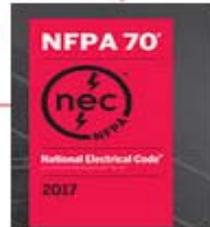
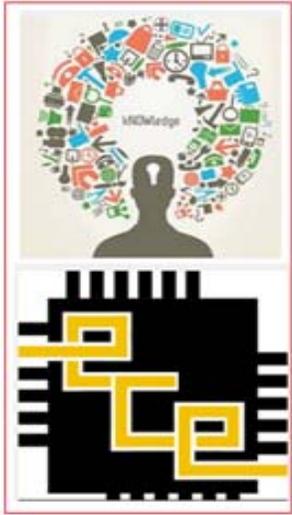




Engineering Design

What is it?

“Senior Design” – brief definition ?



Engineering Design-Overview

⌘ 1. Problem Formulation

- ☒ Recognition of a set of ()
- ☒ **Formulation of a comprehensive problem statement**
- ☒ Determine the **requirements** of the project

⌘ 2. Problem Solving

- ☒ Know the current state of the product relevant to the ()
- ☒ Generate ideas to () the requirements
- ☒ **Generate alternative ideas**
- ☒ **Analyzes all the ideas**
- ☒ **Makes Decision** on which idea (Top Design) will be implemented

⌘ 3. Solution Implementation

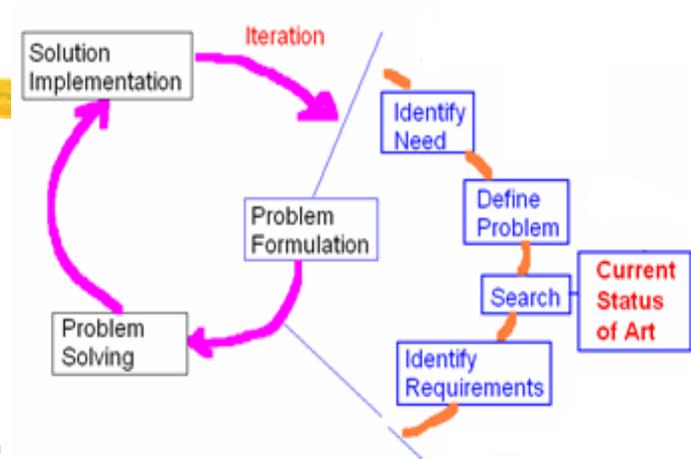
- ☒ Creates an implementation and test plan
- ☒ Follows the plan to **build** the design
- ☒ **Evaluates** against the requirements from problem formulation

Characteristics of Design

⌘ Design is:

☒ Process () through the 3 phases of (), (), and ().

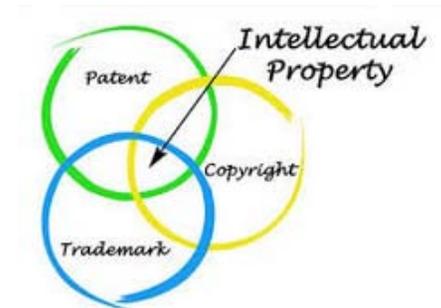
- ☒ (), not trial-and-error
- ☒ (), not a recipe (nor a cookbook)
- ☒ (), not an event or product
- ☒ (), back to earlier phases
- ☒ (), to faithfully execute planned activities



Characteristics of Design

⌘ Design should:

- ⊡ () with regulation, codes, rules, standards, etc
- ⊡ Work under multiple (and sometimes contradictory) ():
 - ⊗ Money, time, socio-cultural, ethical, etc.
- ⊡ **Perform with () behavior** and responsible action
- ⊡ Understand and exercise () **Rights**



Elements of *Unsuccessful* Design Projects: Lessons from Past Design Teams

⌘ Skill sets of team members

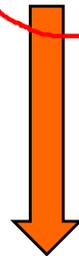
- ⊞ Only EE or CpE students in a team
- ⊞ No Hardware and System Integration Experience
- ⊞ Slow in learning new skills
- ⊞ Did not overcome technical difficulties

⌘ Weak Team Dynamics

- ⊞ Unbalanced Task and Relationship
- ⊞ Leadership Problem
- ⊞ Lack of commitment

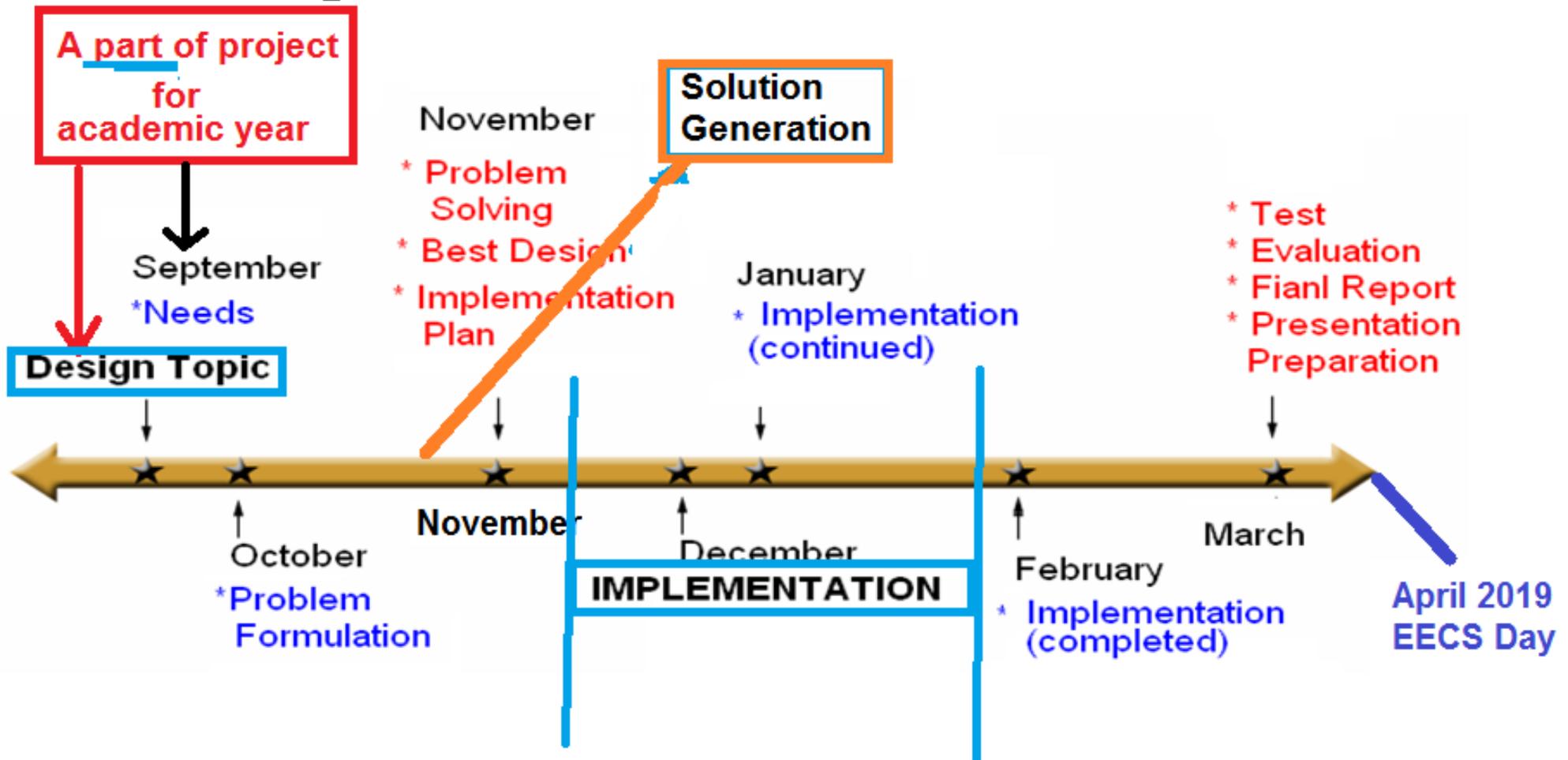
⌘ Frequent Changes in Design

- ⊞ Sought easier path for implementation
- ⊞ Focused only on each component - Did not consider the entire system
- ⊞ Frequent design/component change

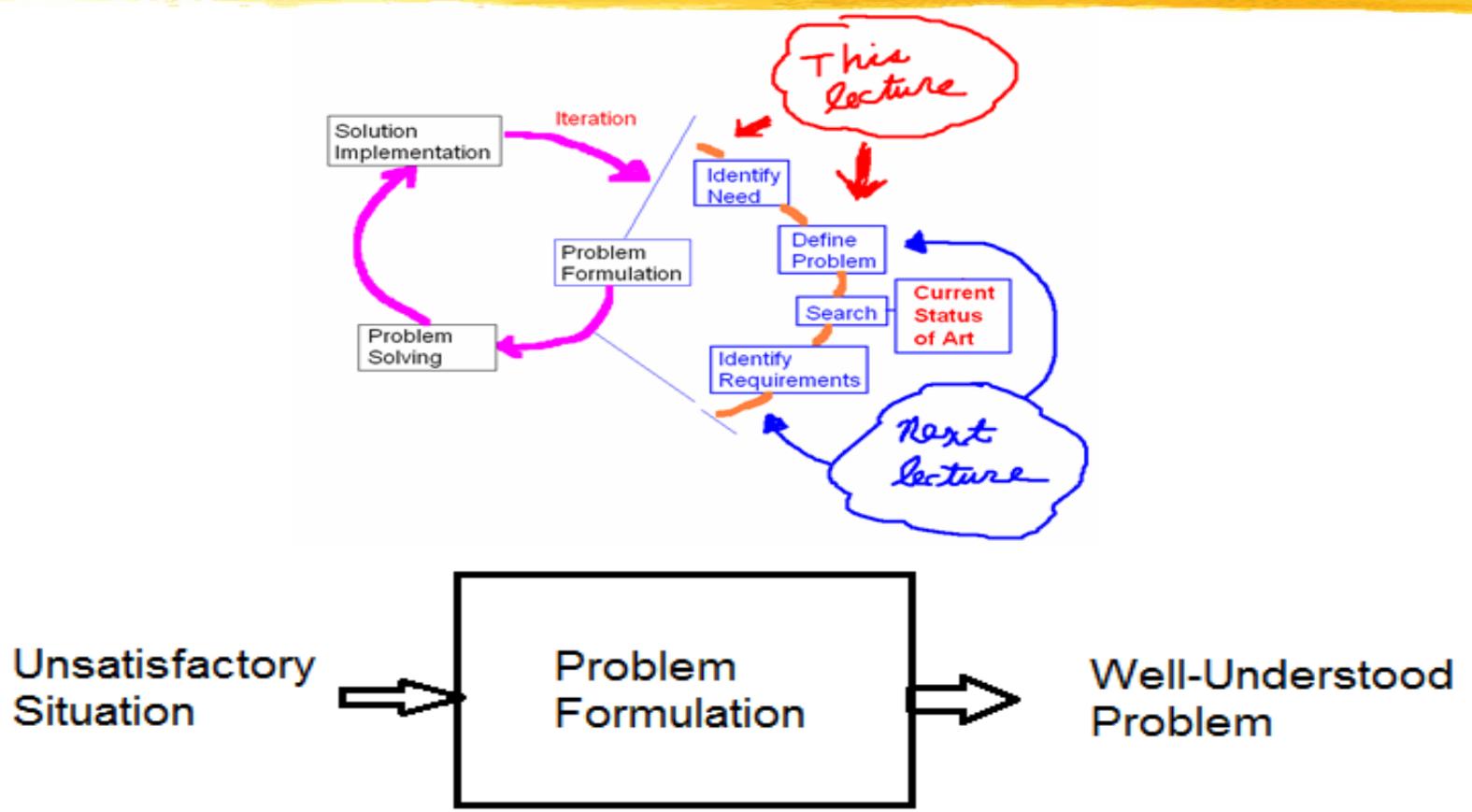


Timeline and Milestones

⌘ Understanding Design Processes: August - September



Problem Formulation



Problem Formulation: What is this ?

⌘ “The process of converting a dissatisfied situation into a ()”

⊞ Understanding the problem (“Needs”), Not finding solution (“Approach”) 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*”

⊞ Why do we do this?

⊞ **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
- ☒ Ask your project advisor what he/she **needs** for the team
- ☒ Ask what **specific problem** you're asked to solve
- ☒ Don't consider Solution yet --- this will limit your solution ideas !!!

⌘ No Rush to get a solution (“Approach”) 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

Checkout Line Complaints: Problem Identification



Situation: Customer Complaint: Cashiers talk each other while serving customer.

Store Manager's Response:

The Blind Men and the Elephant

- ⌘ Pillar? Rope? Tree branch? Hand fan? Wall? Pipe?
- ⌘ Lesson
 - ☑ Parts vs. Whole
 - ☑ Symptoms vs. Root Cause
 - ☑ Project Title (long-term goal) vs. Required Elements (academic year goal) for the entire system



Process of Defining Problem

⌘ Process of Defining Problem

- ☒ Outline why the present situation is so dissatisfying
- ☒ Comparing it to other situations that are familiar or where experience already exists
- ☒ Gaining and understanding what caused it.
- ☒ Then concisely describe the complete set of customer needs

⌘ And make your problem statement (Need)

- ☒ **Specific, Quantitative, and Illustrative**

Problem Formulation in the Context of Value Proposition

⌘ “Value Proposition”

- ☒ Why I am the best person for the position/project
- ☒ Why my proposal solves your problem best

⌘ Contents: “N-A-B”

- ☒ Customer’s Need
- ☒ My Approach
- ☒ Benefits to the Customer
- ☒ *Source: “Practice of Innovation” by C. R. Carlson

Example of Value Proposition - 1

- ⌘ It is the value proposition presented to a cable company executive for a video-on-demand system.
- ⌘ “I understand that you are looking to expand your business. I think we might be able to help.
- ⌘ **(Need)** **(Problem)**
 - ⊞ Movie rentals represent a \$5 billion business opportunity that you currently cannot access.
 - ⊞ The only parts of rentals that people really dislike are the obligation to return the tapes plus the late fees.
 - ⊞ Customers find that it is inconvenient and wastes time.
 - ⊞ *Source: “Practice of Innovation” by C. R. Carlson

Example of Value Proposition - 2

⌘ Hands-Free Car Phone

☞ *Source: "Practice of Innovation" by C. R. Carlson



NEED

- Cell phones are difficult and dangerous to use when you are driving.
- There are more than 500 million cell phones in use around the world.
- Because of the driving risks, many U.S. states and other foreign governments are legislating against the use of cell phones by drivers of moving cars, which would limit cell phone usage in cars.
- Consumers want to continue to be able to use their phones while driving.

Problem Definition Exercise 1

⌘ **Your customer**

☑ **Crowded dorm room**



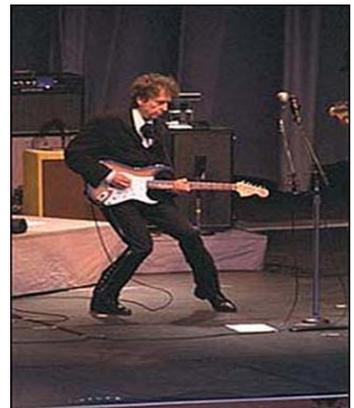
⌘ **Team Exercise:**

☑ **Write a Need Statement following the Value Proposition Examples**

☑ **Submission required**

Problem Formulation Exercise - 2

- ⌘ You (and your company) propose to Jimmy Hendrix and Eric Clapton a wireless guitar amp.
- ⌘ Exercise Focus: You write a need statement for them so that they either buy one or invest to your company.
 - ☑ Draw insight from previous experiences (in other industries or situations) to understand the need
 - ☑ Focus on customers' needs; NOT your own needs
 - ☑ **Do not provide “Approach”**
 - ☑ Follow the Value Proposition Approach
 - ☑ Then, write a concise **problem statement**, covering the complete set of the customer needs
 - ☑ **Specific, Quantitative, and Illustrative**
- ⌘ Submission required



Weekly Meeting Agenda: What is your team's Problem?

Team Activity Assignment

- ⌘ Discuss this problem in your team's next weekly meeting
 - ⌘ Complete the activity for **identifying the problem**
 - ⌘ Submit the Problem Statement which includes all 6 items listed below
- 1. Team Name/Team Project Title:**
 - 2. Team Members:**
 - 3. Team Members of Senior Design Class:**
 - 4. Project's Long-Term Goal:**
 - 5. Project's 2018-2019 Academic Year Goal:**
 - 6. Problem statement**
 - a. Dissatisfied situations – list them all
 - b. Describe the Needs specifically and quantitatively
 - c. Final summary for a concise problem/need statement

Problem Statement Form

⌘ Fillable Form



www.mwftr.com/SD1819.html

Lecture 3: Design Process

- A. Problem Formulation (In-Class Team Assignment) [Problem Statement Form](#) (PDF-Fillable)
- B. Standard and Regulation (HW1 embedded)
- C. Intellectual Property and Contemporary Issues (HW2 embedded)

Problem Statement Form

for VIP and Design Class

Date: _____

Team Name		
Team Project Title		
Team Advisor		
Team Assistant		
Team Members	Senior Design Class Students	
	Other Students	