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. - Albert Einstein
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
  – 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
- Confusing Process relied upon intuition and hard (essential) “soft” skills.
- It’s result?
  - Need Identification and Problem Definition
  - Clear set of Requirements that can guide the design process through to its completion
Identifying Needs and Defining Problem

- **Identify Needs**
  - Dissatisfied situation
  - Need exists
  - Accept responsibility for corrective actions
  - “Attitude”?
    - Pioneer Mentality
    - Identifying a need and accepting responsibility for meeting it
    - Commit time, energy, other resources
    - Take risks
    - Willingness to adapt to situation and use available resources
    - Agent of change

- **No Rush to get a solution** after Needs Identified:
  - A wrong problem may be solved!
  - A symptom may be solved!
  - A part of the problem may be solved!
  - Or a partial solution is obtained
Problem Definition (Answer to “what is THE problem?”)

• 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

• Example
  – Needs from customer: “Actually, we need help figuring out how to fit everything in our room... it’s way too small for all of our stuff,”
  – Problem Definition: “We 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”
Gathering Information

• Search for Current Status of Art
  – Patent Search
  – Web Search
  – Market

• Customer Interview
  – Customer Interview
  – Focus group interview
  – Objective is to define needs not to wring out a solution

• Gathering Information from Within the Design Team
  – Draw insight from previous experiences
  – Focus on customers needs NOT their own needs
  – Use Creativity
Creativity

• Unleashing Your Creativity- “How can one gain better access to his or her creative energy?”

• Creativity as Process
  – **Preparation**: Ground work. Background of the situation
  – **Incubation**: Taking time out. A rest period.
  – **Illumination**: Getting the answer (Aha!). The light bulb is on! Generate Ideas.
  – **Verification**: Does the idea work? Confronting and solving the practical problems.

Fill in the missing number.

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>52</td>
<td>63</td>
<td>94</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>
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

• Powerful approaches
  – 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.
• 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
• 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
• People Involvement
  – Gather a diverse team of people
  – Designate a facilitator
  – Keep everyone involved
Team Idea Generation

• Team Idea-generation Strategy
  – Illuminate the first time individually: “generate ideas”
  – Incubate: “set the problem aside”
  – Presentation of individual ideas and build on them in group brainstorming
  – Incubate
  – Generate ideas as a team, and cycles of incubation-illumination- until…. 
Attention-Directing Tools

• Affinity Chart
  – Team has a big list of ideas (after brainstorming) and is not sure what to do with it
  – Grouping similar ideas into categories
• Fishbone Diagram
  – Team wants to identify causes for a problem
    • Examples:
      – What are all possible safety issues with the design?
      – Why are meetings always so unproductive?
Affinity Chart

• Groping Ideas into Categories
  – Generate Ideas
  – Sort the ideas
  – Create Headings
  – Draw an Affinity Diagram
Fishbone (Cause-and-Effect) Diagram

• The opposite of Affinity Chart
• Start from Categories and Ideas are found to fit within each category
  – Develop a problem statement
  – Construct an empty fishbone diagram with major cause categories identified
  – Generate ideas for each category
  – Identify most likely causes
Class Activity

- Form a Group (temporary)
- **Define the needs** and **Identify the problem** of “Method of E-Waste Reduction” by
  - Individual Idea Generation (10 minutes)
    - Internet Search Allowed
  - Brainstorming (10 minutes)
  - Affinity Chart OR Fishbone Diagram (10 min)
- **Submission** (10 min)
  - Description of (summarizing the chart or diagram)
    - Problem Definition --- 1 sentence
E-Waste Problem

• E-waste:
  – consumer and business electronic equipment that is near or at the end of its useful life
  – Certain components contain hazardous materials
  – The mantra of "Reduce, Reuse, Recycle"

• Fundamentally better way of solving the E-waste problem?
Homework

• Customer Needs:
  – “I am a disabled man and I have difficulties when I am reading to turn page of book.”

• Homework:
  – Identify the problem and
  – Gather information, and
  – Define the problem with 1 sentence.

• Due: Next Wednesday (before class starts)

• Submission:
  – Materials (notes, descriptions, drawing, etc)
  – One sentence problem definition (hardcopy)