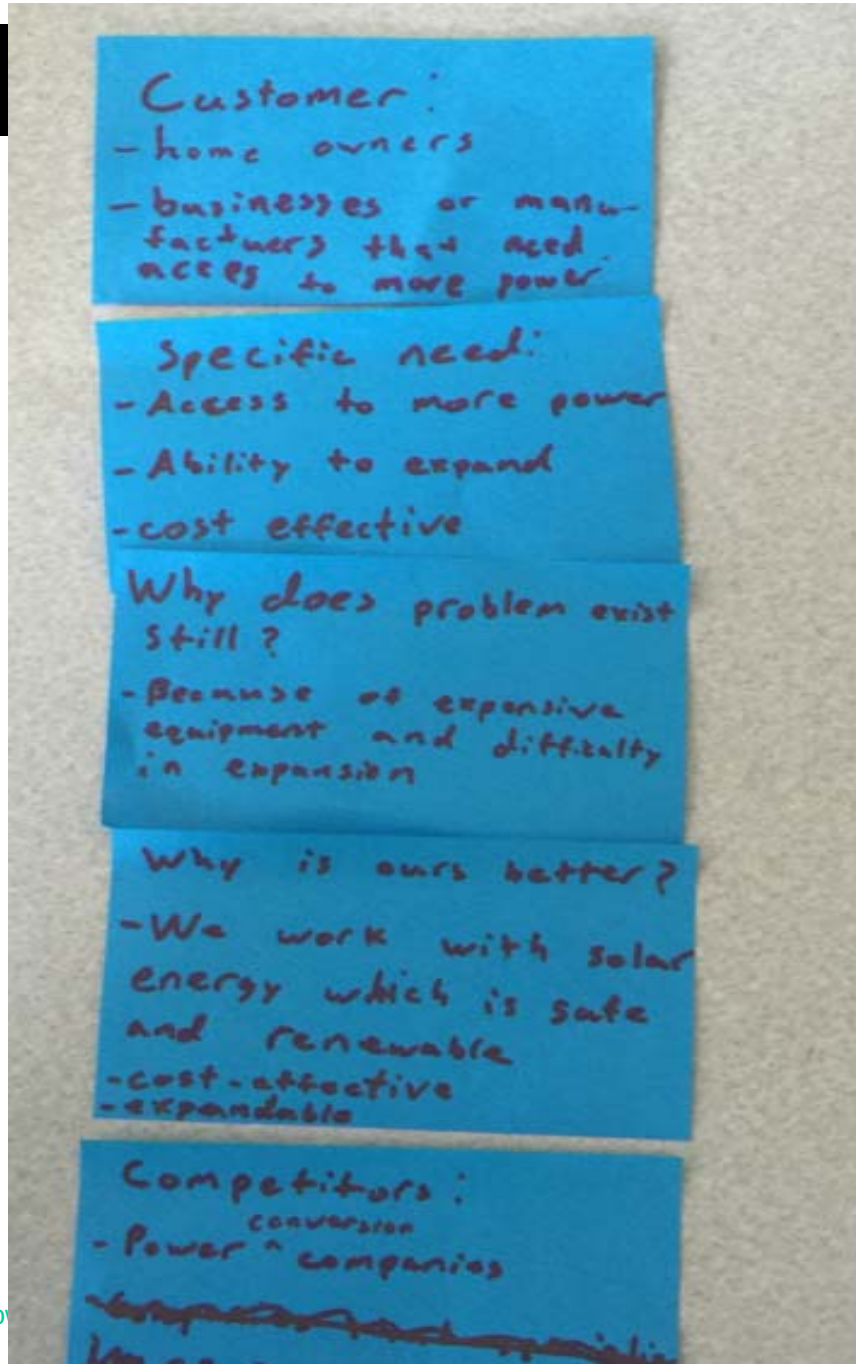
- **Team Intruder**



Before We Proceed

- 1 Customer,
- 2 Specific Needs,
- 3 Why they are not met/Solved,
- 4 Competitors.
- 5 Advantage of yours

- **Team Inverter**



Before We Proceed

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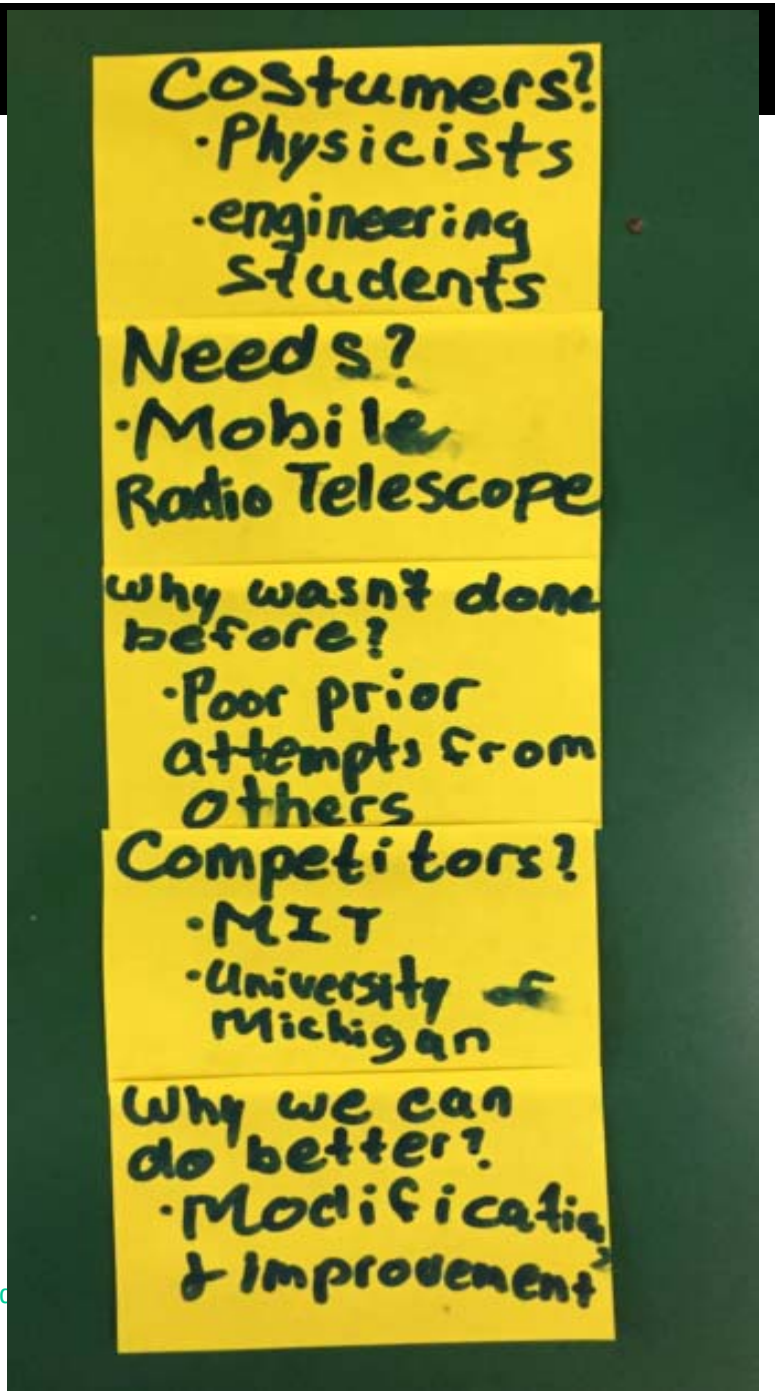
- 5 Advantage of yours

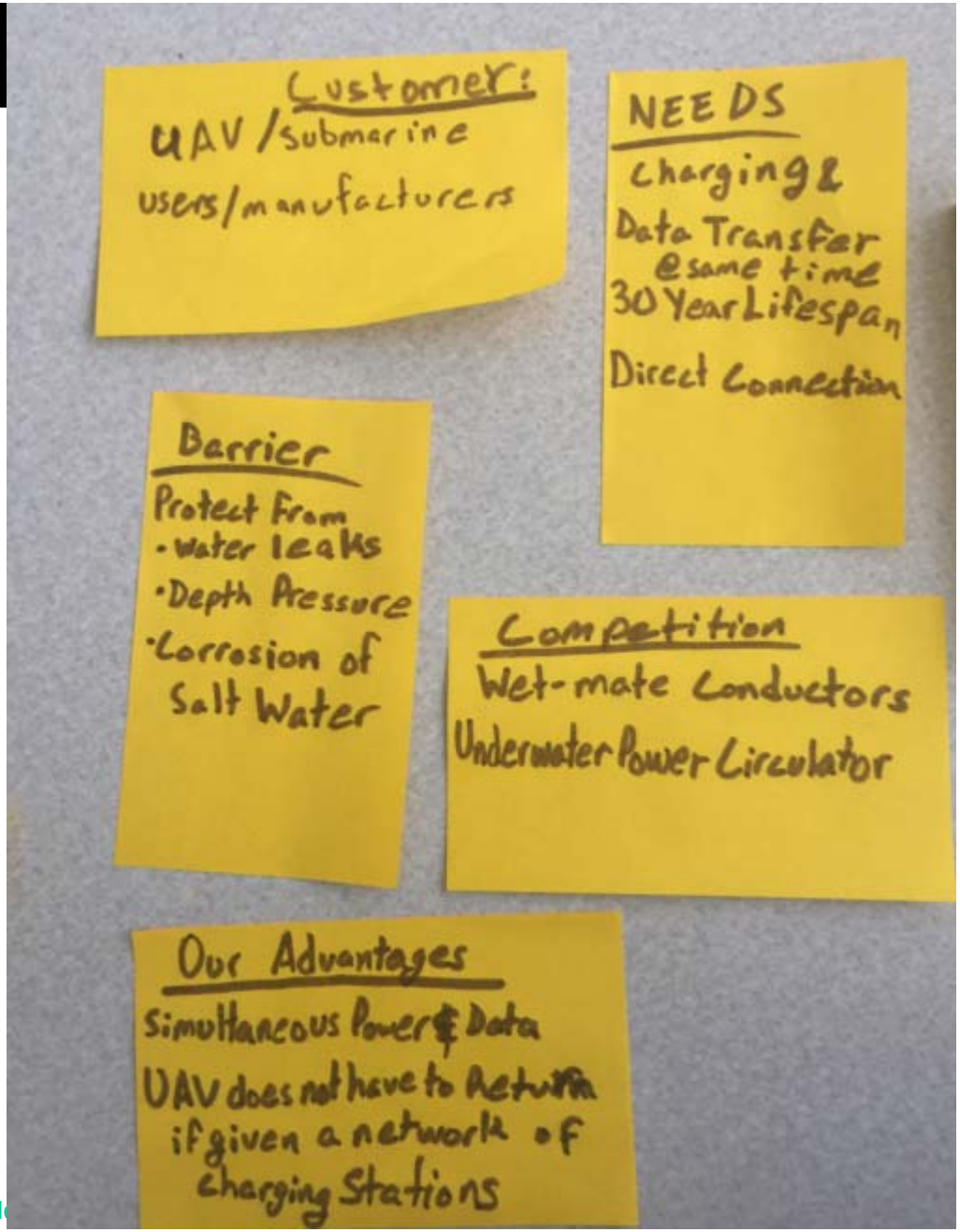
- **Team Telescope**



Before We Proceed

- 1 Customer,
- 2 Specific Needs
- 3 Why they are not met/Solved,
- 4 Competitors
- 5 Advantage of yours

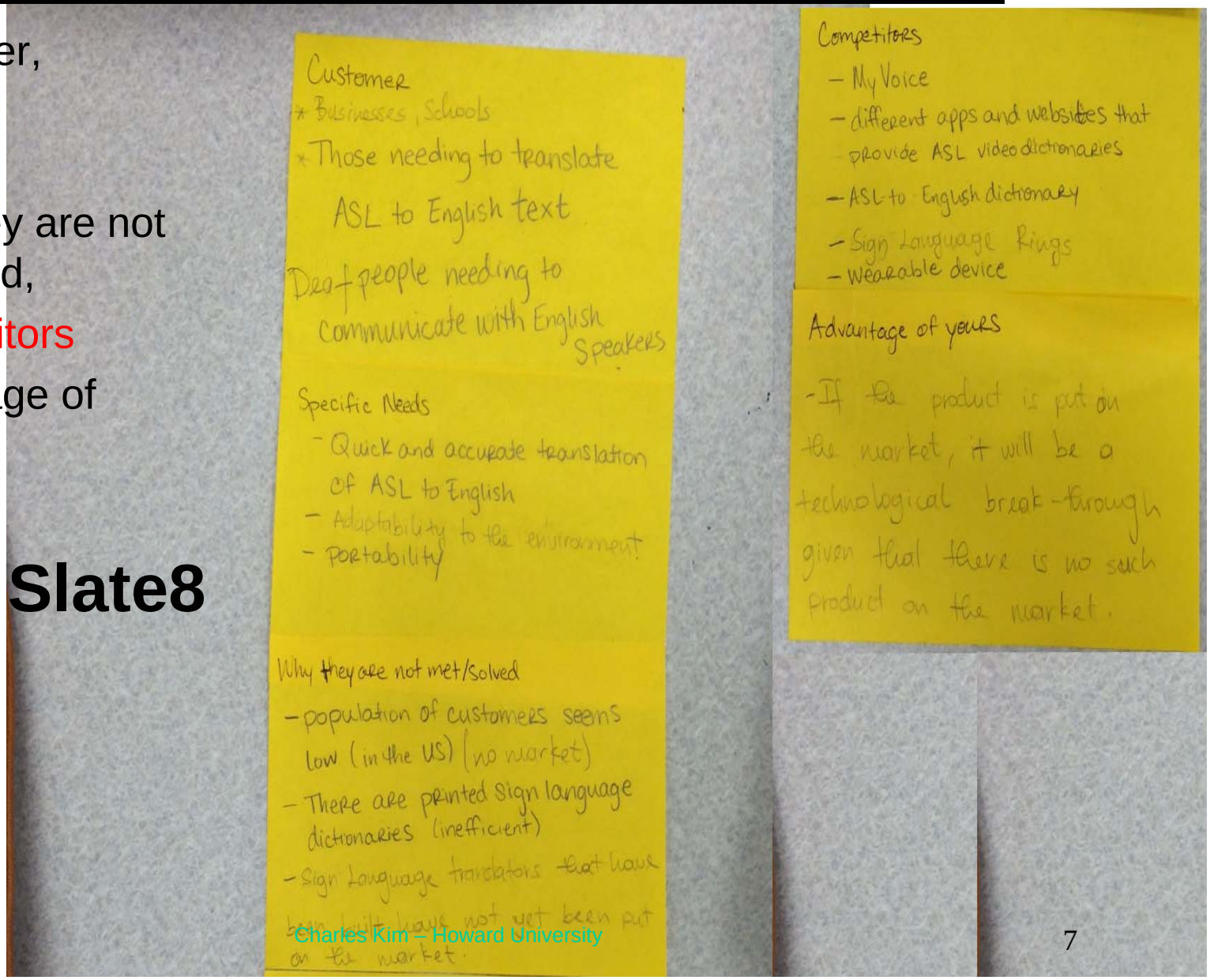
- **Team UCC**



Before We Proceed

- 1 Customer,
- 2 Specific Needs
- 3 Why they are not met/Solved,
- 4 Competitors
- 5 Advantage of yours

- **Team Slate8**



Before We Proceed

- 1 Customer,
- 2 Specific Needs
- 3 Why they are not met/Solved,
- 4 Competitors
- 5 Advantage of yours

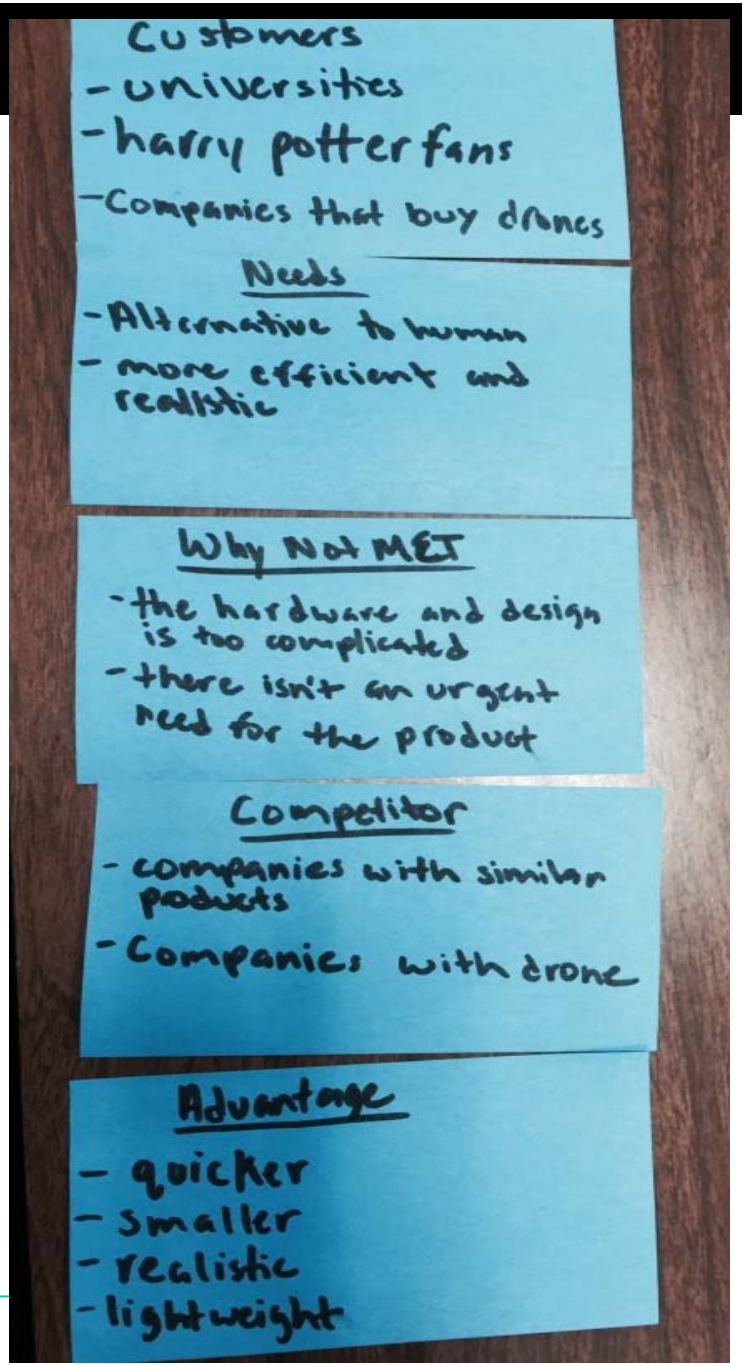
- **Team Terminator Arm**

```
Terminator Arm:

Customers:
Amputees with loss of forearm
Parkinson's disease victims

Needs:
Inexpensive prosthetic hand
Hand with great degree of motion i.e comparable to the human
hand
Reliable hand to use for everyday activities eg writing, picking
objects

Barriers:
People have not used cheaper electromyographic methods
The strength of the material to be used should provide swift
motion but be rigid

Advantages:
Ours will be a cost-effective alternative for amputees
It will present a non-invasive method of prosthesis
Easily detachable which can be advantageous for cleaning/general
maintenance
```

Before We Proceed

- 1 Customer,
- 2 Specific Needs
- 3 Why they are not met/Solved,
- 4 Competitors
- 5 Advantage of yours

- **Team Golden Snitch**



Submission: Problem Statement & Team Contract & Design Requirement & Conceptual Design & Part List

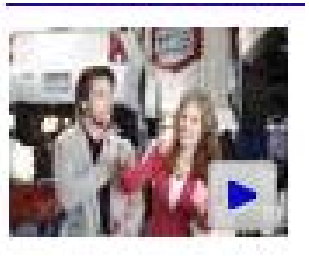
- Assignment/Submission after this week's team meeting
  1. **Sticky Notes** → Final Project Statement
  2. Completed/Signed Team Contract
  3. If possible, Design Requirements [Today's Topic]
- **Submission Due/List**
  - **W 10/28/2015:**
    1. Problem Statement
    2. Team Contract
  - **W 11/4/2015**
    1. Design Requirement
    2. Conceptual Design
    3. Parts/Components List (if applicable)

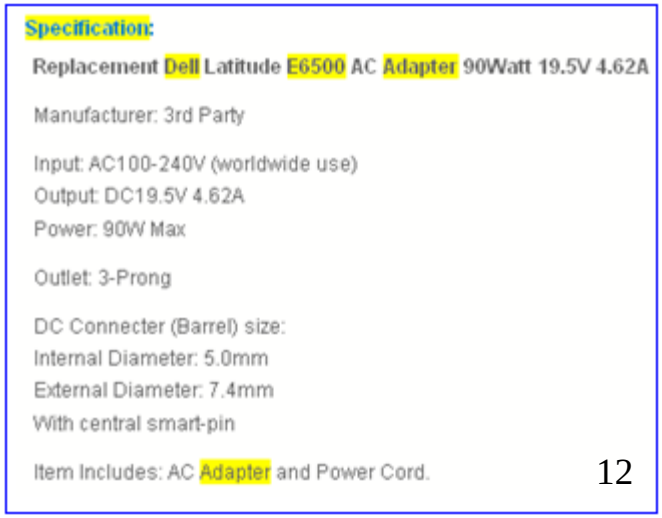
The Next Step

- 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)





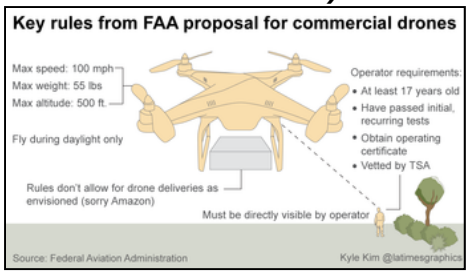
Design Requirement

- 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**

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 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.
  - **"SM" Requirement**

Requirements – Be Measurable

- **If you cannot test if a "requirement" is met or not, then it is not a requirement**
- Testable → Measurable → Quantitative
- Example:
  - UCC
    - Bad: "Connect underwater"
    - Good:
  - Slate8
    - Bad: "Sign is quickly displayed in text"
    - Good:
  - Intruder
    - Bad: "Secure the medical record"
    - 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 a team in the formulation of requirement
  - Keep the customers (or stakeholders) in the loop
  - Checklist
    - Spur Ideas
    - Identify gaps
    - Sticky note session

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)

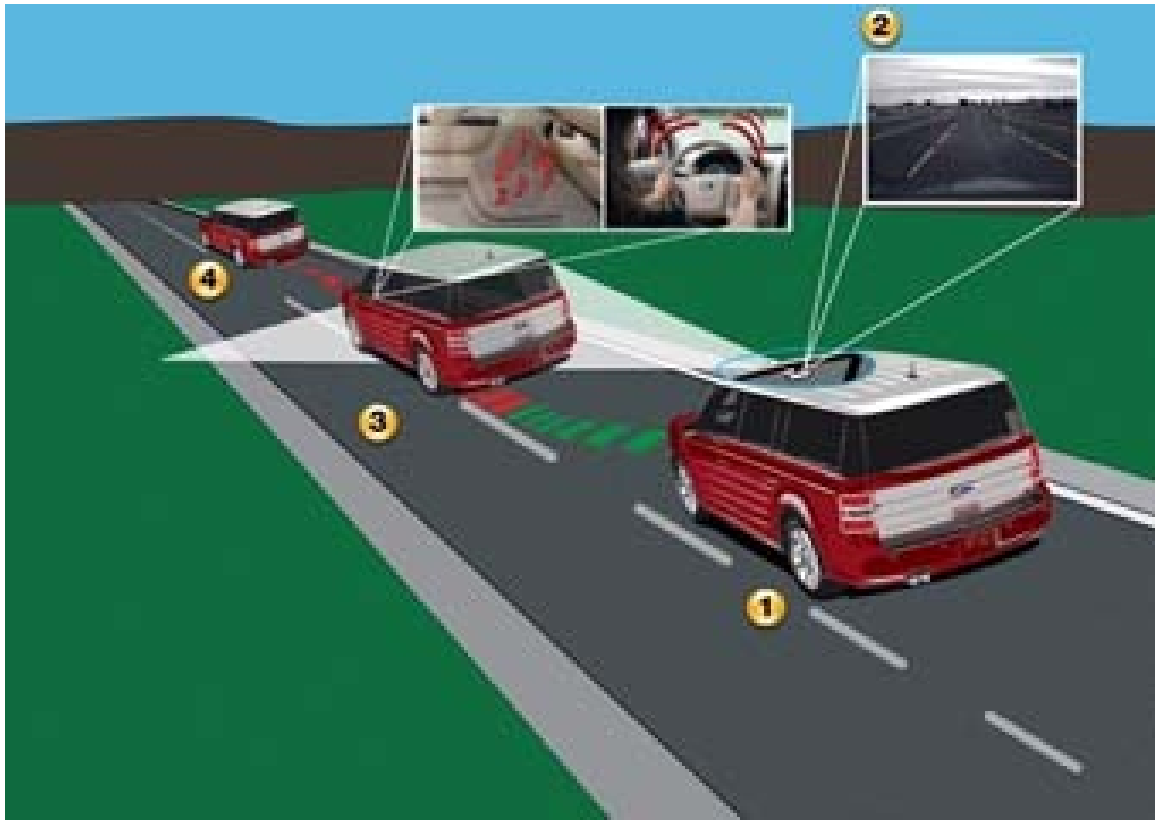
- **Aesthetics**: “70% of target guitarists indicate that the appearance of the system will encourage purchasing it” --- cf. iPad vs. Galaxy Tab
- **Cost**: “Each container must cost less than $0.10 to manufacture given a production of 2 million per year”
- **Dimensions**: “It must fit within 10”x6”15”
- **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”
- **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”

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 complied”
- **Regulation**: Electric wiring must meet and satisfy 2010 NEC code

Sample Design Requirement

- Lane Departure Warning System



Sample Design Requirement

Design Project Title:	Lane Departure Warning System	
Team Name:	Summit	
Team Members:		
Date:		
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 fatalities and crashes	
Objective (Problem)	Should issue a warning signal if car crosses or deviates towards lane boundaries.	
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

Sample Design Requirement

Cost	The LDWS design: • Must cost less than $490 to install the device in a vehicle • Must not incur maintenance costs of more than $150 per year • Be completed and ready for testing by 05/10/2010	
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 louder than 130	National Highway Transport Safety Administration
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	

Sample Design Requirement

- Lane Departure Warning System

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
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: Problem Statement & Team Contract & Design Requirement & Conceptual Design & Part List

- **Submission Due/List**
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