

Before We start

You feel more bright today?

Fill in the matrix.

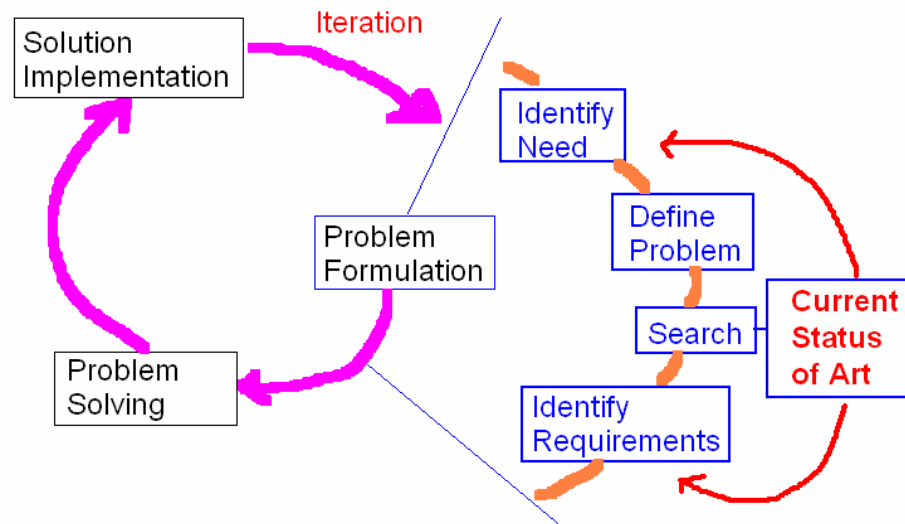
1	2	3	1	1	8
2	2	6	2	2	14
3	4		3	1	20
4	4				23
					31
6			3	2	

Search

- To gather customer needs
- To establish requirements for problem
- Requires the most work
- Three primary activities
 - Working with customers/users to get information
 - Interviews, Concept Maps, Observation
 - Discussing the problem with each other
 - Clarification within a group
 - Researching Information
 - Libraries and online sites
 - Be careful:
 - » Accuracy and Authority
 - » Objectivity
 - » Currency
 - Existing products
 - Benchmarking
 - Experts
 - Consulting Experts
 - Advisors

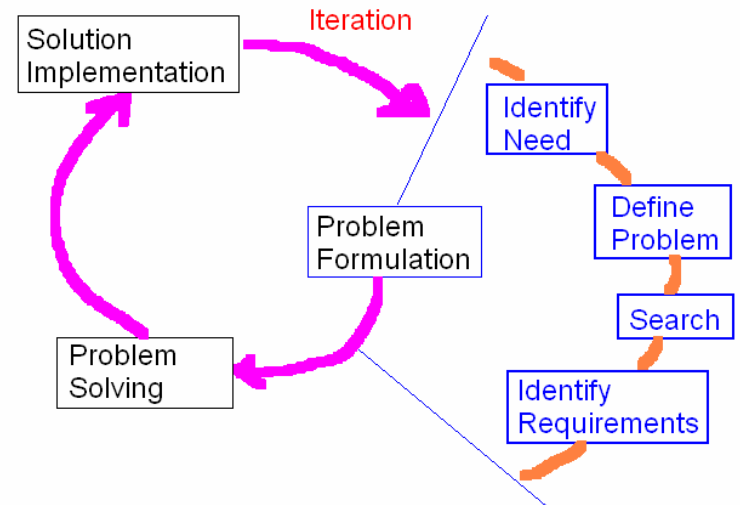
Current Status of Art

- Problem Already Solved?
- Any improvement you can make?
- How does change the Needs and Problem Identified?
- This is the starting point you jump up from



Identifying Requirements

- Identifying Needs & Defining Problems & Searching are for establishment of clear set of requirements
- Clear, unambiguous description of the problem
- Two Elements frequently incorporated:
 - **Functional** Requirements – Core functions
 - **Design** Requirements – Technical guide



Functional Requirements

- Exercise – What are the Fundamental Functions of the follow
 - 2-liter soda container
 - Dolly
 - Towel Rack
 - Wireless guitar amplific
- **Formation of Function Rules**
 - R1: Define the widest area while remaining true to the problem
 - R2: Word the functional requirements so as not to imply a specific solution
 - R3: Things a design will do, not things a customer will do.

Functional Requirements Formation Rule 1

- Rule 1: Define a Wide Area
 - Abstraction of the problem being addressed
 - Do not pin down a problem to a narrowly-defined scope
 - Define the problem as broadly as possible
 - To examine all possible solutions before selecting the one to pursue
 - Soda Container example:
 - **“Hold pressurized soda & provide access to soda”**
 - Anything that can do these things
 - Bladder, syringe, keg, tube, hard plastic container, aerosol can, etc

Functional Requirements Formation Rule 1 - conti

- Design Space
 - Range of options available to a designer
 - Start from huge, later reduced to a single design
- Design Freedom
 - How many choices available to designers
- **Point of Rule 1:** Define the design space as large as it can be to allow for a much design freedom as possible
- Soda Container Example—Do not say
 - “cost less than 15 cents”
 - “be small enough to fit in a refrigerator door”
 - “be made of clear material”
 - “be light”
- Wireless Guitar Amplification System – Do not say
 - “_____”

Functional Requirements Formation Rules 2 & 3

- Rule 2: Should not Imply a Solution
 - Soda Container Example:
 - “Provide access to soda” –yes!
 - “Allow users to twist off cap” –no!
 - Use ***solution-independent terms*** and ways
- Rule 3: State what the design, not customer, must do.
 - Soda container example:
 - “empty soda” “open container” –customer (no)
 - “provide access to soda” – design (Yes)
 - Dolly example:
 - “move boxes” – customer (No)
 - “allow the use to move boxes” – design (Yes)
 - Wireless Guitar Amp Sys example:
 - Customer’s point of view – “_____” (No)
 - Designer’s point of view - “_____” (Yes)

Timeout: Where are we now?

- Still in the **Problem Formulation**
- Identifying Needs – Pioneer, Changes, ...
- Defining Problems – Brainstorming, cha...
- Search – Information gathering activities
- Functional Requirements
 - Core functions
 - Design Freedom and Large Design Space
 - General Guidelines for Generating Designs
- What's the next step?
 - Selection of better designs (alternatives)
 - Any guideline for selection?
 - Any guideline to measure success?
 - Any guideline to evaluate?
 - Any guideline which we follow to the end?
 - **Yes, "Design Requirements"**

Design Requirements

- The process of reducing the size of design space.
- The guideline which guides all the way to the end.
- **Two Components of Design Requirements**
 - Constraints
 - Criteria
- **Constraints**
 - What a design solution must and must not do.
 - Key question: “Does the design meet the constraints?”
 - Boundary of design space
 - Physical, social, ethical, corporate, or personal
 - Examples
 - 2-liter soda container
 - Wireless guitar amplification system
- **Criteria**
 - Differentiation tool between designs that pass the constraints
 - What “should” and “should not” the design do?
 - Key Question: “**How well** does the design meet the criteria?”
 - Example: 10% gas mileage improvement from the stock vehicle

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**

Requirements – Be Measurable

- If you cannot test whether a “requirement” is met, then it is not a requirement
- Testable → Measurable → Quantitative
- Example:
 - 2-liter soda container
 - Bad: “must be safe”
 - Good:
 - Wireless Guitar Amplification System
 - Bad: “lower power consumption”
 - Good:
 - Bad: “Sound quality should not be changed”
 - Good:
 - PV connection to Power Grid
 - Bad: “saving electricity bill”
 - Good:

Requirements – Need is described

- Should not limit the range of solutions unnecessarily
- 2-liter soda container
 - Good: “container”
 - Bad: “bottle”
 - Bad: “must be easy to twist off cap”
 - Good:
 - Bad: “Must be less than 6” in diameter”
 - Good:
- Wireless Guitar Amplification System
 - Bad: “Use Bluetooth technology”
 - Good:
 - Bad: “must have wheels to move around”
 - Good:
- Hybrid Vehicle
 - Bad: “Gasoline engine is minimally used”
 - 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

Checklist – sample requirements 1

- **Aesthetics:** “70% of target guitarists indicate that the appearance of the system will encourage purchasing it”
- **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”

Checklist – sample requirements 2

- **Maintenance:** “Required annual maintenance should be minimized and must not exceed 10 minutes per 1 person”
- **Manufacturability:** “Must be able to produce 1000 systems per day”
- **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”
- **Reliability:** “Less than 0.01% of the system should fail”
- **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 approved”
- **Weight:** “The system must be less than 1 pound”

Grouping the Design Requirements into Design Requirement Template

Design Requirement Template (Example)

KOKAKOLA Co.	REQUIREMENT LIST FOR 2-LITER CONTAINER	3rd Version: 9/13/2007
Bruce Arenas (Leader), Donovan McBride, Abby Wambach, Mia Ham		Replaces 2nd Version of 9/1/2007
DATE	REQUIREMENTS	SOURCES
UPDATE		
9/13/2007	<p><i>Overall Function: Hold pressurized soda and provide means for some to access the soda and recycle the container</i></p> <p>CONTAINER</p> <ul style="list-style-type: none"> Must fit within a volume that is 10" wide x 6" deep x 15" tall volume Volume must be 2.05 liters plus/minus 0.03 liters <p>ACCESS TO SODA</p> <ul style="list-style-type: none"> Soda must exit the container at a rate of 2 ounces/sec to 5 ounces/sec Must not require more than 2 seconds to open or close Must not require any tools to open or close Must require less than 5 in-lb of torque to open or close 	Mia Ham

Design Requirement Template (Example)

Sustainable Eng CO.	REQUIREMENT LIST FOR SOLAR OVEN REFLECTOR	2nd Version: 9/13/2007
Arenas (Leader), McBride, Wambach, Ham		Replaces 2nd Version of 9/1/2007
DATE	REQUIREMENTS	SOURCES
UPDATE		
9/13/2007	<p><i>Overall Function: Collect solar energy by reflecting it into an oven chamber</i></p> <p>PERFORMANCE AND SIZE</p> <ul style="list-style-type: none"> Temperature in the oven must reach at least 220F and no greater than 350F when the ambient temperature is 85F. Hotter temperatures are preferred within 200F to 350F range Oven must be used correctly by people not familiar with solar ovens at least 90% of the time Oven must fit within 3 ft. x 3 ft. footprint and cannot be taller than 5 ft. <p>SAFETY</p> <ul style="list-style-type: none"> Device must not generate a fire hazard beyond that which a grill with charcoal does Device must not have any pinch points or sharp corners/edges 	<p>NPS (National Park Services)</p> <p>NPS</p>

Summary – Problem Formulation

- The most important first step in design process
- Is focused on identifying the requirements of a design project
- Involves activities of
 - gathering information about needs
 - Formulating functional requirements
 - Design Requirements: Constraints and Criteria
- Will be used throughout the design process as Guideline for
 - Concept development and exploration
 - Basis for testing

First Assignment – Individual Work

- For a provisional design project
 - Individual Assignment
 - Identify the overall customer needs using the gathered information
 - Identify the functional requirement
 - Search and investigate the current status of art?
 - Identify the design requirements and Complete a design requirement form
 - SUBMISSION by Wednesday, 17SEP08 Class.
 - **Summary on Current Status of Art**
 - **1-Sentence Functional Requirement**
 - **Design requirement (1st version)**