

# **Objective details**



# Requirements definition

- ✿ Define requirements and features of your project
  - ✿ Find the needs of our society: what customers need
  - ✿ Find the features that you can deliver: deliverables
    - ✱ Test before you make yourself look bad (if you fail to deliver)
  - ✿ Find the constraints that limit your features
  - ✿ Find available standards from IEEE, RFCs, and US government
  - ✿ Find alternatives of your features if the primary features fail
- ✿ Design process
  - ✿ What tools are needed
  - ✿ What are the constraints of available tools
  - ✿ What are feasible features
    - ✱ It is necessary to go back to redefine requirements when dead end is reached
  - ✿ It may need a few iterations before the final design is achieved
- ✿ First iPod story between Steve and his team

# What is “Design”?

## ✿ International Technology Education Association:

*"The systematic and creative application of scientific and mathematical principles to practical ends such as the design, manufacture, and operation of efficient and economical structures, machines, processes, and systems."*

## ✿ Accreditation Board for Engineering & Technology:

*"Students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating engineering standards and multiple realistic constraints"*

# Design Constraints

- Multiple constraints usually apply
- Constraints can be conflicting
- Tradeoffs often needed to satisfy constraints

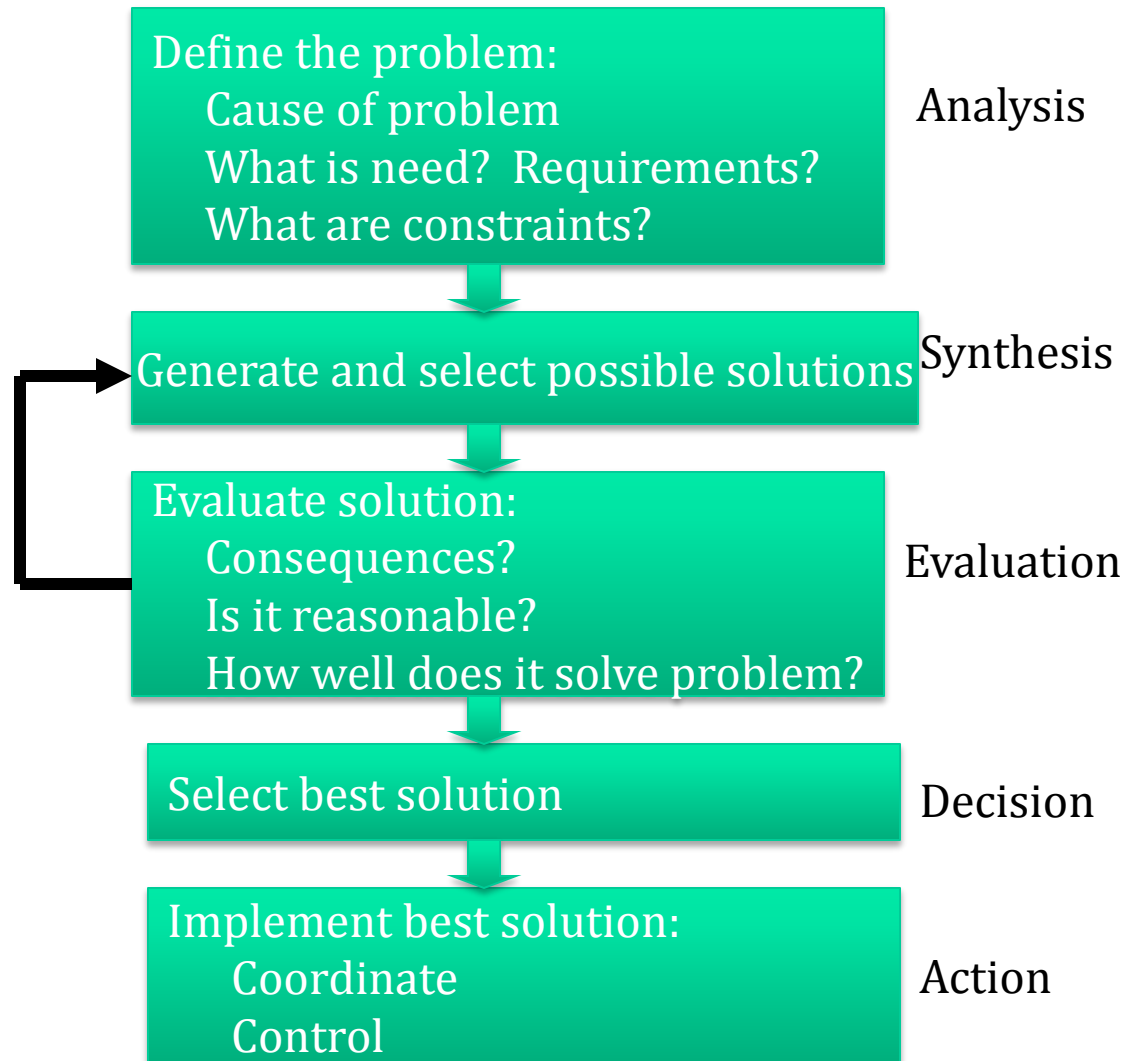
Examples:

- Performance
- Physical
- Economic
- Energy
- Environmental
- Social
- Time to market

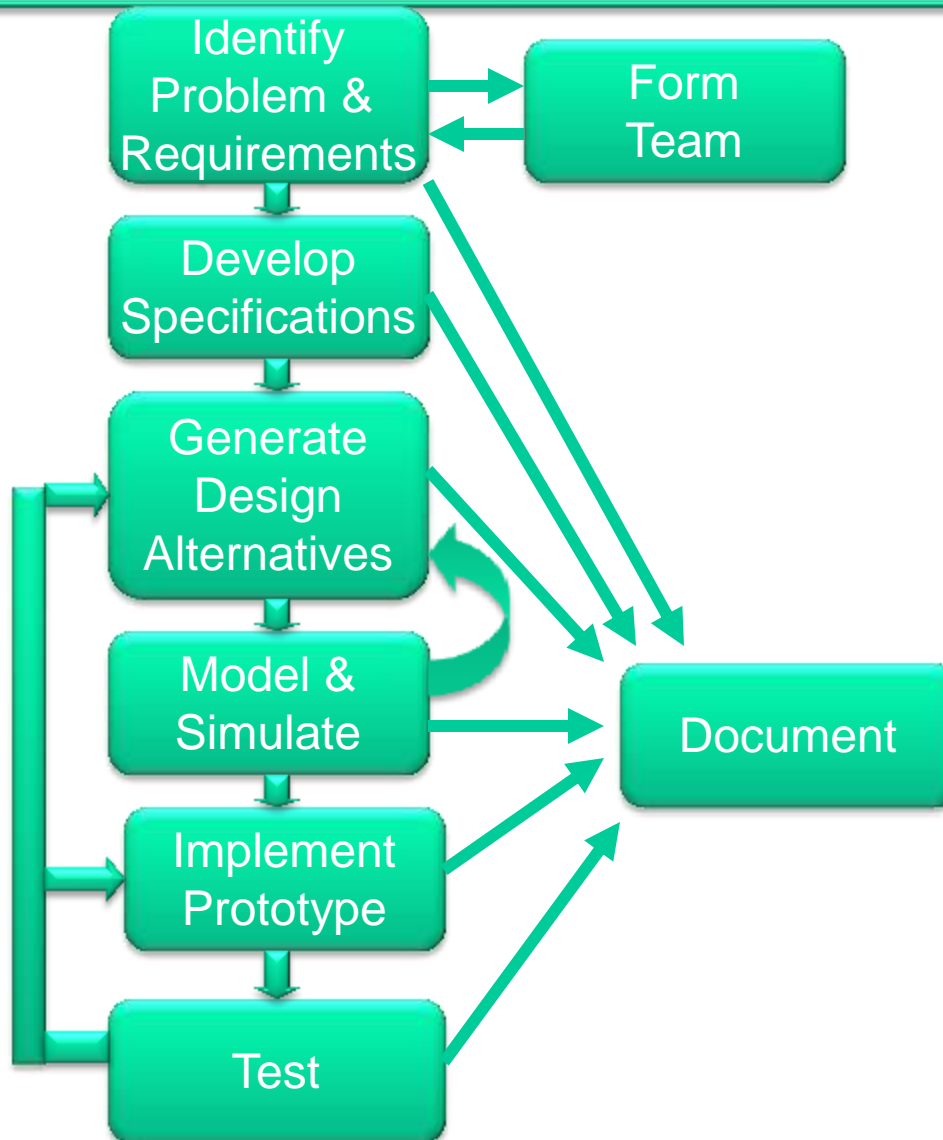
- Ethical
- Health and safety
- Political
- Reliability
- Sustainability
- Adherence to standards:  
RFC, IEEE
- Feasibility

# General Problem Solving Steps

*Engineering Design, Alan Wilcox – Figure 1.3*

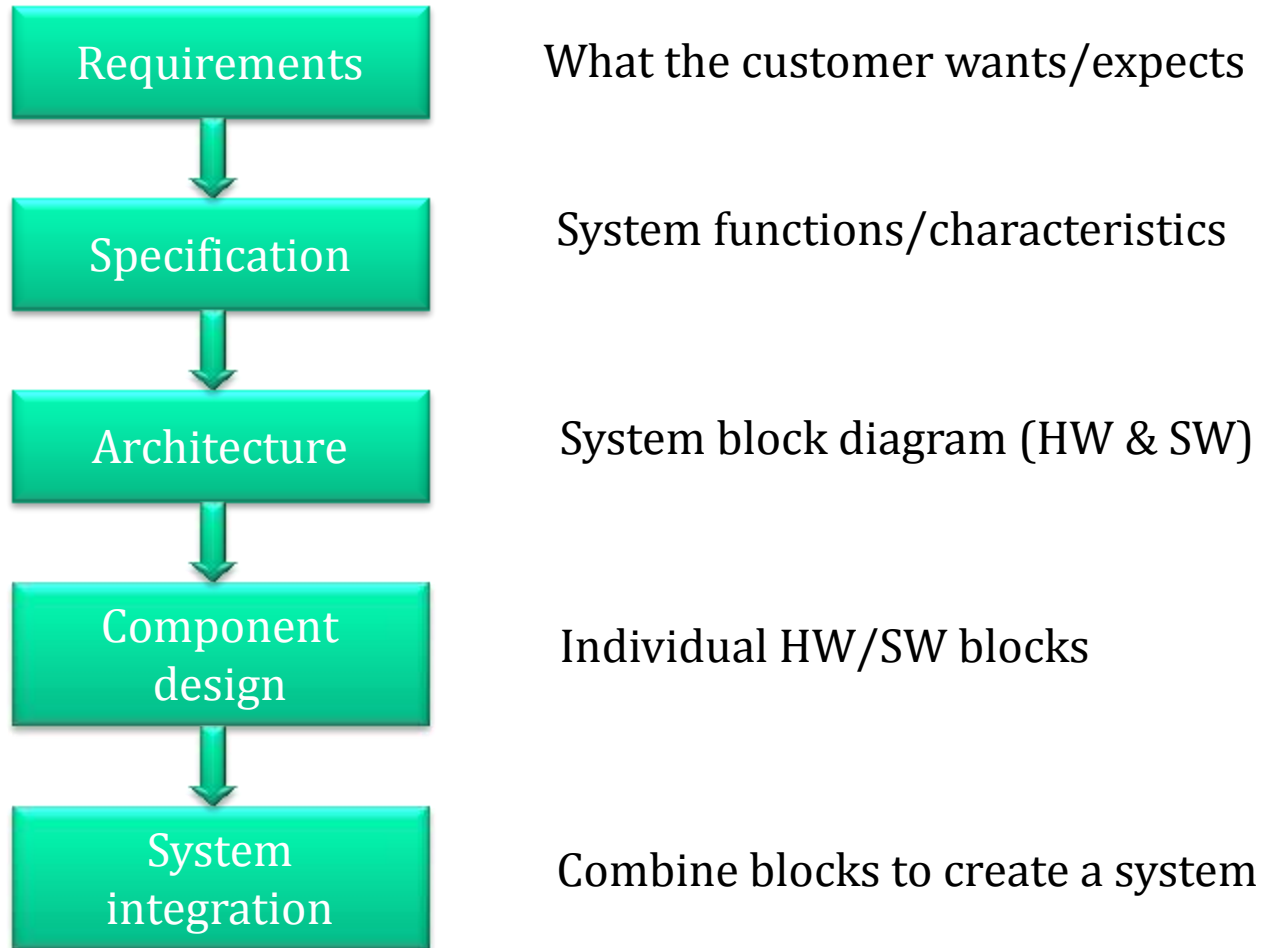


# The Engineering Design Process



*Practical Engineering Design*  
Bystrom & Eisenstein – Figure 1.1

# Levels of abstraction



# Requirements (“User Stories”)

- \* Plain language description of what the user wants and expects to get.
  - \* “features” of the design
- \* May be developed in several ways:
  - \* talking directly to customers;
  - \* talking to marketing representatives;
  - \* providing prototypes to users for comment.
- \* Software tools may be used to organize
  - \* Example: UML “use-case” diagrams
  - \* Want requirements to be complete & consistent



# Functional vs. non-functional requirements

- Functional requirements:
  - output as a function of input
  - Capability
  - User friendly
- Non-functional requirements:
  - latency: time required to compute output;
  - bandwidth: #operations per unit time
  - size, weight, etc.;
  - power consumption;
  - reliability;
  - etc.

# Features merging

- ✿ After 1<sup>st</sup> report, teams will be formed by the features proposed
- ✿ Leaders and I will organize teams based on proposed features

# Report

- \* Document the iterative process of requirements and design process
- \* Talk with other teams from information sharing in order to have corporation and sharing of requirements and tools
  - \* A natural team work for sharing discovery and tools is crucial
  - \* A team evaluation from your teammates will be part of the grade
    - \* Each report will be evaluated by me and your teammates
- \* The evolution is important to capture using logs
- \* Convert logs to minutes and reports

# The Senior Design Process

- ✿ Each cycle is to identify deliverable features and move a step closer to final product

Weeks 1-4

Weeks 5-7

Weeks 8-10

Weeks 12-14

## Week 4, 7, 8 and 14 Deliverables

- ✓ User Stories
- ✓ Cycle Intent
- ✓ Status Report
- ✓ Management Plan

## Week 16 Deliverables

- ✓ Product Presentation
- ✓ Product Demonstration
- ✓ Software and document
- ✓ Peer Evaluations
- ✓ Final report
- ✓ Class final report

# Grading Criteria

- \* Rubric Problems
- \* Rubric Design
- \* Rubric Indentify\_Formulate
- \* Rubric Tools
- \* Rubric Writing
- \* Lifelong Learning Evaluation
  - \* Weekly update of logs in shared site
- \* Rubric Teamwork
- \* status-report-template-S2010 (attach to every report)

		Rubric			
		1 – Unsatisfactory	2 – Developing	3 – Meets expectations	4 – Exceeds expectations
Performance Indicators	Understand system or component designed needs/requirements	Can't understand the system or component desired needs.	Only sometimes can understand the system or component desired needs, or does so partially.	Most of the time can understand the system or component desired needs.	Can fully understand the system or component desired needs and verify consistency in these desired needs.
	Use knowledge, methods, processes and tools to create a design	Can't combine and integrate knowledge, methods, processes and tools to create a design.	Can partially combine and integrate knowledge, methods, processes and tools to create a design.	Can fully combine and integrate knowledge, methods, processes and tools to create a design.	Can fully combine and integrate knowledge, devise new or alternate methods, processes and tools to create a design.
	Evaluate if a design complies with desired needs	Does not verify design against desired needs or design does not respond to desired needs.	Partially verifies design against desired needs or design partially complies with desired needs.	Design is verified against desired needs and complies with most desired needs.	Design fully complies with desired needs or even exceeds the expressed needs.
	Consider realistic constraints in the design	Does not consider constraints of any kind.	Considers some constraints, but does not deal with realistic constraints, or does so weakly.	Considers at least one realistic constraint, and deals with it appropriately.	Considers more than one realistic constraint, and deals with them effectively.
	Considers applicable standards in the design	Does not consider applicable standards in the design.	Shows little evidence of a poor consideration of standards in the design.	Appropriately considers standards in the design.	Considers and applies standards in an excellent way in the design.
	Creativity in solving design problems	Displays no design creativity.	Needs assistance to develop novel design ideas.	Develops some novel design ideas without assistance.	Develops exceptional design ideas without assistance.
	Testing of the final design	Conducts no meaningful tests of the design	Conducts some appropriate tests, but only partial or incomplete.	Conducts reasonable testing of the design.	Develops innovative and complete tests of the design.
	Constructing a prototype of the design	Is unable to construct a reasonable prototype of a design.	Is able to construct partial prototypes of a design, but not an entire system.	Is able to construct a complete working prototype of a design.	Is able to construct a complete working prototype that demonstrates exceptional quality

		Rubric			
		1 – Unsatisfactory	2 – Developing	3 – Meets expectations	4 – Exceeds expectations
Performance Indicators	Recall and state relevant knowledge/ principle	Cannot recall or write down the relevant mathematical, scientific or engineering principle.	Can recall, state or write down mathematical, scientific, or engineering principles.	Can identify the meaning of each element in a mathematical, scientific or engineering principle.	Can state the limitations and constraints implicit in a mathematical, scientific or engineering principle.
	Understand the problem	Shows complete lack of understanding the problem	Shows incomplete understanding of the problem.	Shows basic understanding of the problem.	Shows complete understanding of the problem.
	Approach/ Select knowledge relevant to the problem	Completely wrong approach or formula chosen	A poor approach is chosen that may yield the correct answer	An adequate approach is taken	Most appropriate formula or approach is chosen for solution
	Execution/ Apply the selected knowledge to solve the problem	Unable to implement the solution approach; several math errors	mathematical errors prevent successful solution	A single mathematical error prevents successful solution	Properly implements the approach with no errors in calculation
			Solution or answer is not properly presented	Solution or answer is properly presented	Solution or answer is properly presented
	Vectors (course-specific)	Does not indicate vectors Does not properly apply vectors	Inconsistent use of vectors	Vectors are almost always properly indicated	Vectors are always properly indicated

		Rubric			
		1 – Unsatisfactory	2 – Developing	3 – Meets expectations	4 – Exceeds expectations
Performance Indicators	Research and gather information	Does not collect any information that relates to the topic.	Collects very little information – some relates to the topic.	Collects some basic information – most relates to the topic.	Collects a great deal of information – all relates to the topic.
	Fulfill team role’s duties	Does not perform any duties of assigned team role.	Performs very little duties of assigned team role.	Performs nearly all duties of assigned team role.	Performs all duties of assigned team role.
	Share in the work of the team	Always relies on others to do the work.	Rarely does the assigned work – often needs reminding.	Usually does the assigned work – rarely needs reminding.	Always does the assigned with without having to be reminded.
	Listen to other teammates	Is always talking – never allows anyone else to speak.	Usually does most of the talking – rarely allows others to speak.	Listens, but sometimes talks too much.	Listens and speaks a fair amount.
	Cooperative with teammates	Usually argues with teammates	Sometimes argues	Rarely argues	Never argues with teammates.
	Make fair decisions	Usually wants to have things their own way.	Often sides with friends instead of considering all views.	Usually considers all views.	Always helps team to reach a fair decision.
	Receptive to feedback from team members from other disciplines or backgrounds	Doesn’t accept feedback and/or positive criticism.	Sometimes doesn’t accept feedback from other team members.	Most of the time accepts positive comments from other team members.	Shows receptive to feedback from other team members and uses it to improve the quality of the work performed.
	Express alternate points of view, based on a multidisciplinary perspective	Never expresses alternative points of view.	Sometimes expresses alternative points of view.	Usually expresses alternative points of view.	Has no problem expressing alternative points of view wherever there is an opportunity for it.



		Rubric			
		1 – Unsatisfactory	2 – Developing	3 – Meets expectations	4 – Exceeds expectations
Performance Indicators	Content	Inconsistent or few details that may interfere with the meaning of the text.	Some details, but may include extraneous or loosely related material.	Provides adequate supporting detail to support solution/argument.	Provides ample supporting detail to support solution/argument.
	Organization	Little evidence of organization or any sense of wholeness and completeness.	Little completeness and wholeness, though organization is attempted.	Organizational pattern is logical and conveys completeness and wholeness with few lapses.	Organizational pattern is logical and conveys completeness and wholeness.
	Style	Limited or inappropriate vocabulary for the intended audience and purpose.	Limited and predictable vocabulary, perhaps not appropriate for intended audience and purpose.	Uses effective language and appropriate word choices for intended audience and purpose.	Uses effective language; makes engaging, appropriate word choices for audience and purpose.
	Grammar	Does not follow rules of standard English.	Generally does not follow the rules for standard English.	Generally follows the rules for standard English	Consistently follows the rules of standard English.
	Figures/Tables	Figures and tables do not support the text, or are poorly designed.	Figures and tables sometimes support the text, and sometimes well designed.	Figures and tables generally support the text, and are usually well designed.	Figures and tables always support the text, and are well designed.
	Use of sources	Sources consistently not cited for material used in the report.	Sources not cited for some material used in the report, or inappropriate sources cited.	Sources cited for material used in the report. Most of the sources are appropriate to support the discussion.	Sources cited for material used in the report. All sources support the discussion.

# Q&A