EECE401 Senior Design I

Problem Formulation

Unsatisfactory Situation → Problem Formulation → Well-Understood Problem

Next Lecture

This Lecture

www.mwftr.com/SD1415.html
Projects and Teams

- **ASL2TEXT/VOICE ⇐ Intel Cup 2015**
  - Dhungel, Clestino, Etinne, Ndzami, Yilma, Montgomery, Galani
  - Faculty Advisor: Dr. Mohamed Chouikha
  - Roshil Paudel (Jr, MATH) and Prajjwal Dangal (Sp, CS)

- **Circuit Bending for Voice Encryption (?) ⇐ Intel Cup 2015**
  - Robinson, Clements, Jackson, Smith
  - Faculty Advisor: ?
  - Other participants

- **Niobium ⇐ Northrop Grumman**
  - Woods, Ajayi, Chambers, Mahop, Mahadiow, Kourani, Haley
  - Faculty Advisor: Dr. Charles Kim
  - GR students: Trey Morris and Mpho Mussenga

- **Trojan ⇐ Faculty Research Project & Intel Cup 2015**
  - Ross, Bratcher, Green, Lopera, Powell
  - Faculty Advisor: Dr. Hassan Salmani
  - GR students, Jr/Sp students

- **Android Wear ⇐ Capital One**
  - Fisher, Edwards-EI, McElwee, Monette
  - Faculty Advisor: Dr. Charles Kim
  - GR student: Samuale Ayele
  - JR students

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Final Project Titles, Team Names, Team Leaders - 1

• **SLATE (Sign Language to English)**
  – Team Name: Slate8
  – Leader: Sarad Dhungel
  – Faculty Advisor: Dr. Mohamed Chouikha

• **Circuit Bending for Voice Encryption (?)**
  – Team Name:
  – Team Leader: Michael Robinson
  – Sponsor:
  – Faculty Advisor: ??

• **Underwater Current Connector**
  – Team Name: UCC
  – Leader: Crepin Mahop
  – Faculty Advisor: Dr. Charles Kim
  – Industry Sponsor: Northrop Grumman

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Final Project Titles, Team Names, Team Leaders - 2

- Hardware Trojan
  - Team Name:
  - Leader: Candace Ross
  - Faculty Advisor: Dr. Hassan Salmani
  - Sponsor: Faculty Research

- Android Wear
  - Team Name: Watch Me Now
  - Leader: Dhuel Fisher
  - Faculty Advisor: Dr. Charles Kim
  - Industry Sponsor: Capital One
Next step for Intel Cup2015 Contenders

Senior Design Class of 2014-2015

Announcement:

08-27-2014: New class hours: Wednesdays 1410 - 1700 (Classroom is 3121 LKD)

09-17-2014: Four (4) candidate projects will be presented, and project teams are to be formed.

09-25-2014: Deadline for Intel Cup 2015 Registration is Oct 13, 2014. Link to Intel Cup 2015 Competition, Competition Registration Site, the Summary of the Competition (Rules), and the past Howard University competitors.

Round #1, Intel Open

- Multiple teams from the same University can be selected to attend Round #2, the Intel-Cornell Cup Semi Finals
- Each faculty member advising less than 10 registered Intel Open teams will select 1 team to move on to the Intel-Cornell Cup Semi Finals
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Register for the Intel Open (Round #1) Now!!

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Team Contract

- Goal
- Expectations
- Rules and Policies
- Commitment

- Fillable pdf form is available from the class note Web page.

Lecture 3: Teamwork [Fillable PDF file for team contract form]
Team Contract: Goals and Expectations

• Goal Statement
  – Clear, measurable targets that indicates progress toward the purpose

• Expectation Statement
  – Team’s expectation on team members in
    • Meeting attendance and on-time arrival
    • Activity participation
    • Communication
    • Productivity
    • Assigned task completion
    • Keep the deadline
    • Etc
Team Contract: Rules and Policies

- Rules and Policies
  - Ground rule for common area
  - Running of Meetings
    - Who runs the meeting?
    - Cell-phone policy
    - How team decisions and consensus will be reached
  - How meeting absenteeism and tardiness will be handled
    - Policies for missing one meeting or being late
    - Policies for contacting someone to contact
  - Expectations of quality works
    - How to handle late and incomplete work of a member?
    - How to reward team members who exceed expected performance
  - Relationship
    - What each member to bring to each meeting
    - Developing “can do” attitude
    - etc
First Team Assignment

• Team Contract Submission
  – Wednesday, October 1
  – Typed, printed out document
  – All should sign the contract
  – Make out this one (while working on the Intel Cup 2015 registration)
  – Later joiners can sign too (after handed back)
Team Webpage – future plan

• 2 options
  – (1) Bring your html file to me, then I post in the www.mwftr.com class note page.
  – (2) Maintain your own webpage and give me the link to the page

• Standard format
  – The format will be discussed and determined by the team leaders
  – Will soon be provided to all teams
Reminder

• Personal/Individual project note
  – Basis of scores and grading
  – Your knowledge-base

• Team Project Binder
  – Collection of ALL team activities
  – Basis of team scores
Let’s Discuss about - Assignment #2

• No solution required – optional
• Only “Problem statement” – what is the problem the customer says to solve?
• Individual Work

Assignment #2*: A customer comes and demands by saying: “Devise a better concept to mechanize the loading of cargo (sacks) into railroad trucks from the manual loading, by which workers take one sack from a pallet in a warehouse, carry it to the truck, and place it on another pallet on the truck. The transport of cargo from warehouse to railroad truck can be easily mechanized – perhaps by using a conveyer belt. However, portable and compact machines that can stack cargo inside a railroad truck do not exist. Forklifts that carry six sacks on a platform have difficulty maneuvering inside a truck and, therefore, cannot provide the necessary productivity.” Now, in meeting (solving) the customer need, we have to know the customer’s problem precisely. Make a problem statement which includes (1) the goal (what must be achieved) and (2) the means (what must be done, improved, or changed) to be employed. Bring and submit a typed report to the class of Wednesday, September 24, 2014. *This assignment is based on “The Innovation Algorithm” by Genrich Altshuller, pp.82-83.
4 Student Problem Statements of Assignment #2

• Judge yourself which is a good problem statement.

Problem Statement (for Assignment 2)

#1 The problem statement is that the manager has not implemented a new idea on how to mechanize the loading of cargo, using a forklift that carries 6 sacks, which is difficult to maneuver.

#2 The fundamental problem is that we need to efficiently get cargo such as sacks loaded from a warehouse to the trailer of a train.

#3 Problem Statement: I am seeking a way to automate the loading of cargo for my business. The loading process consists of two steps: first the transport of cargo from the warehouse to the train tracks, and secondly the stacking of cargo into the rail car for efficient use of storage space.

#4 The conveyer belt machine can be used to transport the cargo from the warehouse to the truck but forklifts are too big to maneuver the cargo into the truck. This means that a system has to be set up to get the cargo from the conveyer belt into the back of the truck.
Problem Formulation and Design Requirement

• Contents
  – Identify Needs
  – Define Problems
  – Current Status of Art
  – Identify Requirements

• Goals
  – Why need identification and problem definition are important
  – Strategies for gathering information about a problem
  – Make out a “Problem Statement”
  – Develop a set of requirements for a problem
Problem Formulation

• “The process of converting a dissatisfied situation into a well-understood problem”
  – Understanding the problem, Not finding solution to the problem
  – Einstein: “The mere formulation of a problem is far more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle requires creative imagination and marks real advances in science”
  – It’s result?
    • TRUE Need Identification and CORRECT Problem Definition
    • Clear set of Requirements that can guide the design process through to its completion
Identifying Needs and Defining Problem

• Identify the Needs (of the customer)
  – 1. **Outline** why the situation is so dissatisfying
  – 2. **Ask** questions about it
  – 3. **Compare it to other situations** that are familiar or where experience already exists
  – 4. Gain an understanding of what might **cause** it
  – **Don’t consider Solution yet --- this is a trap !!!**

• **Don’t rush to get a solution** after Needs are Identified:
  – A wrong problem may be solved!
  – A symptom may be solved!
  – A **part** of the problem may be solved!
  – A partial solution is attempted
Problems may be hidden in a Zone of Ambiguity

- Problems are often imbedded in a zone of ambiguity and only accessible through a series of clues.
- Problems may exist for other reasons than seemingly apparent manifestation.
- Take more time to adequately understand the entire problem and identify THE problem.
Misidentified Problem (Cause)

• Headache/Migraine – There are more than 200 types of headaches
The Blind Men and the Elephant

- Pillar? Rope?
  Tree branch?
  Hand fan?
  Wall? Pipe?
- Parts vs. Whole
- Need of communication
Hard “soft” skill?

• We find the “hard” things to be “easy”,
It is the “soft” thing that are “hard” — A CEO of a manufacturing company in expression of concerns on applying technical skills to meet design needs.

– Meaning?

• Problem formulation is one of those essential hard “soft” skills.
Mental Barriers and Inertia Vectors

- Mental Barriers
  - a collection of misconceptions, misunderstandings, biases, mindsets, predispositions, assumptions, and emotions that prevent a person from understanding, identifying, or comprehending a problem and solving it.

- Inertia Vectors
  - Direction of solution is following the Initial tendency
  - Use already existing devices or concepts
  - Usually lead away from the solution
Types of Mental Barriers

• Many different types of mental barriers, including, but not limited to:
  – False assumptions and nonexistent limitations
  – Typical solutions
  – Making things more difficult than they are: being overwhelmed
  – Incomplete or partial information
  – Information and sensory saturation
  – Misunderstanding
  – Emotions-, culture-, and environment-related barriers
  – Fear
  – Improper methods of solution
  – Over-abundance of resources

• Source: S. B. Niku www.mwftr.com/SD1415.html
Attributes of Creative People

- Discipline and Self-Confidence
- Adaptability and Resilience
- Conceptualization and Recall
- Flexibility and Fluency
- Visualization Ability
- Curiosity
- Comfort with Complexity
- Mental Agility, detachment, and playfulness
- Skeptical of Accepted Ideas
- Persistence and Capacity
- Informality
- Originality
Approaches for Creative Solution

• Brainstorming
  • Creation of Affinity Diagram
  • Creation of Cause-and-Effect Diagram

• Synectics
  • “joining together different and seemingly irrelevant elements”
  • Analogy (Personal, Direct, Symbolic, Fantasy)

• TRIZ
  • The Theory of Inventive Problem Solving
  • Systematic method based on the hypothesis that creative innovations follow universal principles which can be followed.
Brainstorming

• A group process
• Popularized but misunderstood –
  – Not just “sitting down and thinking of ideas”
• A process with guiding principles
• Primary Goal
  – Generation of a large quantity of ideas – “quantity breeds quality” (True ???)
• Core Elements
  – No judgment of other people’s ideas is allowed
  – No judgment of your own ideas is allowed
  – Build onto the ideas of others
  – Welcome wild ideas
• Caveat
  – Quantity but not quality (toward solution)
  – Maybe a bunch of wrong directions (quantity)
  – No solution (quality)
But can ‘I’ give a storm to my brain?

- “I’m, therefore, I’m right”: Opinion by Jim Sollisch in Christian Science Monitor, July 21, 2011
  - The culture of ‘I’
  - Base our thinking and behavior almost exclusively on personal experience
  - “I experience, therefore, I am right”
  - Result: Lack of critical thinking → may lead to Narcissism
  - What accelerated Americans to become shallow thinkers? Internet’s segregation by their interests
But can ‘I’ give a storm to my brain?

• “The Shallows: What the Internet is doing to our brains” –by Nicholas Carr
  – “The Internet rewards shallow thinking: One search leads to thousands of results that skim over the surface of a subject.”
  – People **skim** on line; they **don’t read**.
  – And there is tangible evidence, based on studies of brain scans, that the medium is changing our physical brains, strengthening the synapses and areas used for referential thinking while weakening the areas used for critical thinking.
Practical Approach for Problem Identification

• Suggested Approach:
  – Express the customer’s need in your own words
  – Focus on the Root Cause (not symptoms or immediate Source)
  – Don’t try to use existing devices in the statement
  – Think other industry and application for similar situation with precise problem definition
  – If any question, ask customers

• Helpful Tools
  – Brainstorming and Creation of Affinity Diagram
  – Cause-and –Effect Diagram (“fishbone” diagram): Effect → Need, and Cause → Problem
  – Concept Map to gather the NEEDS directly from a customer
Affinity Diagram

- The affinity diagram organizes a large number of ideas into their natural relationships.
- This method taps a team’s creativity and intuition.
- It was created in the 1960s by Japanese anthropologist Jiro Kawakita.
Fishbone Diagram (Causes-and-Effect)

FINISHING/PACKAGING ATTRIBUTES CORRELATING WITH BEER OXIDATION

PACKAGING OPERATIONS

CAUSE

MATERIAL

INSTRUMENT

Parity

Calibration

Selectivity

Handling

Storage

Purity

Communications

Training

SOPs

Robustness

PEOPLE

METHODS

EFFECT

Lower flash pasteurization temps as hold times increase

Throttling back beer delivery valve to filler during beer changes/startups to keep tight beer back pack

Centrifugal pumps better than positive displacement pumps

CO₂ leaves lighter beers quicker

PVPP vs S4H3 (7) Parkinson sez No

 Pasteurization

Lower temp flash pasteurization

Free radicals generating light in luciferin dependent luminescence tests (+)

Saptoporin: faster production of HMF in lower pH beers (-)

Acetaldehyde, fufural, furfuryl thiod (coffee-like), 4-methoxybenzaldehyde, (e), octactetate, (E)-2-damascenone, phenylacetaldehyde

Larger, more open exposure of batches of beer to D.O.

more significant than package D.O. alone.

Oaper neck shape, air more likely to be retained

Fermenting berries chilproofed with PVPP vs tannic acid, PV/PV

be less harsh, less cooked, after three months

Sappeor: chemiluminescence (free radical) activity potential of beer via ESR analysis (-)

Aceto-Cyanase or Oxyrase

*Absorption integral* UV spectrum (240-310 nm) of fresh beer distillates (-)

Low temperature O.G. (+)

DPPH reducing potential (+)

Sutori's Endogenous Antioxidant Activity.

The EAA Measures time required for OH formation in packaged beer. (+). Higher values are good!

Spectrophotometric based assay with PBN. Beer reducing power [polyphenols] (+)

(2-furfuryl ethyl ether) (-)

Beer redox potential predicts both flavor and physical stability

Release of bound aldehydes as O.G modified (-)

Elder character of beer decreases with age (e.g. by GC olfactory analyses)

Lower beer pH accelerates increase in chemiluminescence which increases the rate of free radical n's, flavor tending, degradation of AA's & procyanidins (-)

BEER FINISHING

- Sapporin could not detect sulfur dioxide bound with sulfur aldehydes. Concluded sulfur dioxide acts only by free radical scavenging...not by forming sulfate esters. Two free radicals factors lead to decreased in flavor stability...

- Lipid oxidation and O2 consumption of beer RP during breakhouse operations. 2. When added to packaged beer show no dramatic production of oxygen (18) normal...suggests upstream pressure conversion to breakhouse, etc.

- Keep RP low in breakhouse. 3. Reduces oxygen to water. 4. Are negative molecules of addition...one requiring oxygen, the other occurring in presence of molecular oxygen (e.g. light) or activated thiol radicals: Thiyl radicals with unsaturated lipids...

Tandleman's Beer Blog
Concept Map

- Visual illustration of concepts and ideas

Diagram:
- Plants
- Petals
- Color
- Grow
- Green
- Flowers
- Roots
- Stems
- Leaves
- Food
- Seeds
- Flowers
- Petals
- Color
Now, Back to Problem Formulation

• Customer:
  – “My utility bill is too high. I paid $100 for water and $200 for electricity.”

• Designer:
  – Uhm, this customer has an energy waste problem or is paying above the budget. (Wrong!!)
  – The wrong problem definition would lead a wrong solutions
    • Well, shut your A/C
    • Take a quick shower
    • Do laundry only once a month

• What is the correct problem statement?
  – Work !!
Problem Definition Exercise 1

- **Needs from customers:**
  - “Actually, we need help figuring out how to fit everything in our room… it’s

- **Process of Defining Problem**
  - Outline why the present situation is so dissatisfying
  - Asking questions about it
  - Comparing it to other situations that are familiar or where experience already exists
  - Gaining and understanding what caused it.
  - Then “one sentence problem statement” which includes every element – complete set of customer needs

- **And your problem statement is?**

- **Exercise: Write 1-sentence “Problem Statement”**
Problem Definition

• Problem Definition Example:
  – “The customers need to rearrange the contents of the room in such a way as to increase the efficiency of space usage and the convenience of item location”
How the class did - 1

I need a way to fit all of my things in a tight space without losing comfort or mobility throughout the room.

The customer needs both “she” and her roommates’ belongings to fit comfortably in their shared space, while still allowing for open space and mobility.

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.
How the class did - 2

How can we organize our room so that we can have a comfortable and efficient living area while everybody who lives there has their belongings organized for easy access?

The fundamental problem is to find the most efficient way to use a given space as our living quarters while maintaining comfort, organization, and moveable space.
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Register for the Intel Open (Round #1) Now!!
### Intel Open

**Round 1**

<table>
<thead>
<tr>
<th>What is it?</th>
<th>A college/university level competition where you can create a competition entry with your existing project from your engineering project course, capstone project, or Maker project. Eligible teams must use an Intel Atom board. Galileo board use is encouraged but not required (Schools that are not currently official Intel partner schools and have not recived Intel boards already may apply to receive 2 free boards per advisor)</th>
</tr>
</thead>
</table>
| How do I enter? | 1. create a team of 3-5 students (no duplicate people across teams)  
2. Complete the team registration form which includes a 1 paragraph summary of your project description to be posted on-line |
| How are winners selected? | By the sponsoring professor/advisor will select the winning team from all teams at your college/university. If 10 or more teams are registered under the same advisor / school, 2 winning teams may be selected. |
**Intel Open – Round #1**

<table>
<thead>
<tr>
<th>What is the judging criteria?</th>
<th>The sponsoring professor/advisor will select the winning team. Decisions are recommended to be based upon the criteria for the Final event (see Judging Criteria available on-line for details)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Expectation Level</td>
<td>Proof of Concept design</td>
</tr>
</tbody>
</table>
| Awards/prizes                | 1. Advancement to the Semi-Finals  
Team recognition certificate | 2.                                                                                                                                                                                            |
| Deadlines                    | team registration: Oct 13, 2014  
boards received by schools: Nov 3, 2014  
professors select winning teams: Dec. 8, 2014  
winners publically announced: Dec 12, 2014  
winners sign up for Semi-Final presentation: Dec. 19, 2014 |

www.mwftr.com/SD1415.html
Problem Formulation – Team Activity - 1

• Subject: Jimmy Hendrix and Eric Clapton said “I want my guitar amp wireless-ed”

• Problem Statement Formulation:
  – 1 Gather Information from within the team – Brainstorming (10 minutes)
    • Draw insight from previous experiences (in other industries or situations) to understand the need
    • Focus on customers’ needs; NOT your own needs
    • Use Creativity
  – 2 Construct an affinity map or fishbone or concept diagram (10 minutes)
  – 3 write a 1-sentence problem statement, covering the complete set of the customer’s needs (5 minutes)
  – 4 Submit (a) Diagram/Map and (b) 1-sentence problem statement. [Name the team members joined in the work]
Problem Formulation – Team Activity -2

- **Subject: Your own project**
- **Problem Formulation**
  - 1 Identify the needs by brainstorming (15 minutes)
    - Gathering Information from Within the Team
    - Draw insight from previous experiences or other situations and industry
    - Focus on customers needs NOT team’s own needs
    - Use Creativity
  - 2 Draw an **affinity** or **fishbone diagram** or **concept map** (10 minutes)
  - 3 Make out the correct/comprehensive problem of your project (customer’s point of view. Customer’s need is to be focused)
    - Make into a 1-sentence problem statement (5 minutes)
  - 4 Submit (a) Diagram and (b) Problem Statement [Name the team members joined in the work]