

TCN 4940 : Senior Project - I

Need Analysis – Problem Statement

Instructor

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Outline

- Projects under Senior project-I
- Prescribing the Design Process
- Need Analysis (The Client's need)
- Problem Definition
- Object attributes
- Process Summary
- Client Interview
- User Needs
- The Survey
- Example

Projects under Senior Project-I

- Projects doing in Senior Project-I course are *new*.
 - You need to design something that, to the best of your knowledge, is new or is a different approach to a previous design.
- Projects doing in Senior Project-I course are *ill-structured*.
 - Because their solutions cannot normally be found by applying mathematical formulas or algorithms in a routine or structured way.
- Projects doing in Senior Project-I course are *open-ended*.
 - Because they usually have several acceptable solutions.
 - Uniqueness, so important in many mathematics and analysis problems, simply does not apply to design solutions.

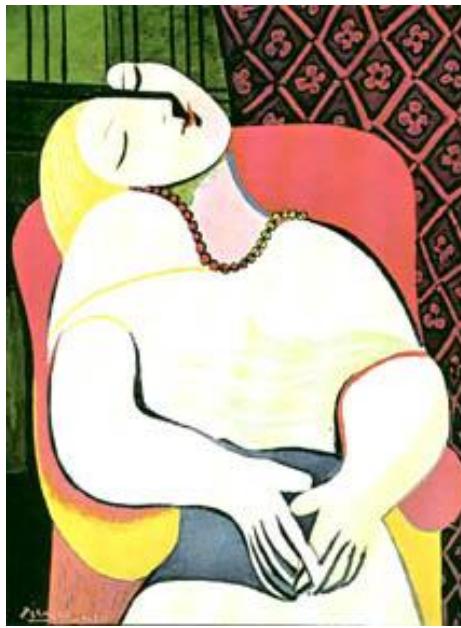
Open-ended and ill-structured

- *Same subject, different Design, same author*

Woman in White, 1923

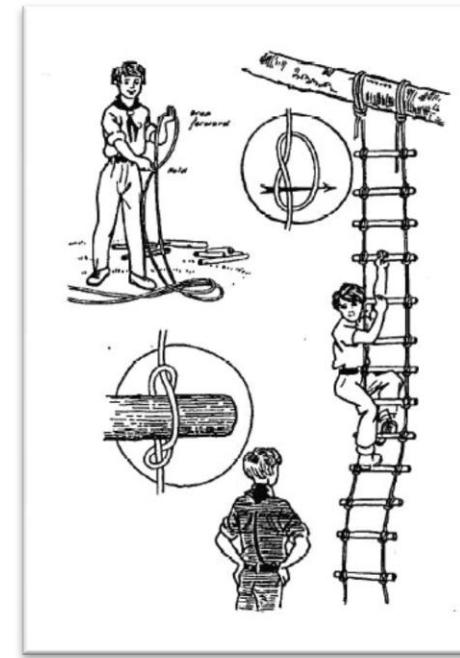


Dream, 1932

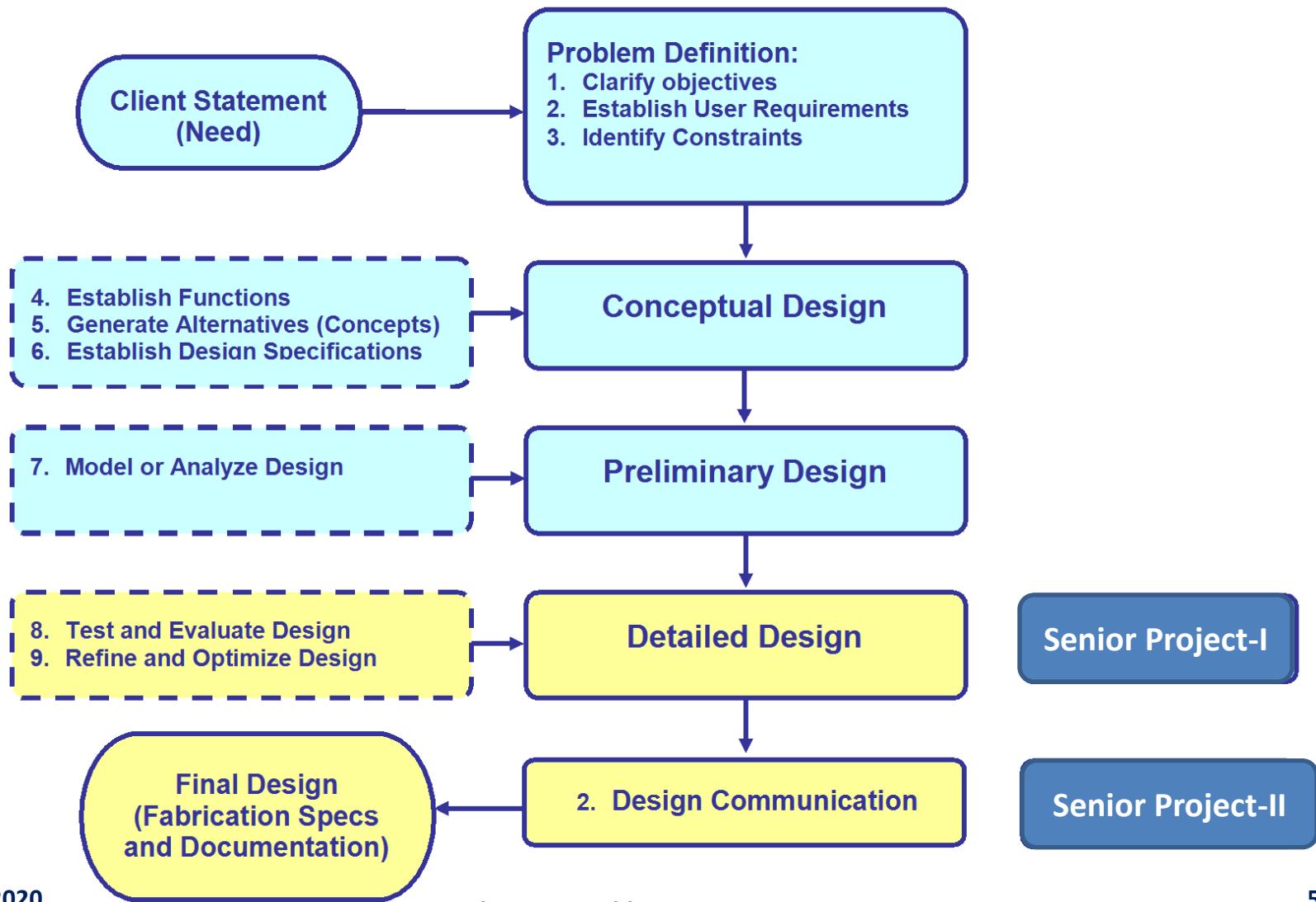


Art by Pablo Picasso

General Example



Prescribing the Design Process



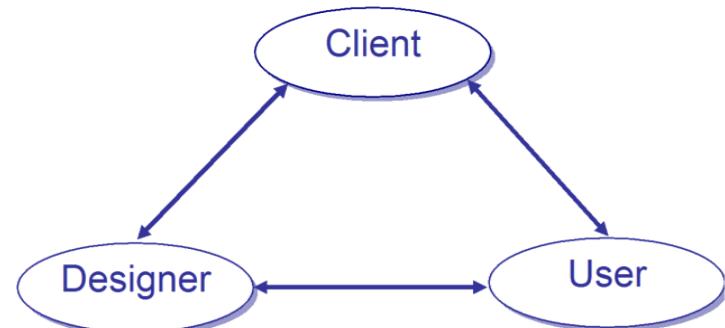
Need Analysis (The Client's Need)

- Client Statements usually have limitations because they often:
 - Contain errors, show biases, or imply solutions.
- **Example:**
 - FIU College of Engineering needs to reconfigure the intersection (Bias, the problem could be timing of the signals instead of reconfiguration) of Flagler Boulevard (Error) and 107th Avenue so students can cross the road.
 - We want a rear door installed on the aircraft we are ordering. (Implied Solution)

Problem Definition

- **Input:**
 - client's Need Statement
- **Tasks:**
 - Talk with the Client, (interview)
 - Some Potential Users (Survey),
 - Conduct your own Brainstorming Sessions, (Fishbone)
 - Review Similar Products, Industry Reports, Literature, Patents
 - Talk to Marketing People, and Experts.
 - Research, Market data publications, Market Trends.
- **Output:**
 - Revised Problem Statement
 - Refined Objectives
 - User Requirements
 - Constraints
 - Assumptions and Limitations

- Your mentor is your Client (Interview)
- People who acquire your product are the Users (Survey)
- You are the Designers (Brainstorming)



Object Attributes (We need to determine them)

Attribute: A quality or characteristic of the object to be designed

- *Objectives or goals* are ends that the design strives to achieve. (We generally view design objectives
 - They are normally expressed as “being” statements that say what the design will be, as opposed to what the design must do.
 - Objectives are abstract
- *Constraints* are statements that expresses measurable bounds for an element or function of the system.
 - Constraints are typically stated as clearly defined limits whose satisfaction can be framed into a binary choice, for example, the ladder material is a conductor or it is not.
 - The cost cannot exceed \$95.
 - Constraints values could be changed to a different value

Object Attributes (We need to determine them)

Attribute: A quality or characteristic of the object to be designed

- Functions are the things a design is supposed to do, the actions that it must perform
 - Functions are usually expressed as “doing”.
- Lastly, *implementations* or *means* are ways of executing those functions that the design must perform .
- Need analysis deals first with objectives and later with constraints . (The result is an abstract description of the project with some bounds)

Object Attributes - Examples

- *Objectives*
 - The Car should be lightweight
 - The Car should be fast
- Constraints are restrictions on a behavior or a value or some other aspect of a designed object's performance
 - The Car must not weight more than 1,000 pounds
 - The Car must run at least 80 mph
- Functions are the things a design is supposed to do, the actions that it must perform
 - The Car will automatically control speed
 - The Car will turn right and left
- Lastly, *implementations* or *means* are ways of executing those functions that the design must perform .
 - The power of the car is to be generated by a 4-cylinder gas engine

Process Summary

1. Conduct Interview
2. Conduct Survey
3. Conduct Brainstorming
4. Put all results in a table
5. Remove repeated entries
6. Eliminate:
 - Functions
 - Constraints
 - Implementations

7. Find Parent Objectives
 - Group children objectives
8. Create Parent Objectives if necessary
9. Indent and order the objectives and sub-objectives
10. Create Problem Statement

The Client Interview

- Prepare a Structured interview with questions like:
 - When and why do you use this type of product?
 - Walk us through a typical session using the product.
 - What do you like about the existing products?
 - What do you dislike about the existing products?
 - What issues do you consider when purchasing the product?
 - What improvements would you make to the product?
 - Are there already products on the market that have similar features?
 - And you can always ask a second question:
 - What does that mean?
 - Why do you want that?
- Every Project is different please customize

Client Interview

(Discovering the Roots)

- **5 Whys** is a problem solving technique that allows you to get at the root cause of a problem fairly quickly. It was made popular as part of the Toyota Production System (1970's.)
 - By repeatedly asking the question "Why" (five is a good rule), you can peel away the layers of symptoms that can lead to the root cause of a problem.

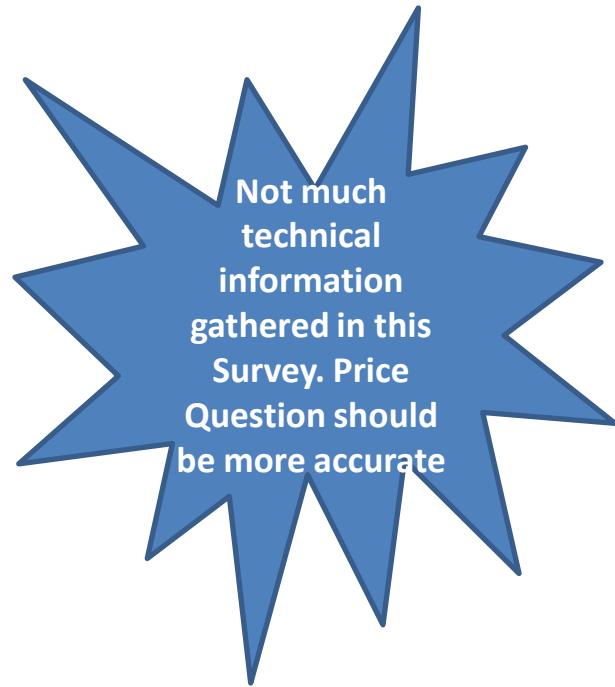
The User Needs

(The Survey)

Characteristics	End User	Corporate
Socioeconomic	Age	Size – Volume
	Gender	Number of Employees
	Income	Number of Plants
	Education	Type of Organization
	Marital Status	Industry
Behavioral	Brands Purchased	Decision Makers
	Coupon Redemption	Growth Markets
	Stores Shopped	Public vs. Private
	Loyalty	Distribution Pattern
	Hobbies	
	Reading Interests	
Psychological	Attitudes	Management Attitudes
	Personality Traits	Management Awareness
	Awareness	Management Style
	Recall	

Example - 1

1	Gender	Female Male	2	Marital Status	Single Married Divorced
3	Age	0 - 20 21 - 30 31 - 40 41 - up	4	Period of Alarm (seconds)	5 - 10 10 - 15 20 and above
5	Placement of Alarm	Close-by Door/Window Far Away Room Garage	6	Education	High School College Graduated
7	Have you ever been burglarized?	Yes No	8	Do you own an alarm?	Yes No No, But I want to.
9	How often do you leave your house unattended?	Always Rarely Never	10	How much are you willing to spend on alarm	Less than \$75 \$75 - \$100 More than \$100
11	What Features would you like on your system? Use the following scale.	1 Desired 2 Does not Matter 3 Undesired		Feature	1 Motion Detector 2 Power Backup 3 Vibration Detector 4 Remote Control Acces 5 Laser Beams 6 Panic Button



Example – 1 (Cont ...)

15 Females and 15 Males

Majority of individuals 20 – 30 year old owners/renters

60 % Singles

77% Leave the home for more than One Day

A total of 5 have been burglarized un the past

50% wanted the alarm to sound between 5 – 10 seconds

Most of the people wanted the alarm close to a nearby door/window

Most of the people want to spend less than \$50

They want in order of preference: Vibration Detector, Panic Button, Power Backup, Remote Control Access, Laser Beams and Motion Detector

Example - 2

about yourself

Additional comments
and/or suggestions

The answers to the following questions are only used to help us group answers according to different criteria. It will not be disclosed.

A1. Age: A2. Gender:

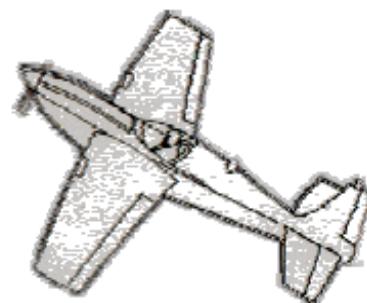
0-20 Male
21-30 Female
31-40
41-up

A3. Skill level (flying R/C models)



A4. Education:

- Some high school
 - High school
 - College
 - University/master
 - Doctor
 - Professor
 - Other



If University, what is your major:

Example-2 (Cont...)

- Electric motor preferred power plant
- Five minute average flight time
- Hard landing causing RC airplane inoperable for flight occurs within the first five flights
- Percentage of night flights negligible
- Majority use NiCd nickel-cadmium batteries
- Manual initiation of autonomous features

- All channels including ailerons, throttle, elevator, and rudder need to be supported
- Slight desire for availability on seaplanes
- Moderate ease of installation
- Device has to be shock resistant
- Device has to land on a flat surface
- Autonomous feature has a manual override
- Automatic recovery from unusual attitude

The Survey

- Survey results could depend on the facilitator and how good that person explains the project and the intention of the survey.
- To mitigate this problem write an introduction explaining the project and the purpose of the survey.

The Survey

- The whole purpose of the survey is to determine the users' needs.
- Group questions by categories
 - All uses related questions together
 - All Price related questions together, etc.
- Make all the questions multiple choice except for some (2 or 3) where you let the user give new ideas like:
 - Please indicate any uses not listed here that you would be interested in.
- Do not use Technical Terms or Acronyms with no meaning to the user:
 - What would you use an ACME3 with DSP for?

The Survey (Cont...)

- **Marketability Section**
 - You will use the information you obtain here to write the section of your proposal about Marketability
 - Determine what will make your project successful
 - Do you have any favorite brand?
 - What makes a brand one of yours favorites?
- Also break the price questions like:
 - Would you pay \$200 for a product like this? (Close to your estimate)
 - Would you pay additional \$150 for additional features.

The Survey (Cont...)

- Include questions on Local Cultural Acceptance on your survey
- Establish contact with students and faculties from universities in other countries (at least two contacts) and find out about their perspective of your product in their countries, will it be accepted in their different cultures? Could it be successful? (This information will also be used in Feasibility Analysis and Globalization)

Brainstorming

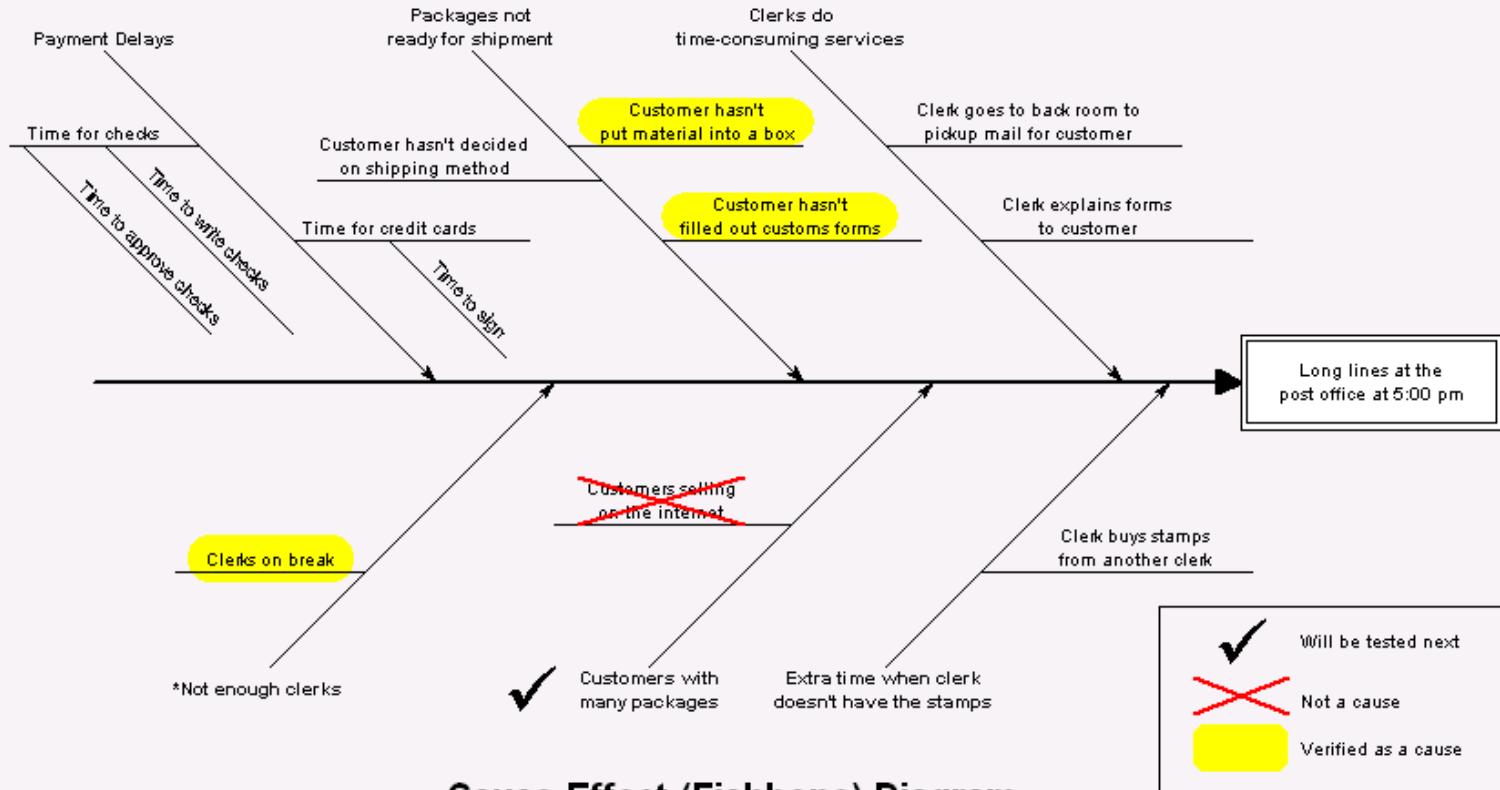
(Discovering the Roots)

- Finally, your team will contribute to the project introducing new needs not presented neither by the client nor by the user. One way to help to unfold the roots of a problem is the Fishbone diagrams. You could use them during your brainstorming in this section of the proposal.
- Example:
 - Fishbone Diagrams.
 - Cause-effect diagrams are also called Ishikawa diagrams after their creator, Dr. Kaoru Ishikawa. These diagrams are used in identifying and organizing the possible causes of a problem. They are sometimes referred to as fishbone diagrams because they resemble the skeleton of a fish, with a head, spine, and bones.

Brainstorming

(Ref: <http://www.xmind.net/> or similar to create your fishbone diagrams)

Long lines at the post office at 5:00 pm

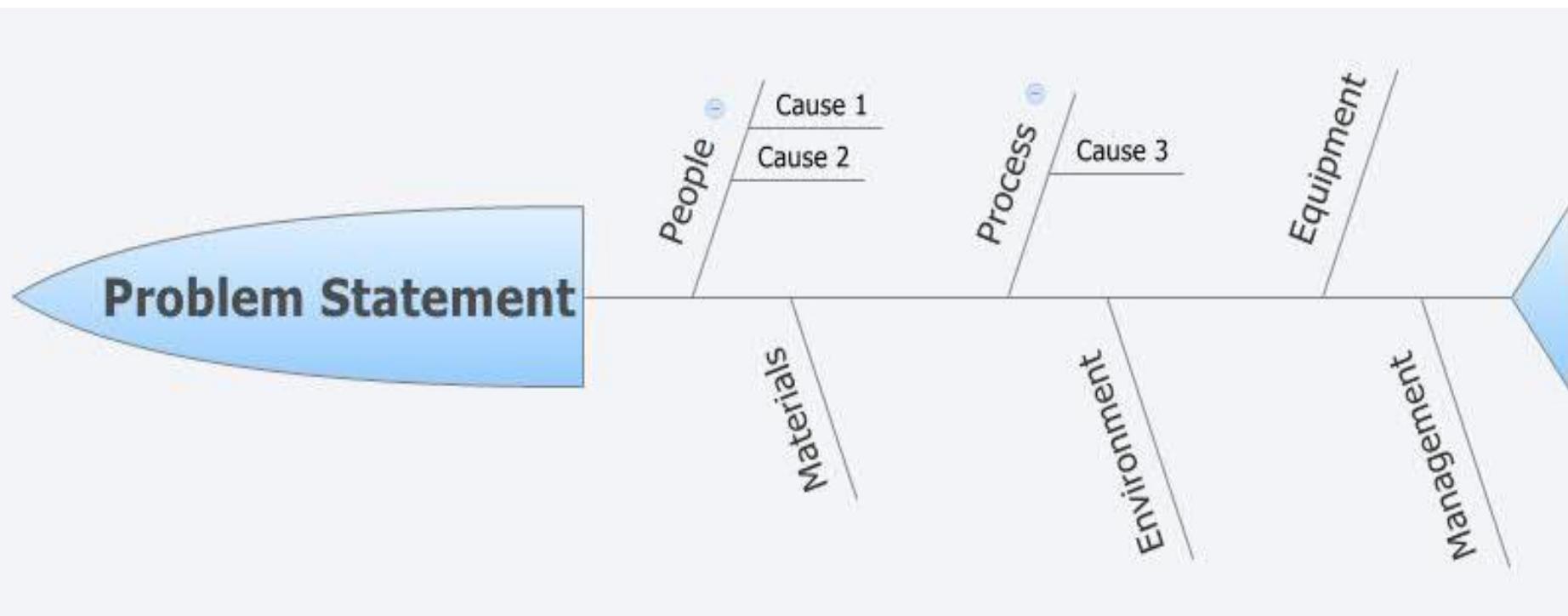


Cause-Effect (Fishbone) Diagram

J. Smith
February 23, 2003

Leading towards Problem Statement

(xmind example)



Customer Needs Example: Boomerang



The Client's Need Statement

- “I need an inexpensive boomerang”

Client's Need Interpretation

(Client Interview)

- The Client needs boomerang:
 - The boomerang should cost less than \$5.
 - The boomerang be safe to be used near glass windows.
 - The boomerang should return near the launcher.
 - The boomerang should be used as a toy

From the Survey

- The boomerang should have nice colors
- The boomerang should be safe to be used by children
- The boomerang should be made of plastics
- The boomerang should not cause harm to a house
- The boomerang should be made of plastic

Your Brainstorming

- The boomerang should be light weight
- The boomerang should reach far
- The boomerang should not hurt a person if hit by it
- The boomerang Should be innovative design

List all The attributes from: Client Interview, Survey, Brainstorming

Source	Attribute
Client	The boomerang should cost less than \$5.
Client	The boomerang should be safe to be used near glass windows.
Client	The boomerang should return near the launcher.
Client	The boomerang should be used as a toy
Survey	The boomerang should have nice colors
Survey	The boomerang should be safe to be used by children
Survey	The boomerang should be made of plastics
Survey	The boomerang should not cause harm to a house
Team	The boomerang should be light weight
Team	The boomerang should reach far
Team	The boomerang should not hurt a person if hit by it
Team	The boomerang should be innovative design

Remove repeated entries

Source	Attribute
Client	The boomerang should cost less than \$5.
Client	The boomerang should be safe to be used near glass windows.
Client	The boomerang should return near the launcher.
Client	The boomerang should be used as a toy
Survey	The boomerang should have nice colors
Survey	The boomerang should be safe to be used by children
Survey	The boomerang should be made of plastics
Survey	The boomerang should not cause harm to a house
Team	The boomerang should be light weight
Team	The boomerang should reach far
Team	The boomerang should not hurt a person if hit by it
Team	The boomerang should be innovative design

Object Attributes

- We need to eliminate from the table all those attributes which are not objectives.
- From the eliminated attributes, only the constraints will be incorporated back latter.
- The remaining table will be the list of Objectives

- Project Attributes
 - Eliminate Constraints, Functions and Implementations

Source	Attribute	
Client	The boomerang should cost less than \$5.	Constraint
Client	The boomerang should return near the launcher.	
Client	The boomerang should be used as a toy	Use
Survey	The boomerang should have nice colors	
Survey	The boomerang should be safe to be used by children	
Survey	The boomerang should not cause harm to a house	
Survey	The boomerang should be made of plastic	Implementation
Team	The boomerang should be light weight	
Team	The boomerang should reach far	
Team	The boomerang should not hurt a person if hit by it	
Team	The boomerang hould be innovative design	

Pruned List of Objectives

Attribute		
The boomerang should return near the launcher.		
The boomerang should have nice colors		
The boomerang should be safe to be used by children		
The boomerang should not cause harm to a house		
The boomerang should be light weight		
The boomerang should reach far		
The boomerang should not hurt a person if hit by it		
The boomerang should be innovative design		
Toy is important, keep for problem statement		

Project Objectives

- Next we have to order the objectives by similar categories.
- One way to start grouping entries on the list is to ask ourselves why we want them.
For example, why do we want the boomerang not to cause harm to a house
 - The answer is probably because that's part of what makes the boomerang "safe", which is another entry on our list. (Safe is a parent Objective)
 - Now we test "safe" against all the objectives and group together all of them related to "safe".

The Result is the Grouped Objectives List

Source	Attribute	
Survey	The boomerang should be safe to be used by children	safe
Survey	The boomerang should not cause harm to a house	safe
Team	The boomerang should not hurt a person if hit by it	safe
Client	The boomerang should return near the launcher.	marketable
Survey	The boomerang should have nice colors	marketable
Team	The boomerang should be light weight	
Team	The boomerang should reach far	marketable
Team	The boomerang should be innovative design	marketable
	Toy is important keep for problem statement	

The Result is the Grouped Objectives List

- **The Problem Statement** is a paragraph summarizing the objectives and the main function and constraints that is later followed by the list of objectives and constraints.
 1. **Safe**
 - 1.1. The boomerang should be safe to be used by children
 - 1.2. The boomerang should not cause harm to a house
 - 1.3. The boomerang should not hurt a person if hit by it
 2. **Marketable**
 - 2.1. The boomerang should return near the launcher.
 - 2.2. The boomerang should have nice colors
 - 2.3. The boomerang should reach far
 - 2.4. The boomerang should be innovative design
 3. **The boomerang should be light weight**

This project is about designing a safe toy boomerang that cost less than \$5. The boomerang should be able to fly long distances but must preserve the safety of people and homes around the playing area. It is desired to produce a new design that will also be decorated with attractive colors. Special attention would be placed on making sure that the boomerang returns near the person using it.

Objectives: Objectives and Constraints should be self-standing

1. Safe

- 1.1. The boomerang should be safe to use by children
- 1.2. The boomerang should not cause harm to a house
- 1.3. The boomerang should not hurt a person if hit by it

We created parent objectives safe and marketable

2. Marketable

- 2.1. The boomerang should return near the launcher.
- 2.2. The boomerang should have nice colors
- 2.3. The boomerang should reach far
- 2.4. The boomerang should be innovative design

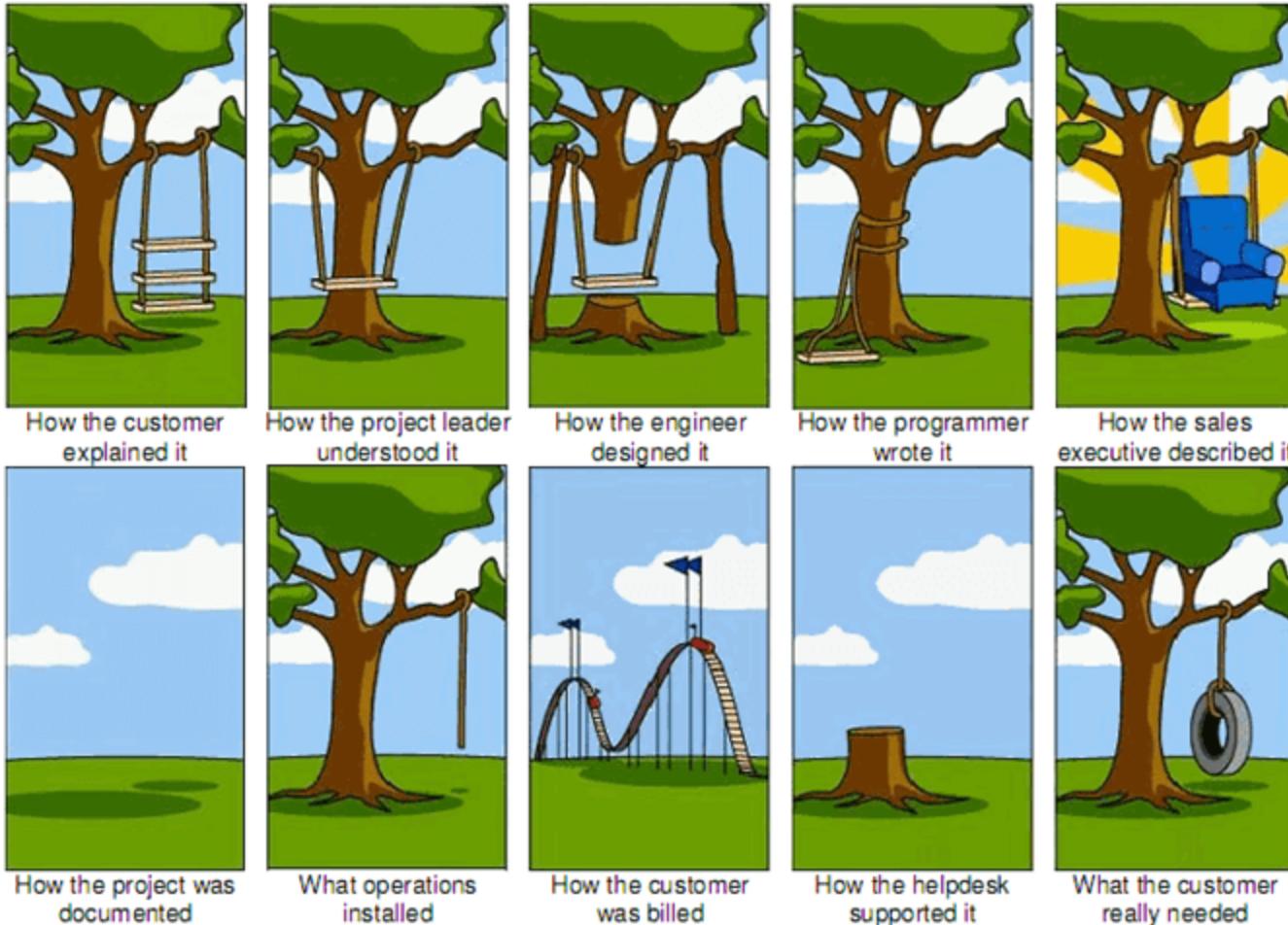
3. The boomerang should be light weight

Constraints: Constraints were re-introduced

- 1. The boomerang sale price should not exceed \$5

Problem Statement and Objectives are the conclusion of the Need Analysis Section

Something Similar to This May Happen When Need Analysis is Not Done



<https://www.tamingdata.com/2010/07/08/the-project-management-tree-swing-cartoon-past-and-present/>

Q&A