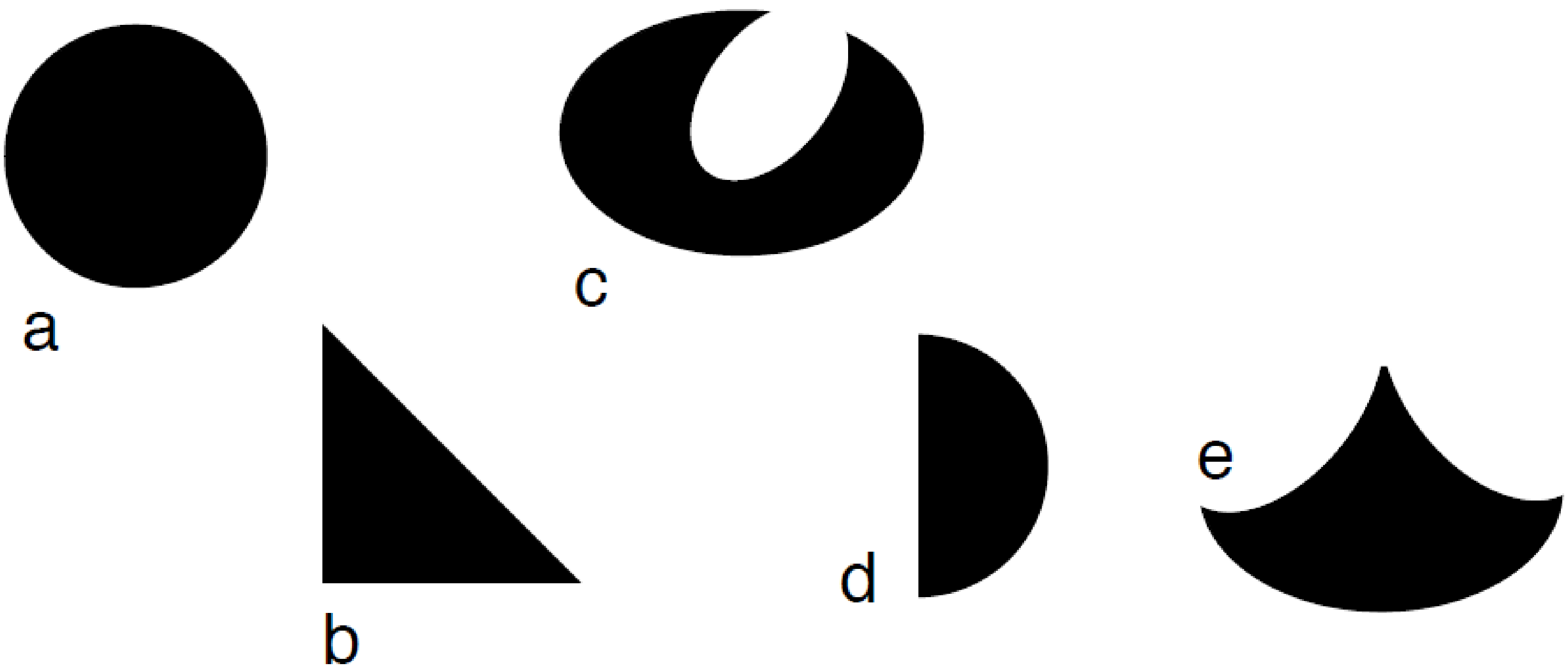
ME 481 Fall 2023

Introduction & Design Process Safety Protocols

Dr. A. Zachary Trimble
Dr. Mehrdad Ghasemi Nejhad (Presenter)
Dr. Trevor Sorensen

Mini Quiz

- Which object is different from all the others?



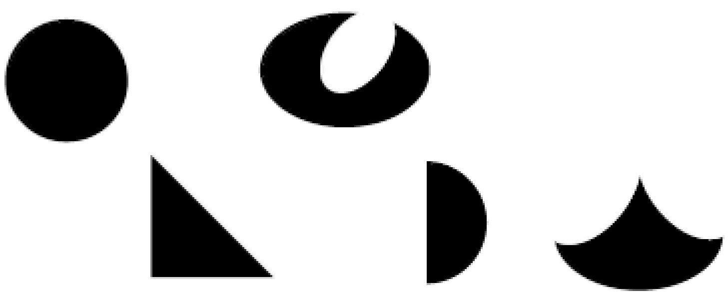
1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Mini Quiz

b

Congratulations!

The only one with all straight lines



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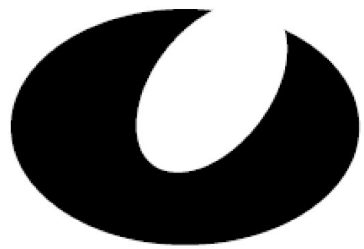
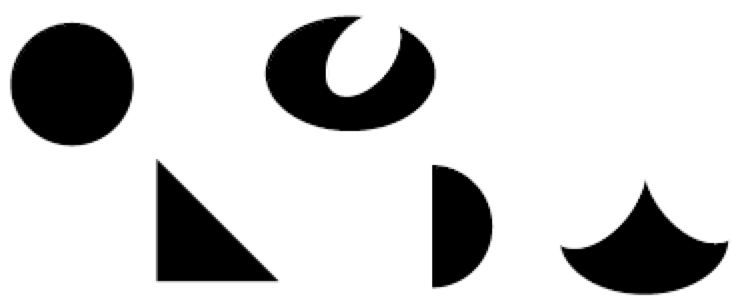
Mini Quiz



c

Congratulations!

The only one with Internal Cut



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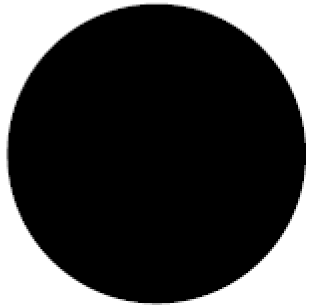
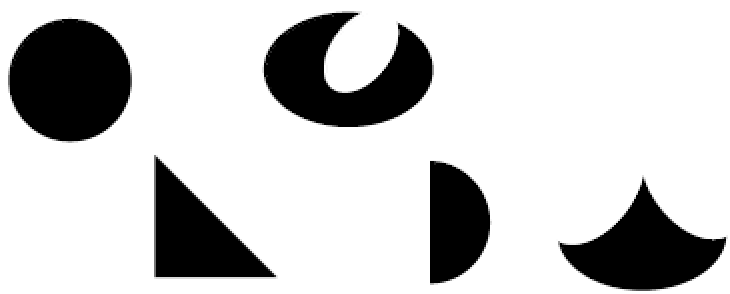
Mini Quiz



a

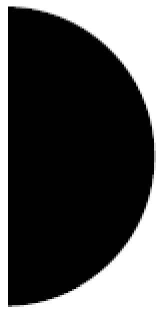
Congratulations!

The only one with no points



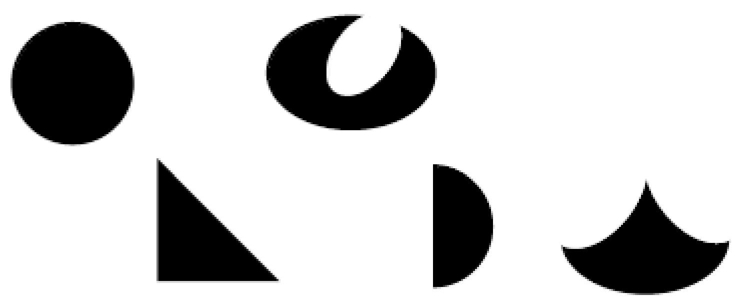
1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Mini Quiz

d


Congratulations!

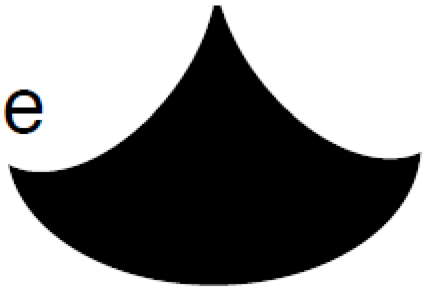
The only one made with line and arc



1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

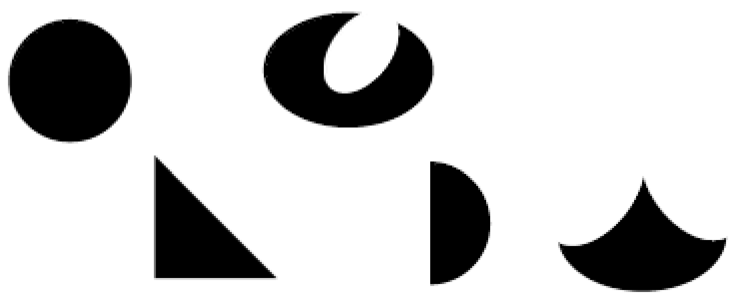
Mini Quiz

e



Congratulations!

The only one that is the projection of a triangle onto a curved surface



1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Mini Quiz

- There are many right answers

1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Mini Quiz

- There are many right answers

… and even more wrong answers

1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Outline

- Introduction
- Course Mechanics
- Conclusion
- Projects

Introduction

What is Design?

"…to create, fashion, execute, or construct according to plan"

Merriam-Webster

Design – Potential Definition 1

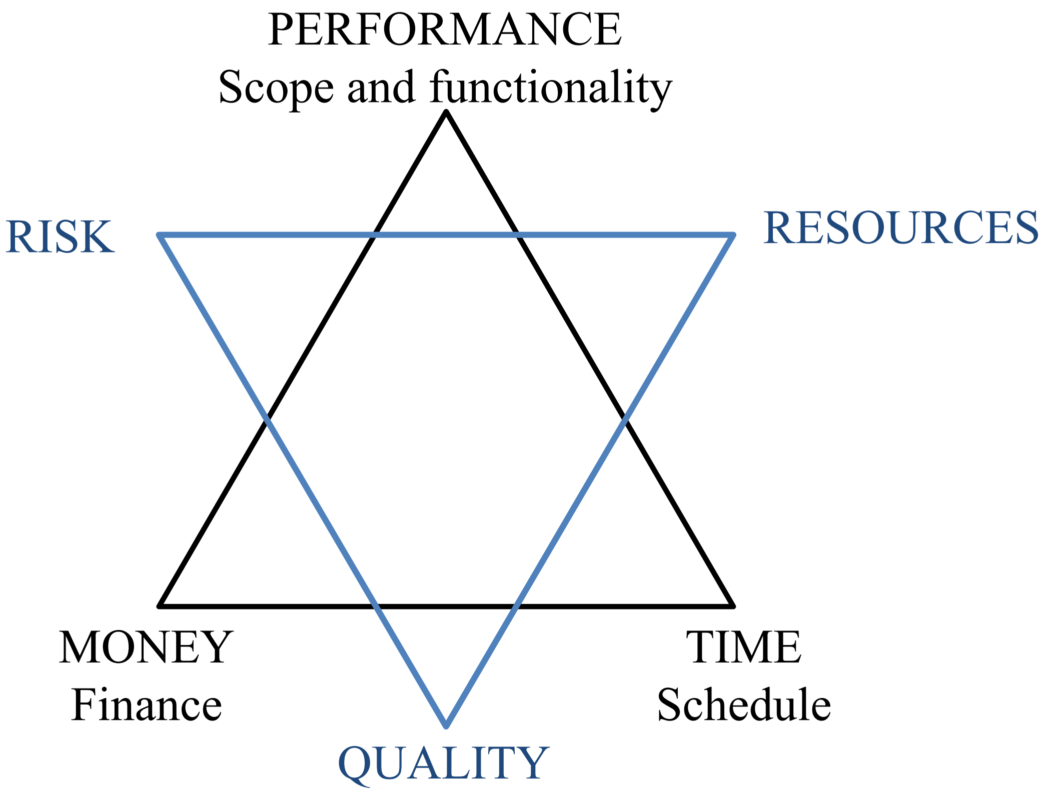
- Find a "cost effective" solution that lies amongst the RIGHT answers.
  - Creativity to generate solutions
    - Inherent understanding of physics of problem
  - Ability to *see* many unique viewpoints
    - Lateral thinking
  - Capability to understand/analyze/model/test viewpoints
    - Majority of your formal education up to this point
    - Engineer can do with $1 what a "maker" can do with $10.

1. Wallace, David (2013) 2.009 Product Engineering Processes, MIT

Design – Potential Definition 2

- Most design problems don’t have unique solutions.
- Creating new devices or improving exiting devices in an attempt to provide the “best,” or “optimum” design consistent with the constraints of time, money, risk, safety, ethics, environmental considerations, etc. as dictated by the application and the marketplace.
  – Ulrich, Eppinger

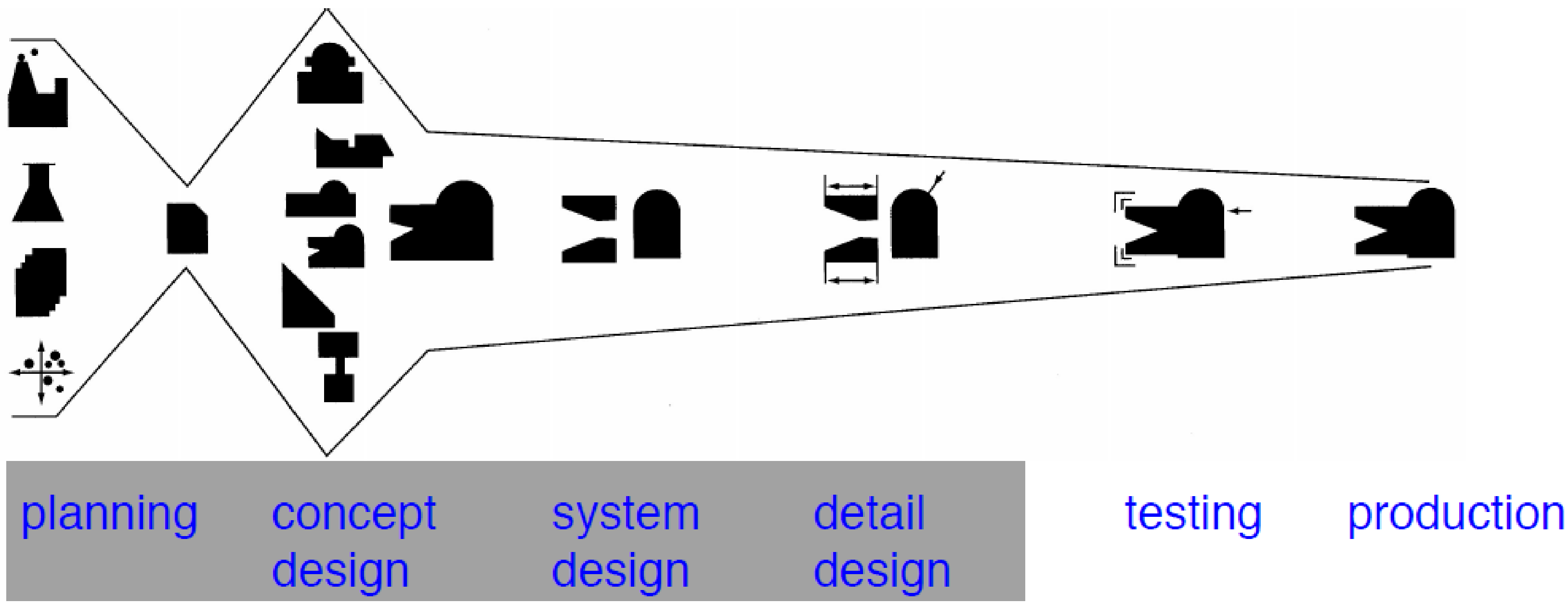
The Iron Triangle



Design Process Structures

- A collection of strategies to help ensure that you have a high likelihood of being successful.

ON TIME, every time.



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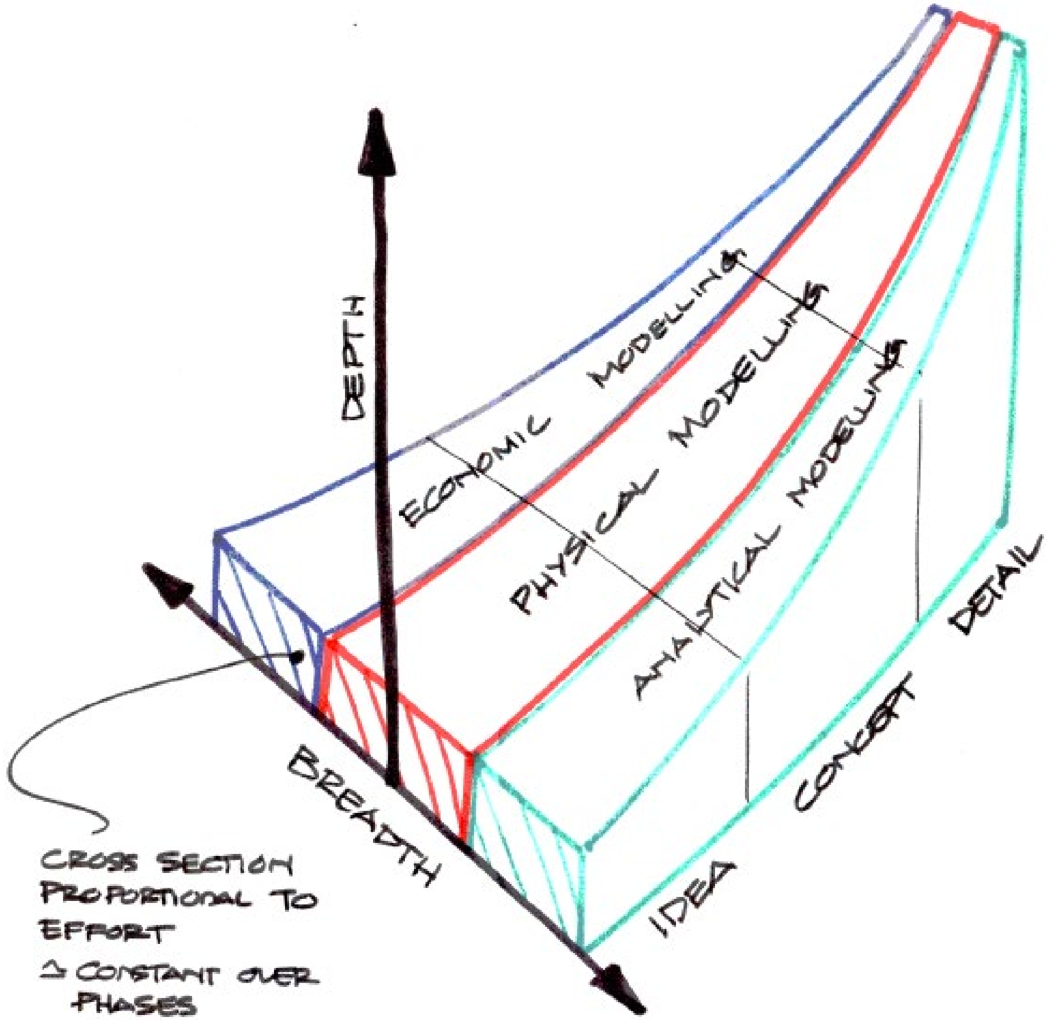
Design Process Structures



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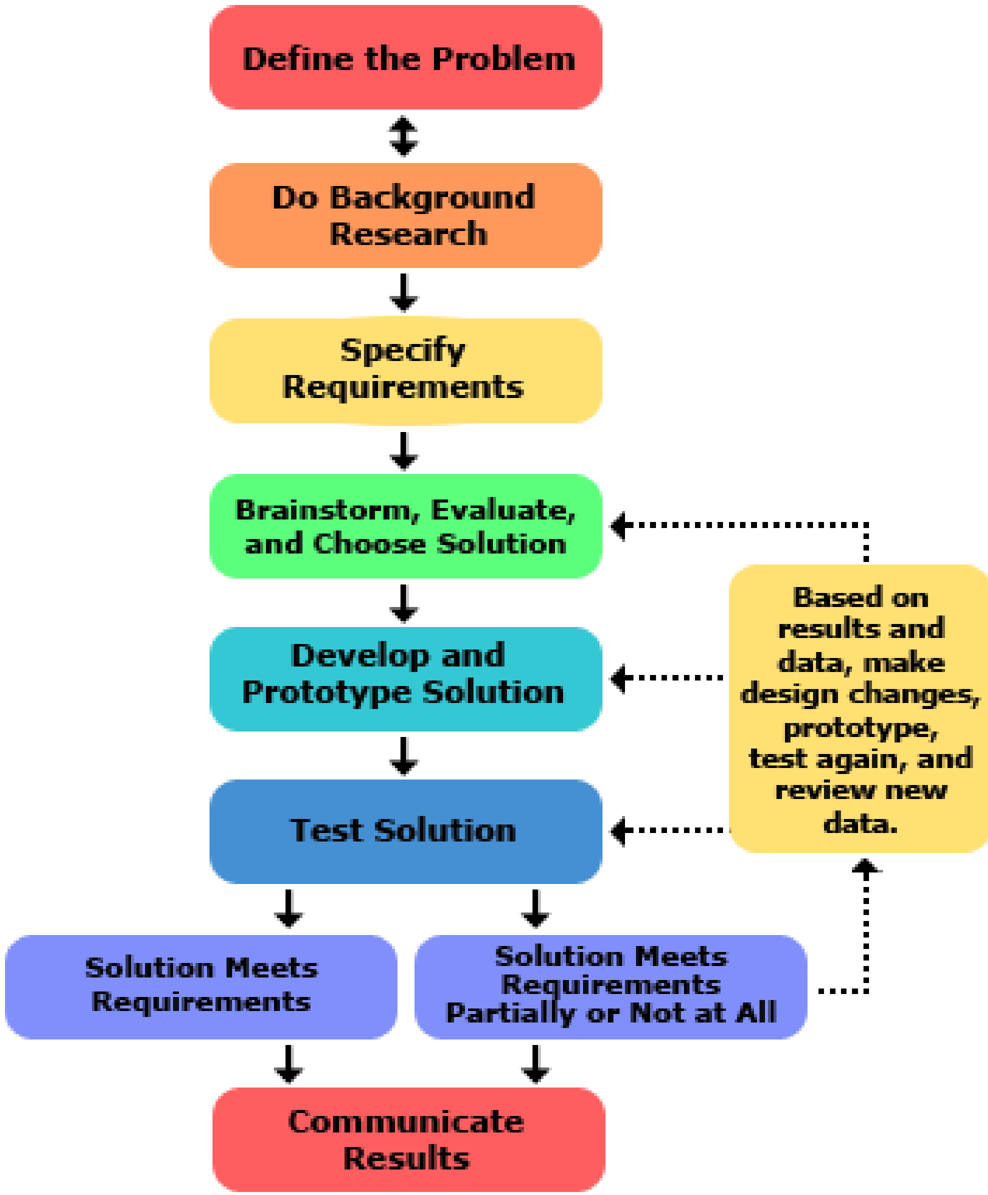
Design Process

- **Design:** Designs establishes and defines solutions to and pertinent structures for problems not solved before, or new solution to problems which have previously been solved in a different way, to satisfy a recognized need of society.
- Is Design a Discovery ?
- Is Design and Invention
- Good Design Process: Analysis + Synthesis
- **Designing a System:**
- System ----→ Subsystem ----→ Components ----→ Parts
- Automobile----→ Engine----→ Pistons Assembly ----→ Piston, Rings, Pins, etc.

Design Process Structures



https://www.sciencebuddies.org/Files/5083/9/2013-updated_engineering-method-steps_v6b.png

Brainstorming (Rules)

- **I. RULES OF BRAINSTORMING:**
- **a) Criticism is ruled out**
- **b) The wilder the idea, the better the outcome**
- **c) Quantity is needed**
- **d) Participants should seek ways to improve the proposed ideas**

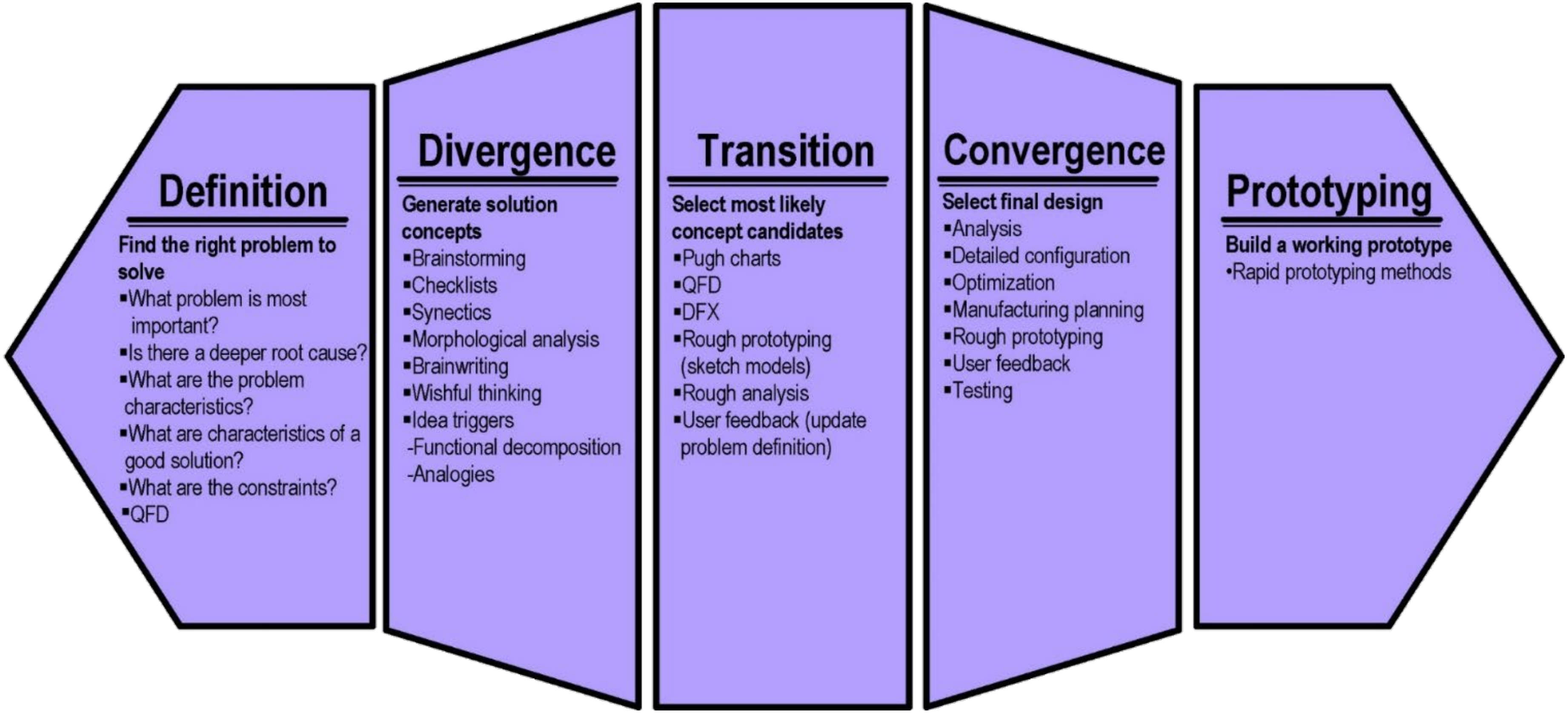
Brainstorming (Organization)

- **II. ORGANIZATION OF A BRAINSTORMING SESSION:**
- **a) A one-page outline of information about the session should be given to panel members a few days before the session**
- **b) The problem to be brainstormed should be defined**
- **c) A moderator (not a leader) should be selected to be in charge of the session**
- **d) The moderator should not permit long responses that would slow down the flow of ideas**
- **e) Each team member should generate at least three ideas**
- **f) A recorder should produce the list of ideas gathered during the session for distribution among the participants**

Brainstorming (Best Ideas)

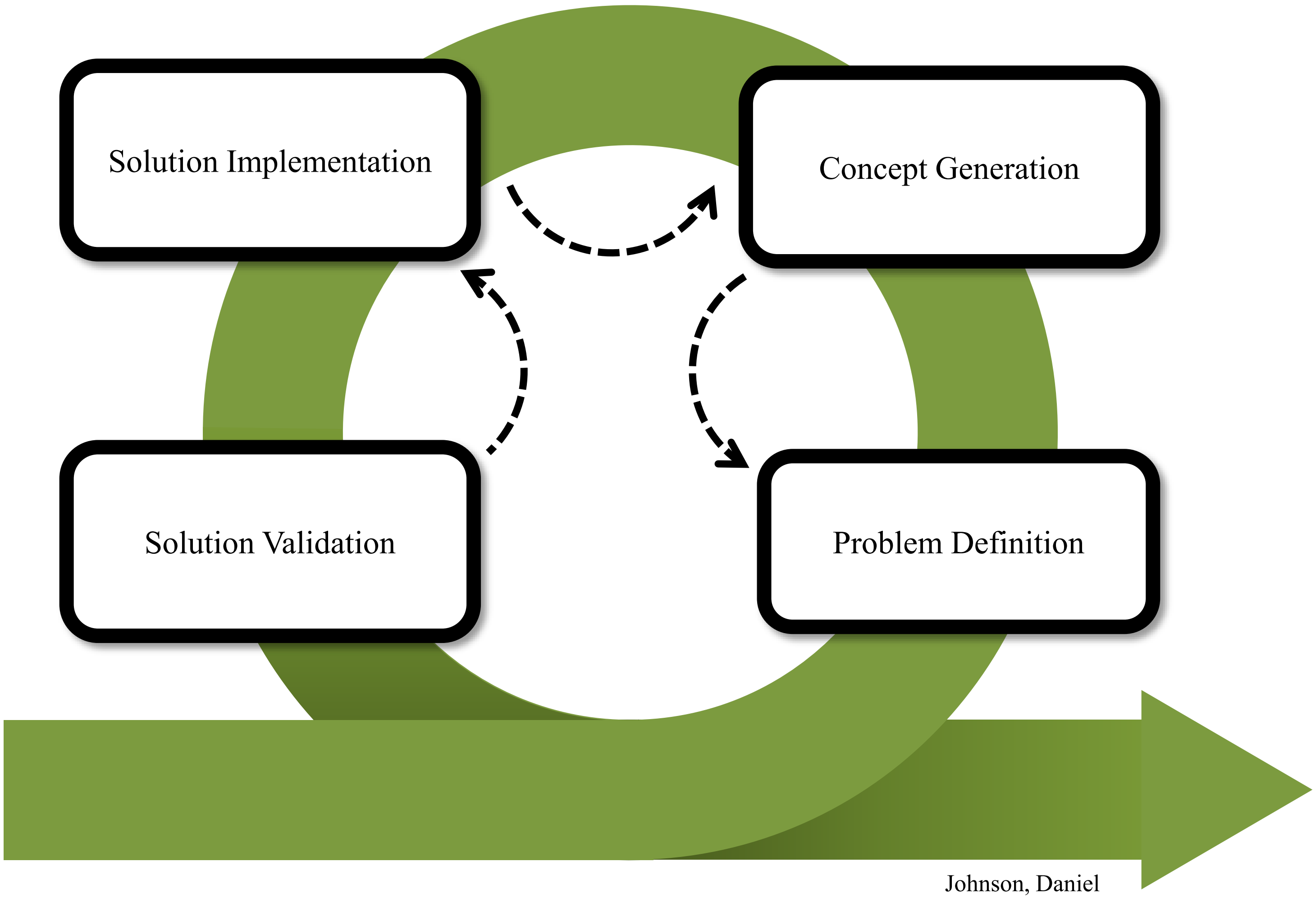
- **SELECT BEST IDEAS FROM THE IDEAS GENERATED DURING THE BRAINSTORMING SESSION. USE THE SELECTED IDEAS OR THE MODIFICATION AND/OR COMBINATION OF THE IDEAS**

Design Process Structures



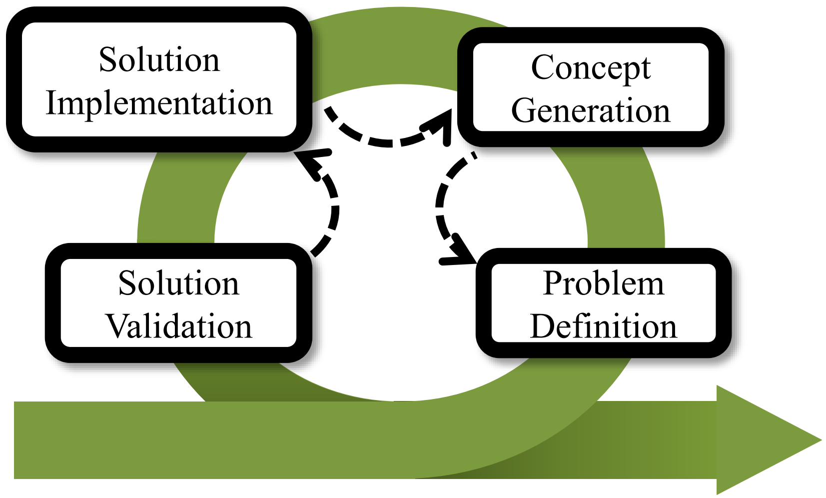
Johnson, Daniel

Fundamental “Design Process Unit”



Johnson, Daniel

Design Process Structures

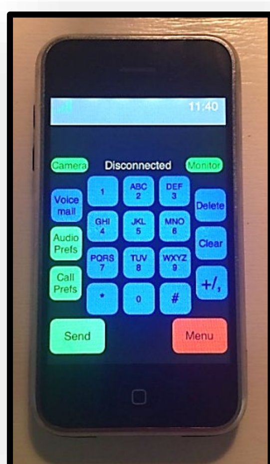


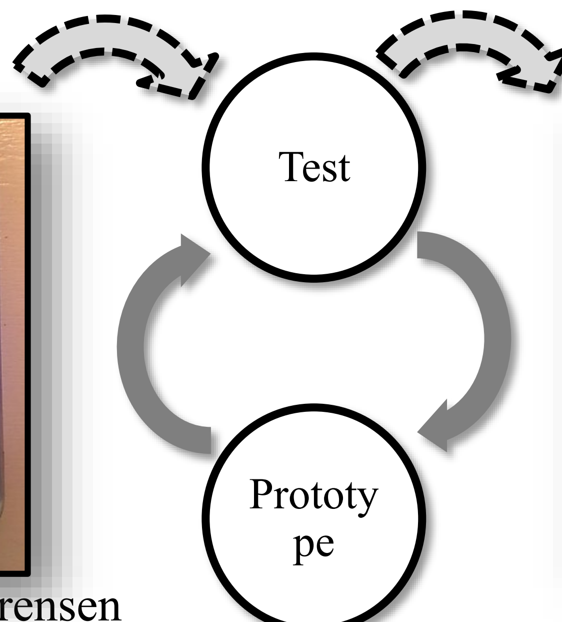
Classical Complex Product Design

Agile Product Design

1.4 Agile Product Design

- Problem definition evolves during the project
- Appropriate for multiple types of projects:
  - Disruptive technologies needing adequate product/market fit
  - Discovery-driven research projects that can't foresee where data will lead
  - Optimization projects that rely on intensive analytics
- Delivers quickest initial product release
- Requires small, close-knit, co-located team
- In practice, often delivers inferior documentation and testing than other methods



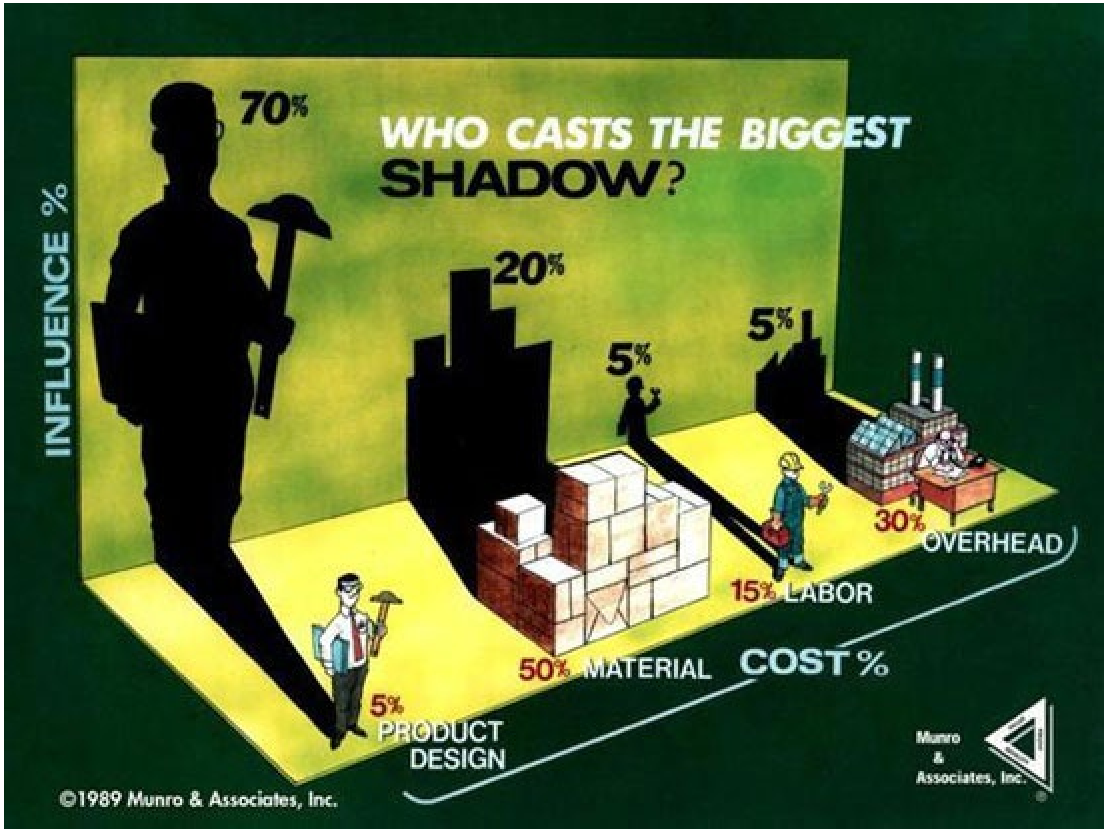


Classical Complex Product Design

- Problem definition does not change (typically)
- Commonly utilized for
  - Mission-critical system development
  - Products requiring significant **integration of subsystems**
  - External vendor component development
- Allows for more precise prediction of time and cost
- Can support **large teams** of designers
- Results in more detailed documentation
- Typically found in hardware-centric systems with many mechanical components (*e.g.*, spacecraft, automobiles)
- Also used in heavily regulated, critical software (*e.g.*, medical devices)

https://upload.wikimedia.org/wikipedia/commons/thumb/b/bc/COTS2Dragon.6.jpg/375px-COTS2Dragon.6.jpg

Development Costs



https://www.apriori.com/wp-content/uploads/2016/09/Who-Cast-The-Biggest-Shadow.jpg

Course Mechanics

- Safety
- Lab Access
- Expectations
- Syllabus & Calendar

Safety

- Safety culture
  - Nothing we do here is worth getting hurt over.
  - According to OSHA[1] the #1 workplace injury is "strains"
    - i.e. little stuff that people just don't even think will get them hurt (3Ts: tired, time, tight).
  - Safety policy isn't to encourage sneaking or hiding violations or to deter the reporting of incidents – incidents aren't necessarily violations.
    - Report stuff immediately (close the feedback loop) if there is a problem we want to get if fixed. Make sure everyone knows why it happened so it never happens again.
- Lab specific training
  - Anywhere you work make sure you have been trained about the specific hazards of that lab and the safety procedures.
    - Including location of first aid kits, eyewash stations, etc.
- Safety PPEs: **The PPEs are personal and each student should have his/her own**)
  - If you do not have your PPEs then don't go into the lab until you get them.

1. https://www.osha.gov/oshstats/commonstats.html

<u>**PPE:**</u>

Personal Protection Equipment

- **Masks**
- **Goggles**
- **Gloves**
- **Long-Sleeve Shirts**
- **Long Pants**
- **Covered Shoes**

Lab Access and Usage Policy

- ❑ Lab Access – All items must be renewed every *Academic Year*
  1. Read Safety Manual
     - Posted to website
  2. Online Quiz
     - Link on the website
  3. Safety Briefing
     - **September 13/Weak of October 2, 2023 (Mr. Lewis Moore: ME Tech) – do not miss or be late**

- ❑ Equipment Usage
  - Training Modules: *Online course, Online quiz, Hands-on check-off*

    1. ***Red***: Hand tools, Drill press, Band Saw, Grinders
    2. *Yellow*: Mill, Lathe, Welders
    3. ***Green***: Train other students, Work on Personal Projects
    4. ***Specialty***: E.g., Epoxy/Composites, High Risk Electrical

Safety Enforcement Policy

- Violation of any of the safety policies results in your lab privileges and access being revoked until you can complete a safety assessment and refresher with Mr. Moore.
  - I.e. I'm done telling people to put safety glasses, masks, and gloves on. If you're in the lab without PPE that is a violation.
- Mr. Moore will complete safety assessments and refreshers as necessary at most once per week (<u>most likely Sept/Oct 2023</u>).
- If you are found in the lab during a time your access is revoked you will receive an automatic 10% reduction of your grade for each offense.
- A second and all subsequent offenses also results in a 5% reduction for your team.

Behavior Expectation

This is a project-based class

- You will be assigned to a team of students, with whom you will work for the next **two semesters**.
- Limited homework will be required from in-class workshops.
- All individual work will be documented in **design notebooks**.
- Rather than quizzes and tests, each team will be responsible for project deliverables presented at **key milestones (such as PDR, CDR, etc.).**
- Students are graded as both a team *and* on an individual basis.

Frequent Group Meetings (e.g., In-Person or on Zoom, etc.) are expected outside of Regular Lecture and Lab times

- Weekly team-only meetings and work-time should be announced to all team members.

Typical Structure of a Design Team

- PM = Project Manager
- SI = System Integrator
- FO = Fiscal Officer
- MO = Marketing (& Fundraising) Officer
- CM = Competition Manager

Expectations

Behavior Expectations

- Participation is *not* just showing up, it includes **professionalism**.
  - Be on time, and communicate potential lateness/absences, *including to teammates*.
  - When visiting sponsors or presenting, be professional.
  - Give plenty of notice when scheduling meetings or expecting feedback (*i.e.,* 24 hrs minimum).

- When communicating with sponsors and other stakeholders, your job is to **listen** to their feedback and **explain** your work, ***not to argue***.

- In team meetings, ***everyone*** is expected to contribute.
  - Describe your ideas clearly.
  - Challenge your teammates and justify your own ideas.

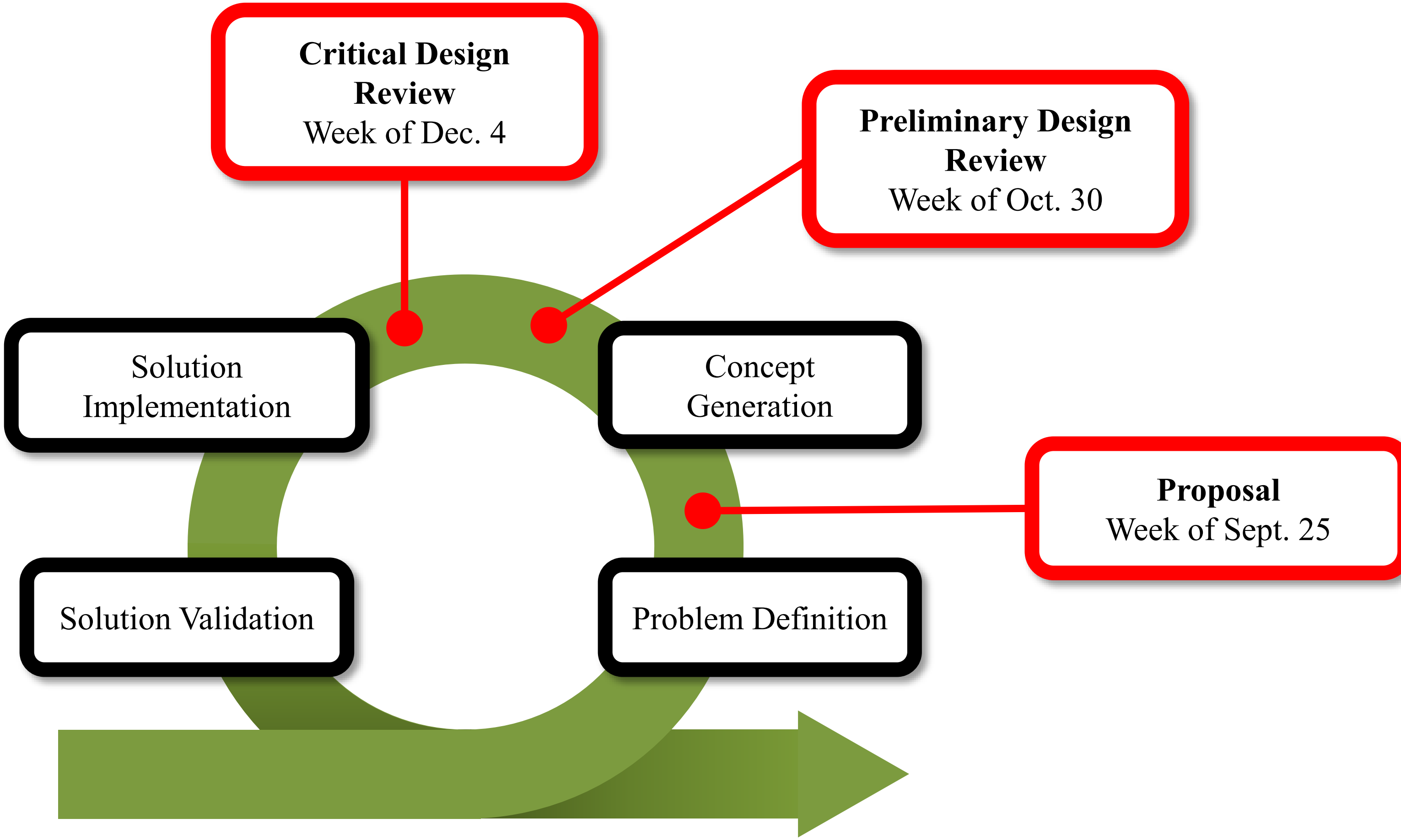
Syllabus and Schedule/Calendar

- Syllabus & Schedule/Calendar are posted on the RIP Website:

- http://rip.eng.hawaii.edu/courses/me-481482-design-project-iii/

- For Project **Assignments & Grading**: Review **Syllabus**
- For Project **Milestones/Deliverables**: Review **Schedule**

1.5 Course Map



Conclusions:

A few final philosophical ramblings

- Science
  - Any organized body of knowledge
- Art
  - A skill or set of skills acquired through a combination of study, observation, practice, and experience, or by intuitive capability or creative insight.
- Engineering
  - A judicious blend of science and art in which natural resources, including energy sources, are transformed into useful products, structures, or machines that benefit humankind.
  - Engineer's objective: fulfillment of some human need or desire
  - Engineers utilize or apply scientific knowledge together with artistic capability and experience to produce products or plans for products.

Fail Early and Often

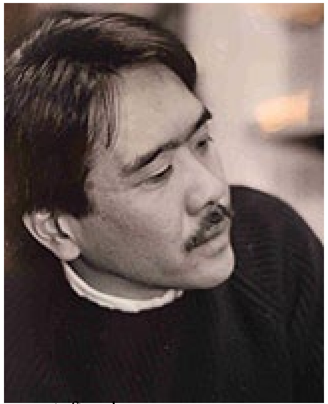
- Yet it is that discipline of quickly leaving mistakes in the past that distinguishes the superstars from the "also-rans.“
  - Simon Constable

- Toddler Effect
  - Must get your hands dirty
  - Focus on end goal – Final success, but not incremental failures
- Mark Rober, “The Super Mario Effect,” TEDxPenn, YouTube.
  - Attitude
    - “Okay, that failed, but what did I learn and what correction do I need to make or what else should I try”
    - Reframe your challenges
    - Learn from but not focus on the failures

Heuristic Course

"… we run the danger of losing sight of the larger purpose of learning. When learning is reduced to the acquisition of information, and education's only purpose is to build a resume and get a job, then something critical is lost."

- Charles Inouye



ase.tufts.edu

ME 481/482 Projects

- Maximum bandwidth of about 3-5 projects per section
- Scope, potential for success, existing obligations & constraints