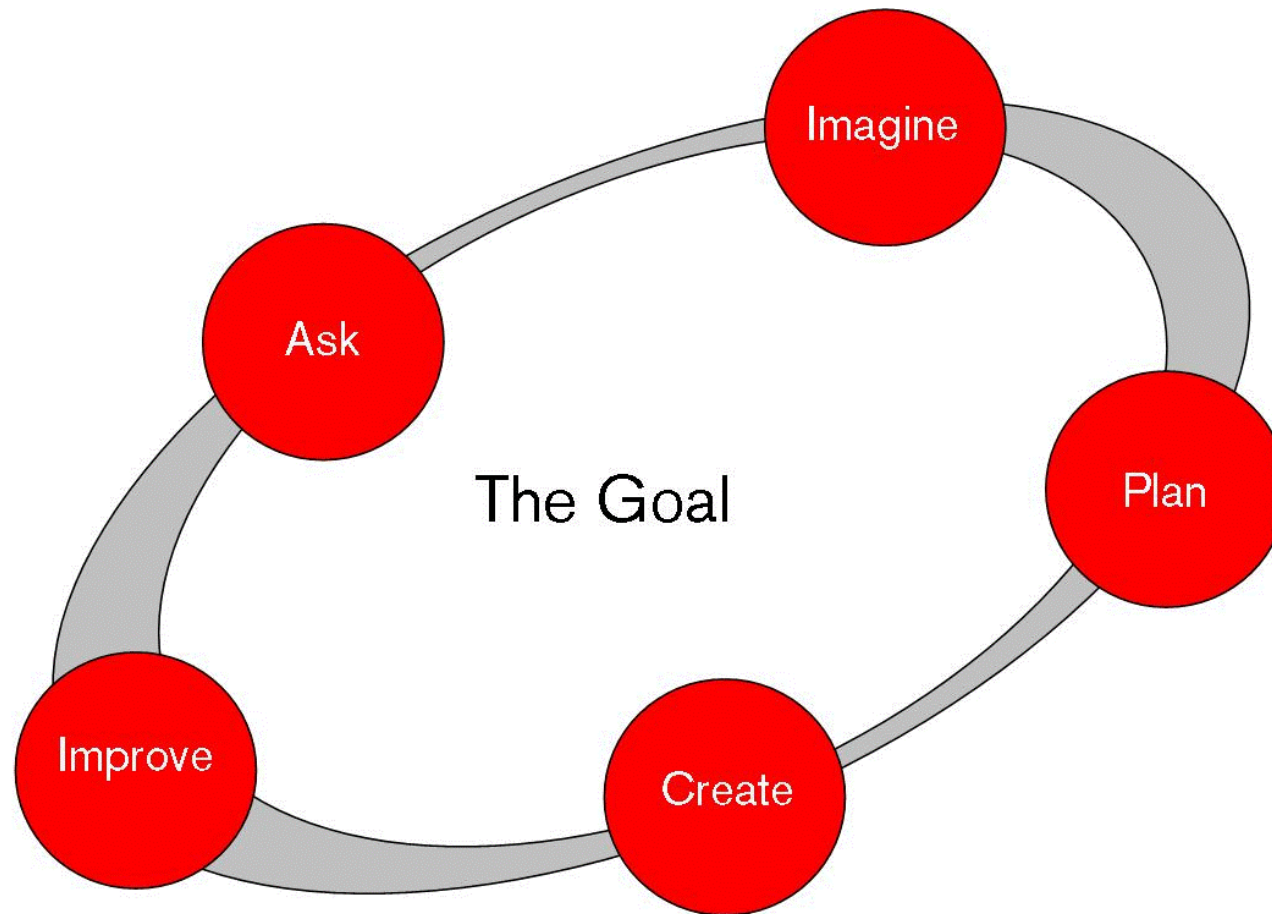# Introduction to Design I

Presented by:
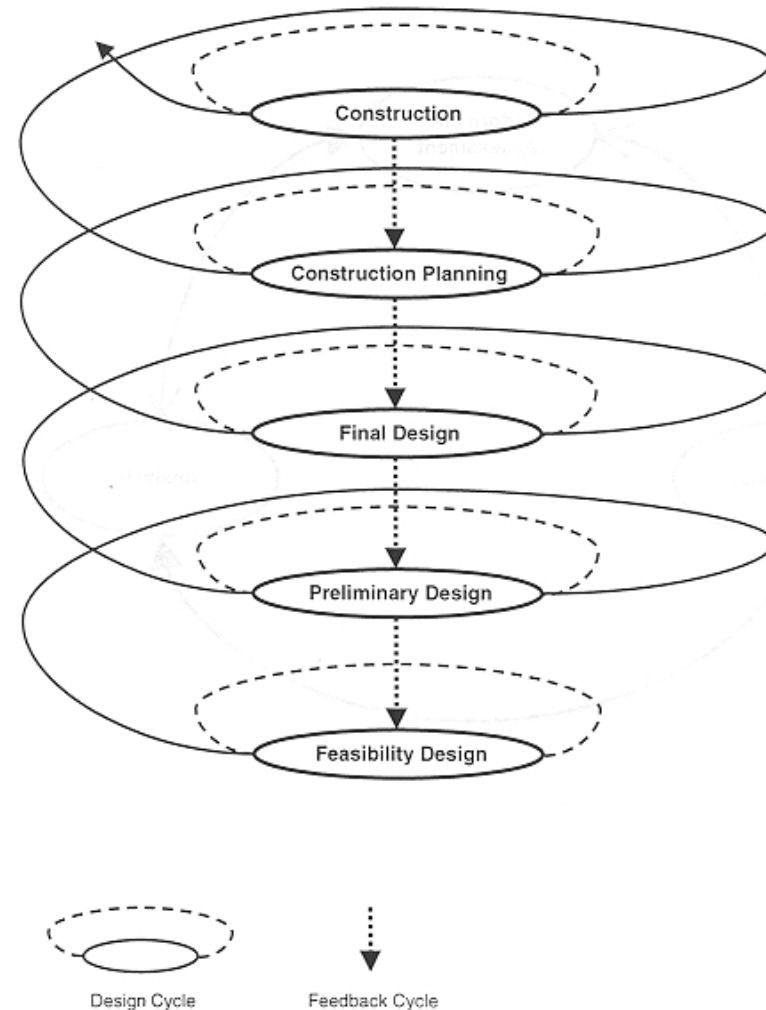
Dr. Carla Zoltowski

EPICS – Summer 2016

■ At the end of this class period, you will be able to:

1. Have understanding of design thinking mindsets.

2. Identify tasks and strategies that are effective for the initial phases of the design process

3. Identify how these tasks and strategies can be/were used in your project

Human-Centered Design

- Human-Centered Design as a <u>Process</u>
- Human-Centered Design as a <u>Mindset</u>

http://www.mos.org/eie/engineering_design.php

Construction

Construction Planning

Final Design

Preliminary Design

Feasibility Design

Design Cycle   Feedback Cycle

http://ocw.mit.edu/courses/civil-and-environmental-engineering/1-012-introduction-to-civil-engineering-design-spring-2002/projects/design_process/

D.Mindsets

SHOW DON'T TELL
Communicate your vision in an impactful and meaningful way by creating experiences, using illustrative visuals, and telling good stories.

FOCUS ON HUMAN VALUES
Empathy for the people you are designing for and feedback from these users is fundamental to good design.

CRAFT CLARITY
Produce a coherent vision out of messy problems. Frame it in a way to inspire others and to fuel ideation.

http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf

D.Mindsets

EMBRACE EXPERIMENTATION

Prototyping is not simply a way to validate your idea; it is an integral part of your innovation process. We build to think and learn.
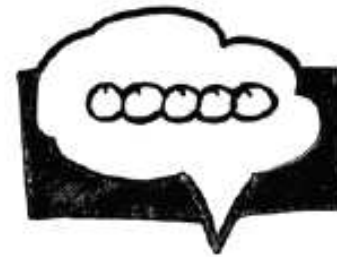
BE MINDFUL OF PROCESS

Know where you are in the design process, what methods to use in that stage, and what your goals are.

D.Mindsets

BIAS TOWARD ACTION
Design thinking is a misnomer; it is more about doing that thinking. Bias toward doing and making over thinking and meeting.
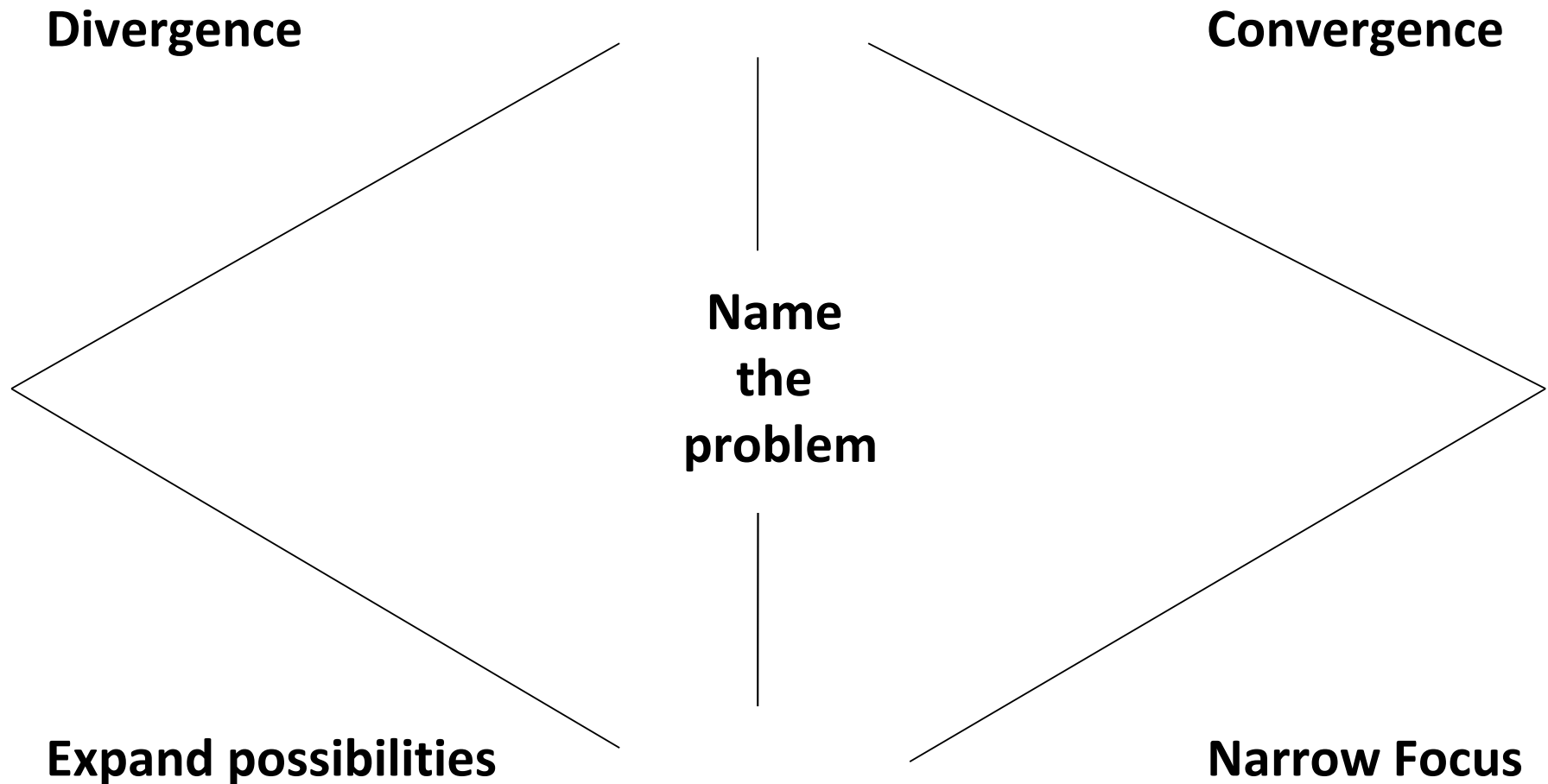

RADICAL COLLABORATION
Bring together innovators with varied backgrounds and viewpoints. Enable breakthrough insights and solutions to emerge from the diversity.

http://dschool.stanford.edu/wp-content/uploads/2011/03/BootcampBootleg2010v2SLIM.pdf
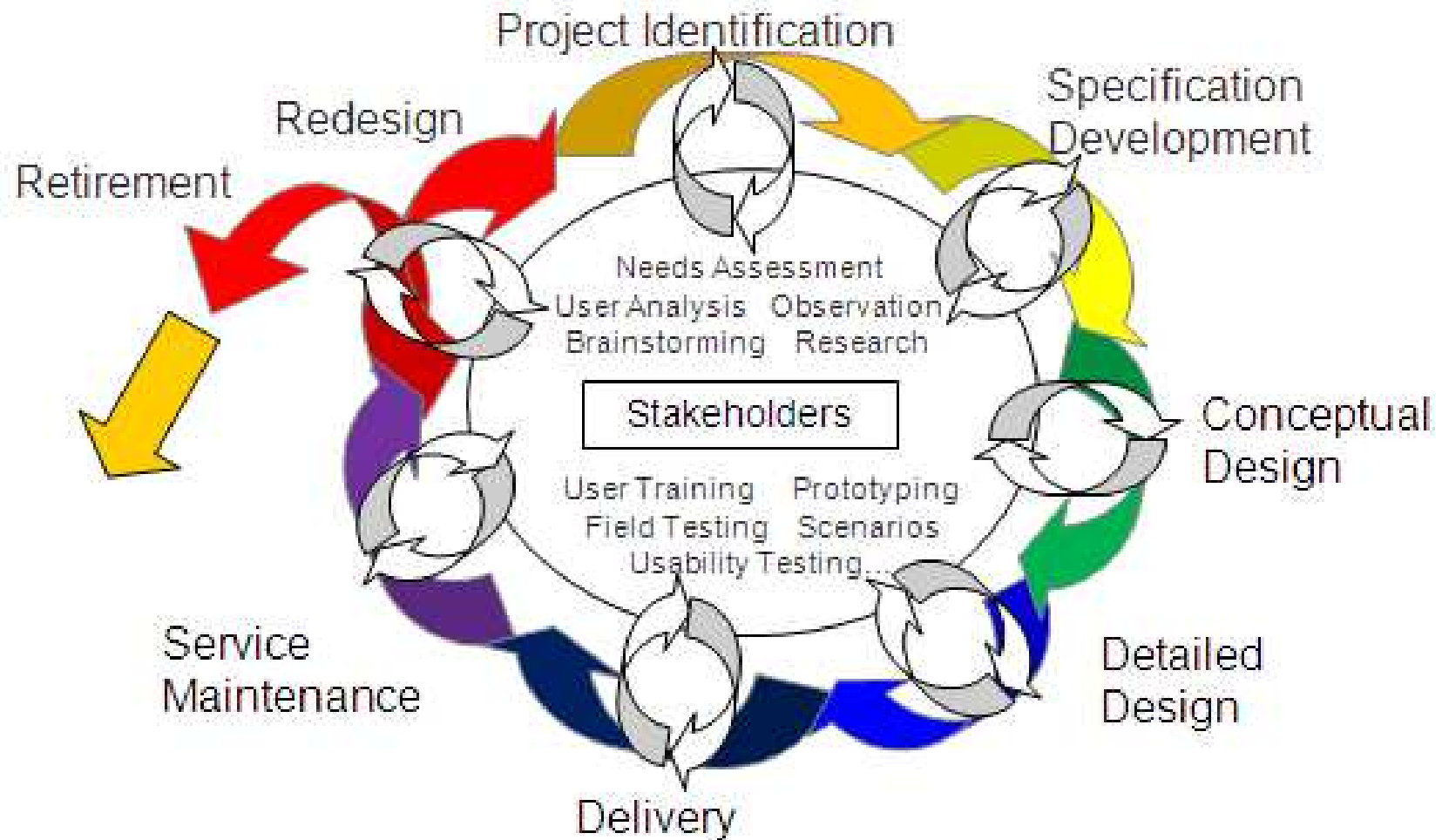
Why is design difficult?

- **Engages different types of thinking**
  - o Design is one of the most cognitively complex forms of "problem solving"
- **Requires designers to manage so many ideas and aspects**
- **Addresses different types of problems**
  - o Ill-defined
  - o Complex (number of requirements and constraints)

PURDUE UNIVERSITY

EPICS PURDUE

Divergence

Convergence

**Name
the
problem**

Expand possibilities

Narrow Focus

■ EPICS compiled resources:
https://sharepoint.ecn.purdue.edu/epics/teams/Shared%20Documents/Design%20Process%20Resources.pdf

o IDEO website: Human-Centered Design Toolkit (http://www.ideo.com/work/human-centered-design-toolkit/)

o Stanford d-school website:

http://dschool.stanford.edu/use-our-methods/

o Universal/inclusive design:
http://www.inclusivedesigntoolkit.com/betterdesign2/

	Project Identification Phase: Goal is to identify a specific, compelling need to be addressed
Common tasks	• Conduct needs assessment (if need not already defined) • Identify stakeholders (customer, users, person maintaining project, etc.) • Define basic stakeholder requirements (objectives or goals of projects and constraints) • Determine time constraints of the project
	Gate 1: Continue if have identified appropriate EPICS project that meets a compelling need

- Identifying the gap between current situation and desired situation
  - o What product or processes is your project partner currently using, and what are the problems with current approach that is motivating this project?
  - o What is the preferred state that the project is attempting to achieve?
  - o How will addressing this need be important to your project partner?

Specification Development Phase: Goal is to understand "what" is needed by understanding the context, stakeholders, requirements of the project, and why current solutions don't meet need, and to develop measurable criteria in which design concepts can be evaluated.

- Understand and describe context (current situation and environment)
- Create stakeholder profiles
- Create mock-ups and simple prototypes: quick, low-cost, multiple cycles incorporating feedback
- Develop a task analysis and define how users will interact with project (user scenarios)
- Compare to benchmark products (prior art)
- Develop customer specifications and evaluation criteria; get project partner approval

Gate 2: Continue if project partner and advisor agree that have identified the "right" need, and if no existing commercial products meet design specifications.

- What do we mean by context?
- Why it is important?
- What are effective ways to learn what is needed?

Understanding the social challenge addressed by the project partner and the client served

- What is the mission of my project partner?

- Describe the clients that your project partner serves and the particular challenges these clients face in their situation

- Are there stereotypes or prejudices associated with these clients?

- What about socio-economic status (especially issues of poverty and lack of resources), gender, race, ethnicity and/or physical or cognitive disability?

- Does your project partner have a religious affiliation?

Understanding the project partner as an organization
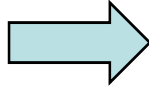
- What governing body or persons govern the behavior of my project partner?

- How is my project partner funded? What constraints do funding put on the organization?

- What institution(s) impact the patterns of behaviors expected of my project partner and how the organization responds to particular social issue (i.e., family, education, economic, political, religious, health-care, social service)?

- Are there regulations (city, county, state, federal, and/or professional) that dictate the behavior or guide the operation of my project partner?

http://ruralhealthcare.weebly.com/stakeholder-analysis.html
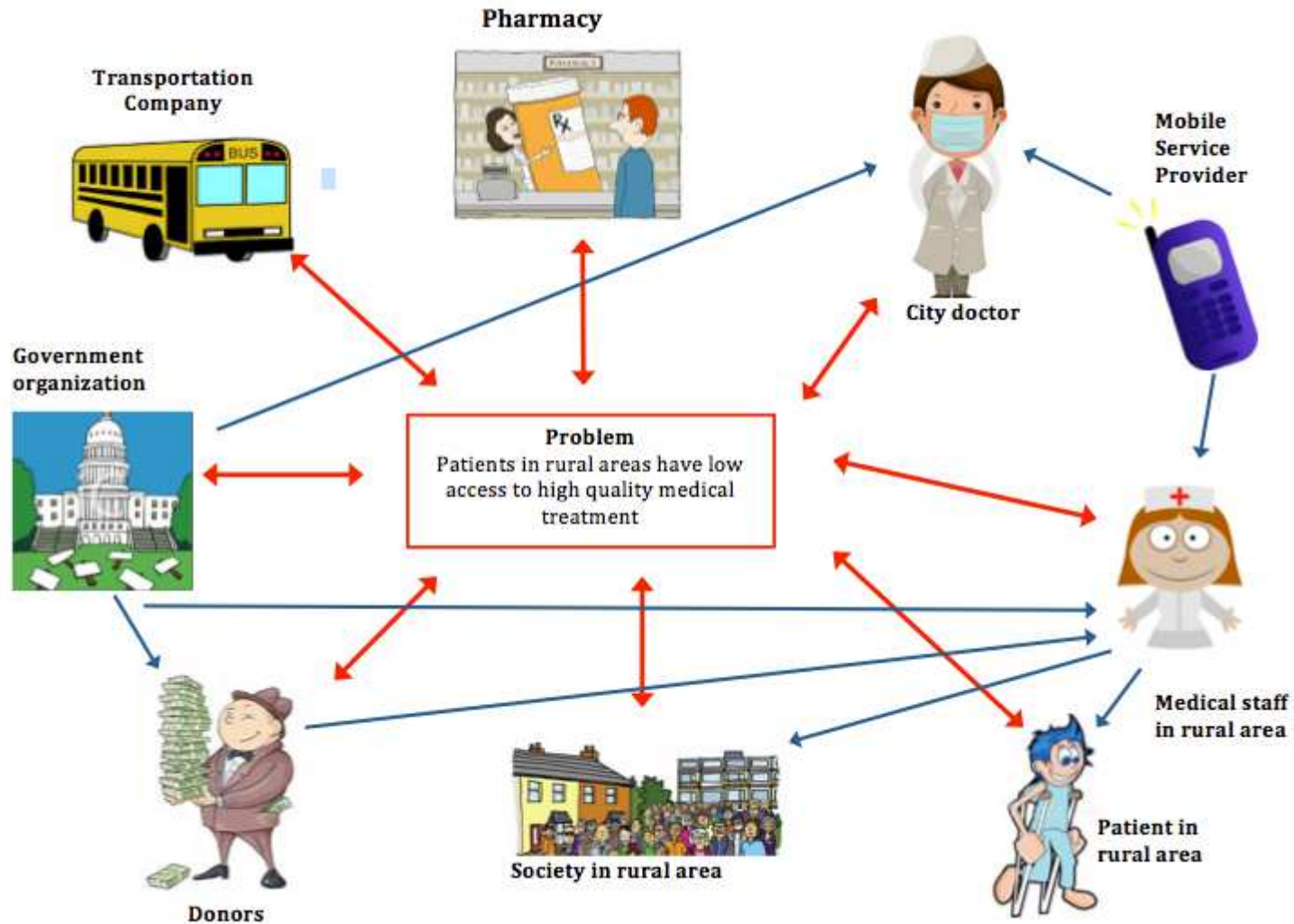
Stakeholders	Expectation/ Needs	Project impact	Project Strategy to respond to negative impact	Interest (L M H)	Power (L M H)
	Promoting CSR and advertising their brand	(+) Good image and reputation by being socially responsible, especially in rural areas (-) Spending significant amount in money in projects without guarantee for success and promotion	• Cooperate with the government to promote this as a pilot project • Arrange the event to promote our sponsor and our success • Keep donors informed about the progress of the project in regular basis	M	H
	Having accesses to efficient and effective medical treatment	(+) Receiving better quality medical treatment (+) Providing quick response to illnesses of people in rural areas (+) Easy access to skilled doctors (+) Reducing transportation cost to see doctors in the city		H	H
	Convenient working conditions and environment	(+) Working remotely from city instead of commuting to rural areas (-) Creating a conflict in their schedule, and make them get busier than before	• Ask government organization to provide specific city doctors to be responsible for only serving rural area project, in order to avoid conflicts in their current tasks	M	H
	Receiving valuable advice from experts to improve diagnosis and treatment	(+) Increasing efficiency and effectiveness in medical treatment (+) Being able to provide appropriate treatment to patients with serious disease (+) Reducing mistakes by contacting skilled doctors (-) Creating more complexity in their work processes	• Promote and inform medical staff about the objective of the project and benefits they gain	H	H

■ http://ruralhealthcare.weebly.com/stakeholder-analysis.html

Stakeholder Analysis

Stakeholder (designation of the individual in the organization)	Stake in the project (job responsibilities of the stakeholder)	Impact on project (intensity or level of impact)	Risks (possible risks involved)	Strategy to manage stakeholder

- Importance (Power)
- Interest
- Ally or critic?

→

- Engage actively
- Protect
- Keep satisfied
- Keep informed
- Monitor

http://www.sampletemplates.org/wp-content/uploads/2011/12/Stakeholder-Analysis-Template-829x1024.png

- **Formal/Informal Interviews**
  - Focus groups– interviews with multiple people
- **Observations**
  - Observation vs. interpretation
- **User profiles/Persona**
  - Prototypical user, described in detail
- **Scenarios**
  - "before and after" stories of your persona using your product
    - Focus on the user's need and how their life might be improved
- **Role-playing: put yourself in the user's shoes, chair, and/or space**
  - Empathic modeling: Simulating the sensory/motor/cognitive constraints
- **Prototyping – at every stage**
  - Rough, frequent prototypes

- Sharepoint->Shared Documents-> Project Partner meeting planning document
  o Developed by Prof. Megan Sapp Nelson
- Stanford d-school website: http://dschool.stanford.edu/use-our-methods/
- IDEO website: Human-Centered Design Toolkit (http://www.ideo.com/work/human-centered-design-toolkit/)

Personas

- Fictional character with all the characteristics of the user

- Created after the field research (observations, interviews)

- Members of the primary stakeholders (users)

- Depicts the "typical" or "average" individual in the primary stakeholder group

- Include a name and picture, demographics, roles and responsibilities, goals and tasks, motivations and needs, environment and context, and a quote that can represent the character's personality.

HEARD Device

GLASS

Example Personas
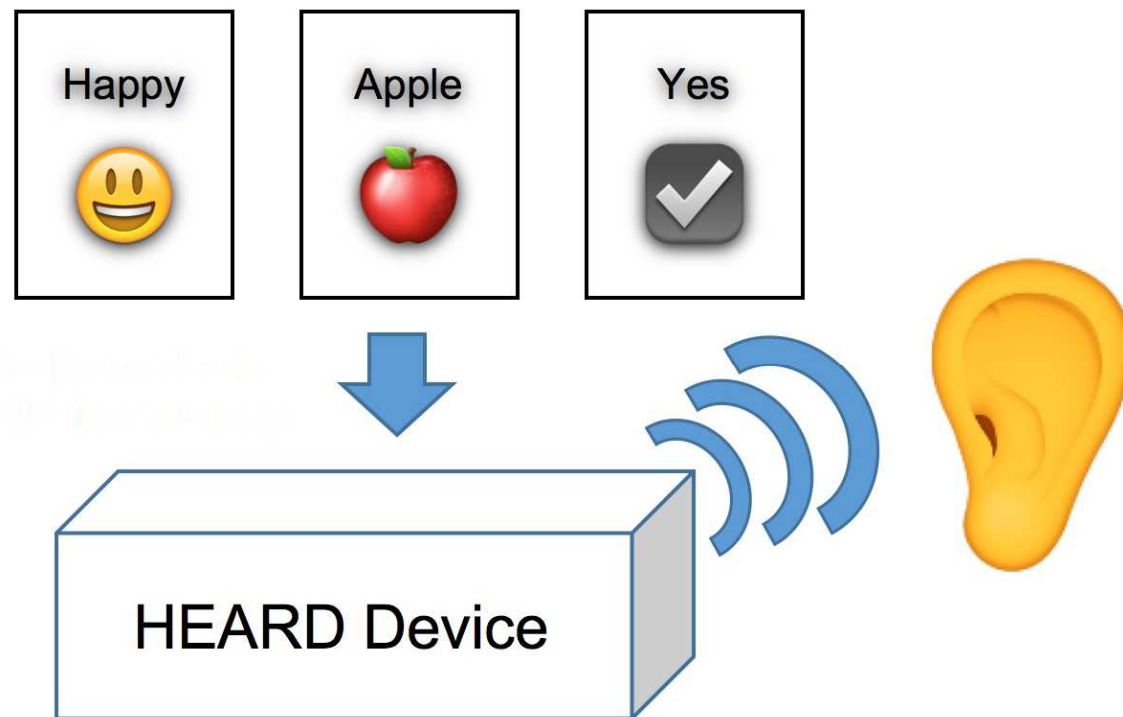
■ *Stakeholders:*

o <u>Primary users:</u>

- Student
- Instructor

o <u>Secondary Users:</u>

- Maintenance Person
- Parent

- **Instructor:**
  - Age: 25-55 years old
  - Job Titles: Special Education Teacher
  - Experience: may have up to 30 years experience
  - Work Hours: 40 hours per week; Monday – Friday; morning into early afternoon
  - Education: At least Bachelors degree – Masters degree; State Licensure
  - Disabilities: No specific disabilities
  - Technology: Basic Computer skills (word processing, email, web browsing), some experience with augmented communication devices
- **Student:**
  - Age: 6-20 years old
  - Education: Elementary- High School; currently enrolled
  - Work Hours: Required school attendance; Monday – Friday; morning into early afternoon
  - Disabilities: Limited communication ability; possible physical and/or cognitive limitations
  - Domain Knowledge: may have previous experience with similar devices

Mrs. Brown

31 years old

Works 7am – 4pm Monday –Friday

Goals: Encourage and motivate students to learn, Be support structure to families of students, Provide the best learning environment for each student, Efficiently use class time to learn

Mrs. Brown is dedicated to the children in her classroom. While there are long, tiring days, she values the difference she is able to make with her job. She encourages a healthy, positive learning environment where the students can be comfortable.

In the classroom, she is focused on ensuring that each student is carefully considered. She tries to cater activities to the individual students' abilities, needs, and interests. Mrs. Brown stays up to date on new techniques, activities, and assistive devices. She tries to implement some of the new technology that will benefit her students.

She also sees herself as a resource to the parents. With her education and experience, she tries to be available to parents to ensure they can be engaged in their child's schooling.

10 years old

Elementary School Student

Attends school Monday-Friday

Disabilities: limited ability to communicate, limited upper body fine motor control

Alex is a student in a special needs classroom. He displays a limited ability to communicate and limited upper body fine motor control. He is learning the basics of communication by interacting with his instructor. One of the activities he completes at school is designed to help reinforce symbolic understanding. He is having difficulty understanding the connection between the images and the items they correspond with. He is able to request things he needs and wants. Alex has good coarse motor control, however his fine motor control is sometimes limited. Sometimes this makes it more difficult to hold items and operate moving parts.
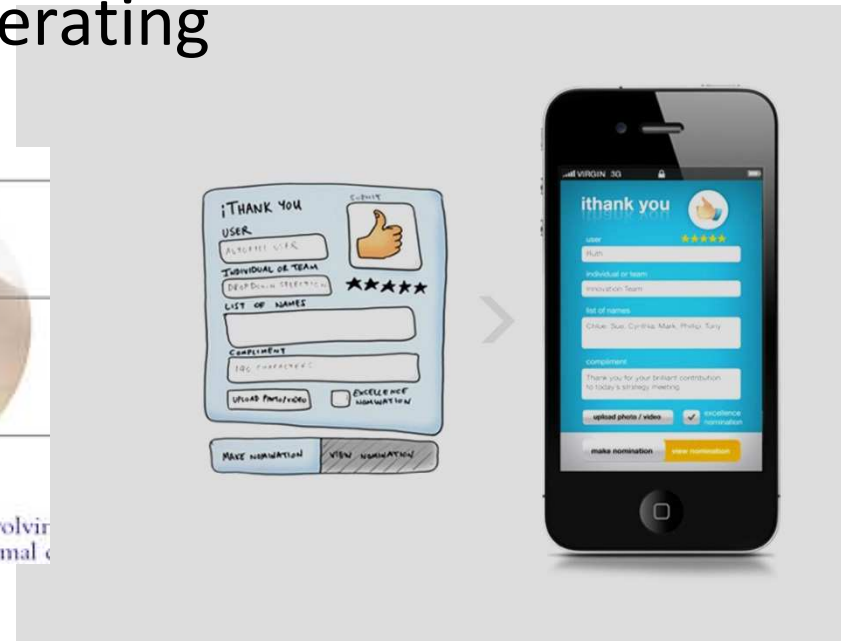
Overall, Alex enjoys school and learning even though it can be frustrating at times.

- **Involves**: instructor and student; Mrs. Brown and Alex

- **Situation/Task**: Classroom learning activity in which a communication device would be used. Teacher and student work together. Students choose cards and hand to teacher to practice communication. Teachers respond appropriately to the cards (e.g., give requested food or item).

- **Goal**: The student's goal is to learn to request. The teacher's goal is to help the student understand basic communication concepts.

- **Methods of addressing task**:

  o Mrs. Brown has four or five items in front of her, including some of Alex's preferred food, apples. Alex has cards corresponding to these items on a table in front of him. Mrs. Brown waits to see if Alex requests apples. If not, she models putting the card on the device and handing it to her. She then gives him the apple. If Alex requests other items, Mrs. Brown gives the appropriate item to him. Mrs. Brown removes the card from the device, and encourages Alex to request another item.

- Can Role-play

- Simulate condition
  - o E.g., Arthritis: Tape coins to knuckles

- *Caution!* These tools should not replace getting feedback and information from the users and stakeholders themselves!
  - o Just because you have "pretended" to have a disability or in a certain situation, doesn't mean you understand what it really like for those users and stakeholders.

<u>Prototypes</u> promote feedback that promotes negotiation and appropriate iteration

- Visual – drawings, sketches, CAD
- Functional – mock up or prototype
- Intermediate or component
  - Partial prototypes

■ Prototyping….rough, quick, very interative

○ IDEO working with Gyrus ACMI to design new apparatus for operating on delicate nasal tissues

Revolvi...
optimal ...

www.ludicgroup.com

http://cataligninnovation.blogspot.com/2008/11/prototyping-foundational-competency-of.html

✚ What worked...	━ What could be improved...

❓ Questions...	❗ Ideas...

https://dschool.stanford.edu/groups/designresources/wiki/4dbb2/attachments/e100 5/TheWalletProjectB%26W2012.pdf
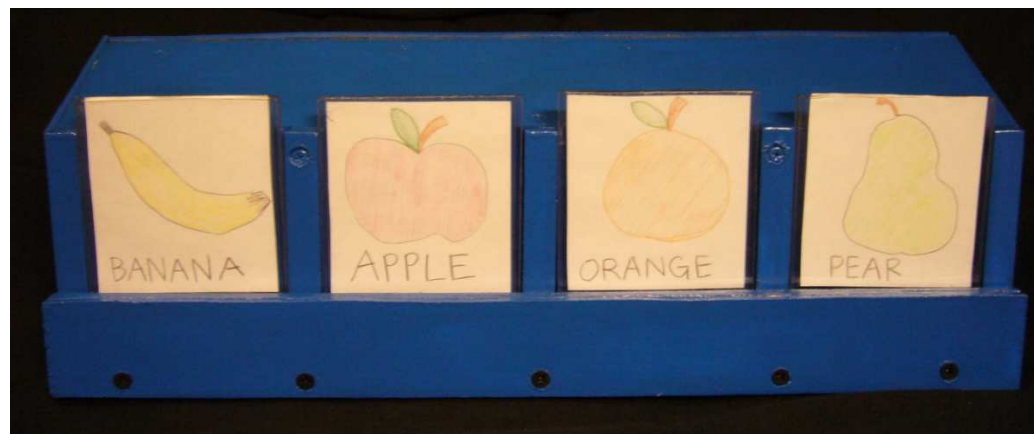
Design Specifications

- Quantified
  - Measurable
  - Testable
- Objective quantities (based on some metric)
- A set of units should be associated with each specification
- Forms the basis for your specifications document

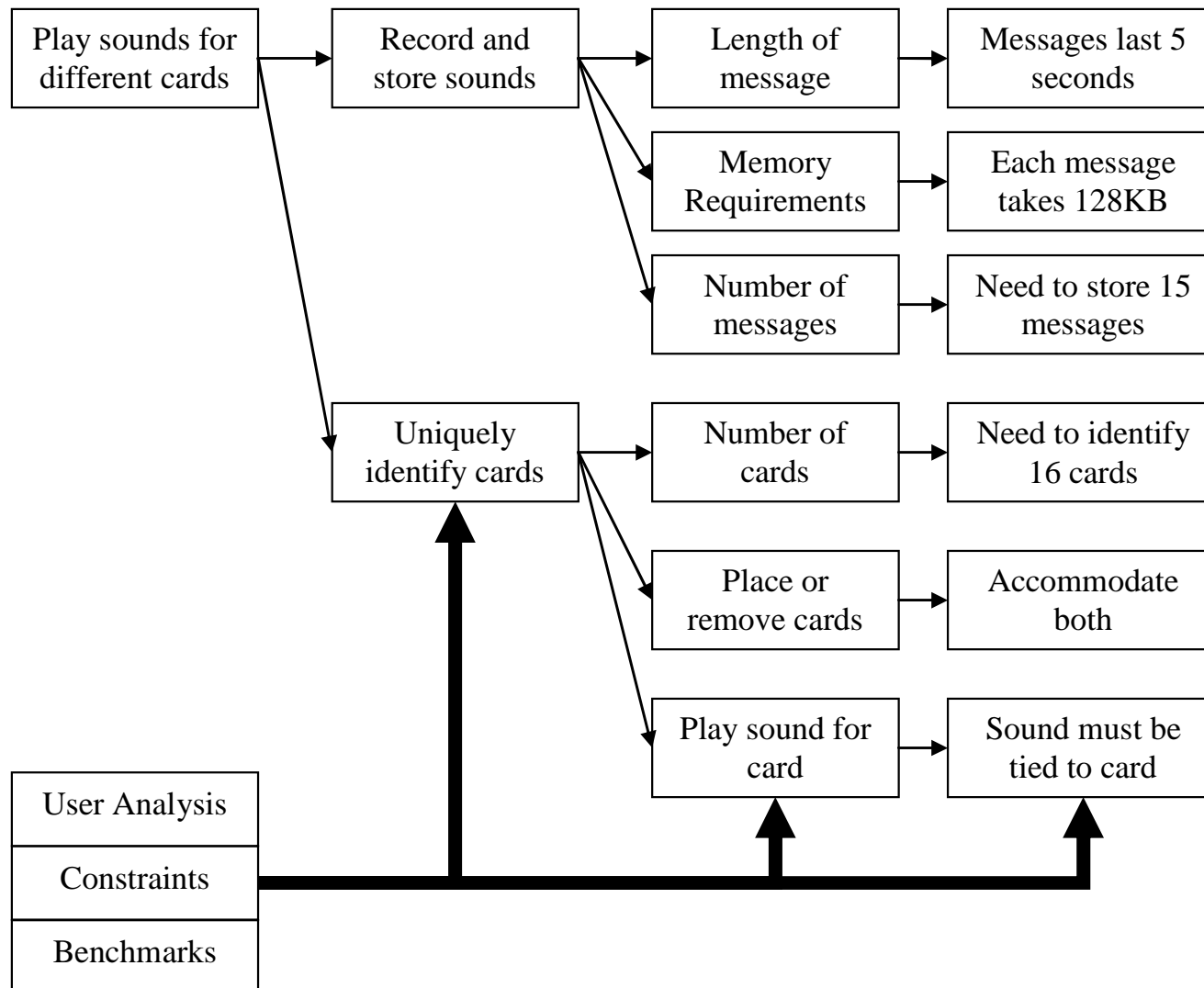## Categories of Evaluation Criteria (Voland 2004):

- **Physical:** space allocation or dimensional requirements, weight limits, material characteristics, energy or power requirements

- **Functional/Operational:** acceptable vibration ranges, operating times, input/output requirements

- **Environmental:** moisture limits, dust levels, intensity of light, temperature ranges, noise limits, potential effects upon people or other systems that share the same environment

- **Economic:** limits on production costs, depreciation, operating costs, service or maintenance requirements, existence of competitive solutions in the marketplace

- **Legal:** governmental safety requirements, environmental or pollution control codes, production standards

- **Human Factors/Ergonomics:** strength, intelligence, and anatomical dimensions of the user

GLASS Talkie Board

☐ Device to help in development of communication skills
  ■ Teach communication act as well as power of communication

☐ Talkie Board allowed 4 cards to be placed into the device at a time and up to 15 cards to be programmed with any word or sound to be played back.

Play sounds for different cards	Record and store sounds	Length of message	Messages last 5 seconds
		Memory Requirements	Each message takes 128KB
		Number of messages	Need to store 15 messages
	Uniquely identify cards	Number of cards	Need to identify 16 cards
		Place or remove cards	Accommodate both
		Play sound for card	Sound must be tied to card

| User Analysis |
| Constraints |
| Benchmarks |

Benchmarks

- o What is available

- o Why did they use their approach

- o Patent searches

  - Avoid Infringement

  - Protect IP

- o Do current products meet specifications or what is missing that necessitates the team working on the project?

Spec or Requirement	Origin	How will you know if you achieved it?	Completed?

Spec or Requirement	Origin	How will you know if you achieved it?	Completed?
1. Sound audible in classroom	Project Partner Requirement	Test in classroom	
1.1 Sound range between 15 dB and 85 dB	Project Partner Requirement of audible sound		
1.2 Variable output			
2. Project should be educational	Project Partner Requirement	Pre-, post-test? Interview students?	

■ Rover Power Supply

- o Output range of voltages needed for Rover Subsystems (12V, 7.4V, 5V, 3.3V)
- o Supply power to all subsystems for at least 12 hours at a level of performance deemed fit for the museum.
- o Operate with a minimum efficiency of 80%

■ Mechanical Arm

- o Reach a minimum distance of 2 feet from the rover.
- o Able to lift and support at least half a pound.
- o Include a separate camera to assist the arm operator in viewing and picking up objects.
- o Not interfere with other rover control systems.

■ Collision Avoidance System

- o Must prohibit museum guests from driving the rover into objects.
- o Provide the operator distance warnings when approaching an object.

- Goal is to understand "what" is needed by understanding the context, stakeholders, requirements of the project, and why current solutions don't meet need, and to develop measurable criteria in which design concepts can be evaluated.

- *At the end….*

  o *Gate 2: Continue if project partner and advisor agree that have identified the "right" need, and if no existing commercial products meet design specifications.*

Reflective/Critical Thinking format

- What did I learn?

- How did I learn it?

- Why does this learning matter?

- What will could I or others do in light of this learning

Can be applied to personal/professional, disciplinary, and civic learning.