Introduction to Design II

Presented by:
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Professional Development Series Lecture (Understanding Stakeholders and Understanding Social Context) is in ARMS B071

EPICS – Fall 2013
At the end of this class period, you will be able to:

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

2. Identify how these tasks and strategies can be/were used in your project
Course Deliverables

- Individual Evaluation Rubric
- Semester Plan
- Updates to website
1. Consider your project as related to the design process:
   a. Where in the design process (what phase) is your project and how do you know?
   b. What are your project goals for the semester? What design tasks are planned to meet those goals?
   c. How well do your project goals and tasks align with the phase of the design process?
   d. When was/is your project promised? How does your current semester plan align with the overall project timeline?

2. What are ways you can incorporate one or more of the “Mindsets” within your design approach?

3. How do you plan to keep stakeholders at the center of the design?
EPICS Design Process

- Project Identification
  - Needs Assessment
  - User Analysis
  - Observation
  - Brainstorming
  - Research

- Specification Development
- Conceptual Design
- Detailed Design
- Delivery
- Redesign
- Retirement
- Service Maintenance

Stakeholders:
- User Training
- Prototyping
- Field Testing
- Scenarios
- Usability Testing...
Project Identification Phase: Goal is to identify a specific, compelling need to be addressed

<table>
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<tr>
<th>Common tasks</th>
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<tr>
<td>• Conduct needs assessment (if need not already defined)</td>
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<tr>
<td>• Identify stakeholders (customer, users, person maintaining project, etc.)</td>
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<td>• Define basic stakeholder requirements (objectives or goals of projects and constraints)</td>
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<td>• Determine time constraints of the project</td>
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Gate 1: Continue if have identified appropriate EPICS project that meets a compelling need
At a very high level, you should:

1. Conduct Needs Assessment: What needs could be addressed? What are potential projects?
2. Identify outcomes or deliverables (is it a report, software, actual product, etc.)?
3. Who are stakeholders?
4. Determine duration of project

OUTPUT => Typically a “project charter”

Continue if have identified appropriate EPICS project that meets a compelling need
Identifying the gap between current situation and desired situation

- What product or processes is your project partner currently using, and what are the problems with current approach that is motivating this project?
- What is the preferred state that the project is attempting to achieve?
- 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?
Who are the stakeholders?

Customer → inquiry → reservation → Ticket system

Seats reservation → inquiry

Bank system → billing → Payment notification
Stakeholder Analysis

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

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

http://www.axia-consulting.co.uk/assets/images/autogen/2011-Stakeholder-02.gif
1. Watch lecture “Understanding Stakeholders and Understanding Context” (will be available Wednesday)

Who and what?

- 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
Interviews and Observations

- Sharepoint -> Shared Documents -> Project Partner meeting planning document
  - Developed by Prof. Megan Sapp Nelson


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

- Watch lecture from last semester: Effective Interview and Observation Techniques
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.
Handheld Educational Augmentative RFID Device (HEARD)
Stakeholders:

- **Primary users:**
  - Student
  - Instructor

- **Secondary Users:**
  - 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.
Alex Smith

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.
**Example Scenario: Learning Communication**

- **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:**
  - 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
- E.g., Arthritis: Tape coins to knuckles

**Caution!** These tools should not replace getting feedback and information from the users and stakeholders themselves!
- 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.
Prototypes 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 interactive

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

- Prototype:

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.
Talkie Board Specifications

- 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

- What is available
- Why did they use their approach
- Patent searches
  - Avoid Infringement
  - Protect IP
- Do current products meet specifications or what is missing that necessitates the team working on the project?
<table>
<thead>
<tr>
<th>Spec or Requirement</th>
<th>Origin</th>
<th>How will you know if you achieved it?</th>
<th>Completed?</th>
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<tr>
<td>1. Sound audible in classroom</td>
<td>Project Partner Requirement</td>
<td>Test in classroom</td>
<td></td>
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<tr>
<td>1.1 Sound range between 15 dB and 85 dB</td>
<td>Project Partner Requirement of audible sound</td>
<td></td>
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<tr>
<td>1.2 Variable output</td>
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<tr>
<td>2. Project should be educational</td>
<td>Project Partner Requirement</td>
<td>Pre-, post-test? Interview students?</td>
<td></td>
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</table>
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….

- Gate 2: Continue if project partner and advisor agree that have identified the “right” need, and if no existing commercial products meet design specifications.
Conceptual Design Phase: Goal is to expand the design space to include as many solutions as possible. Evaluate different approaches and selecting “best” one to move forward. Exploring “how”.

- Conduct Functional Decomposition
- Brainstorm several possible solutions
- Create prototypes of multiple concepts, get feedback from users, refine specifications
- Evaluate feasibility of potential solutions (proof-of-concept prototypes); select one to move forward

Gate 3: Continue if project partner and advisor agree that solution space has been appropriately explored and the best solution has been chosen.
Expanding the Design Space
Functional Decomposition

- Breaking tasks or functions of the system down to the finest level
- Create a tree diagram starting at the most general function of your system
  - What is the purpose of your system?
- Break this function down into simpler subtasks or sub-functions
- Continue until you are at the most basic functions or tasks
Functional Decomposition Diagram

Overall Function

- Sub-function 1
- Sub-function 2
- Sub-function 3
Each function has a box with
- An action verb
- The object(s) on which the verb acts
- Possibly a modifier giving details of the function
- Known flows of materials, energy, control or information

Consider WHAT not HOW
Sample Diagram – Coffee Maker

Make Coffee

- Store and Heat Water
- Store (and grind) Coffee
- Brew Coffee
- Keep Coffee Warm
Functional Decomposition Example

Talkie Board

Card Identification
- Identify specific cards

User Interface
- Present cards in viewable manner
- Controls accessible to teacher, cards to student
- Change between record/play, put on/take off, power on/off

Mode Selection
- Identify when cards placed or removed

Sound System
- Record/play messages
- Access messages dynamically
Expanding the creative process

• Take functional decomposition and brainstorm on each of the functions
  • How can we ______?
  • Capture the best of each idea
  • Rebuild the system as combinations
  • Morphological matrix
Brainstorming: SCAMPER

• **Substitute** – can you use a different method, device, or material or changed the environment?

• **Combine** – can you combine ideas together to produce a better idea?

• **Adapt** – what ideas are similar that could be emulated or adapted to fit the current need?

• **Modify, Minify, Magnify** – can you change the current idea, make it smaller or larger in some way?

• **Put to other uses** – can you use the idea in a new way?

• **Eliminate** – are there any ideas that have been shown to not work?

• **Reverse, Rearrange** – would an opposing idea give you additional information, or can you interchange the key elements of the idea to form a new one?
Brainstorming – 6-3-5

- Group of 6 people
- Each person writes down 3 ideas
  - Written description or graphical (sketches)
- Pass to right, next person adds to paper for 5 minutes..
  - Ideas can be new, extend, or modify original ideas
- No verbal communication during activity
APPLY EXISTING MECHANISM IN NEW WAY

Consider whether existing products or their components can fulfill the desired function. This can facilitate reuse of existing products, make the design process more efficient, and expand the pool of options.
APPLY EXISTING MECHANISM IN NEW WAY

WANTUZ
Reha Erdogan
Hand vacuum cups are used to transport large sheets of glass. Here, they are used to hold the seat and back of this chair in place.

PRATONZOLO
Max Battaglia
This desk organizer uses brush bristles to hold pens, pencils, and business cards.
Iterative within Process

Seeking and Selecting

Divergence

Expand possibilities

Convergence

Narrow Focus

Name the problem
Decision Matrix

- Table with alternatives
- Quantify categories and score alternatives
  - Importance in different categories
- Use judgment to do reality checks
- Leaves documentation of thought process of design
  - Can be shared in design reviews
# Decision Matrix

<table>
<thead>
<tr>
<th>Criteria for Comparison</th>
<th>Ideas to be compared</th>
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<td>Weights</td>
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<td>Scores</td>
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<td>Totals</td>
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**Decision Matrix Example: Getting a Job**

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<td>Boss</td>
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<td>Totals</td>
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EPICS Week 5 Homework

Due: September 16th (Week 5) in notebook; bring to lecture

1) Identify how techniques discussed today could be or were already implemented in the design for each of the phases. Provide specific examples/point to where they are documented for your project:

a) Specification Development
b) Conceptual Design
Attendance

- Fill in your name
- PUID
- True for #1

Need to turn in individually to TA/Instructor
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