ADMINISTRATIVE DETAILS

- Due tonight at midnight
  - Writing Assignment 1
  - Weekly Project Meeting Notes

- Due next Wed at midnight
  - Revised Problem Statement
  - Preliminary List of Project Roles & Tasks
  - Objective Tree
  - Weekly Project Meeting Notes

- Field trip to Tesla – February 27 at 2PM
  - Any students under age 18 will be required to have their parent/guardian sign the NDA in advance and bring it on the day of the tour

- Will be mid-quarter online survey open Feb. 6-12
  - More details via Canvas announcement and in class next week
OUTLINE

- Lecture
  - Constraints
  - Design Teams and Management

- Speaker
  - Jim Fruchterman, Benetech
LECTURE

CONSTRAINTS

DESIGN TEAMS & MANAGEMENT
Constraints set limits on what the client can have

A check list to prune set of designs to a more manageable size

Constraints versus metrics:

- A metric measures a design’s success in meeting a given objective.
  - Example: objective is “low cost”, metric is it costs less than $1.
  - This metric is not a design constraint
  - A successful design might be low cost but still cost more than $1, in which case this metric was not a good measure of success

- A constraint is binding on the design, e.g. it must cost less than $1
The problem presented to the team involves Jessica, a third-grader at Danbury Elementary School. Jessica has recently begun painting, but because she suffers from cerebral palsy, she has difficulty pursuing her new interest. Jessica painting with her left hand, with her elbow held above the rest position, using a combination of arm and torso movement. While painting, Jessica exhibits exaggerated movements, and lack of control of finer movements, in all direction. These problems are amplified when her arm is fully extended. Currently, when Jessica wants to paint, she requires a teacher or staff member to hold her left elbow stable.

The staff at Danbury school has asked the team to try to design a device that would decrease the magnitude of the exaggerations and assist Jessica in controlling her finer movements. The device must permit the same range of voluntary motion currently employed while painting. Thus, the device would take the place of the teacher or staff member and increase Jessica’s functional independence while painting in a classroom environment.

The Danbury staff must be able to set-up the device in a classroom environment in eight minutes or less. Optimally, the device could be used by other students with cerebral palsy or other functionally similar conditions at Danbury Elementary school.
TEAM 1 - CONSTRAINTS LIST OF DANBURY ARM SUPPORT PROJECT

- Must fit Jessica.
- Must be able to reach entire area of a 9x13 canvas as well as her paint.
- Must have a 2-3 minute set-up time for one person.
- Must be usable on a classroom environment.
- Must not cause user physical pain.
- No toxic materials.
- Must be usable without assistance between dips of her paint brush.
In this class you will learn the design process by designing an engineering product with your team.

So how do you organize and manage an engineering design team?
### STAGES OF DESIGN TEAM FORMATION

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
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<tbody>
<tr>
<td>1. Forming Stage</td>
<td>forming a team, getting acquainted and oriented to design task, testing group behavior, initial ground rules.</td>
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<tr>
<td>2. Storming Stage</td>
<td>resistance to task demands, interpersonal conflict, disagreement, struggle for group leadership.</td>
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<tr>
<td>3. Norming Stage</td>
<td>clarity of roles, emergence of informal leadership, consensus on group behaviors and norms, and on group’s purpose.</td>
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<tr>
<td>4. Performing Stage</td>
<td>clearly understood tasks and roles, well defined norms, task accomplishments, solutions and results.</td>
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<tr>
<td>5. Adjourning Stage</td>
<td>disbanding of the team.</td>
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These stages may occur more than once in a team’s lifetime.
CONSTRUCTIVE CONFLICT:  
*Five Basic Strategies*

- **Avoidance**  
  Ignore the conflict and hope it will go away.

- **Smoothing**  
  Allow the other party to win to avoid the conflict.

- **Forcing**  
  Impose a solution on the other party.

- **Compromise**  
  Each party meets the other “halfway.”

- **Constructive engagement**  
  Determine underlying desire of all parties and seek ways to realize them.
EFFECTIVE LEADERS

- Open to other viewpoints
- Dedicated to team’s success
- Respectful of others
- Decisive, but only after considering all points of view
- Willing to do their share of work
- Knowledgeable about team’s subject

Effective Leaders are made rather than born
# TEAM BEHAVIORS AND ROLES

<table>
<thead>
<tr>
<th>BEHAVIORS</th>
<th>ROLES</th>
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<tbody>
<tr>
<td>Communication</td>
<td>Active Listener</td>
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<tr>
<td>Decision Making</td>
<td>Influencer</td>
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<tr>
<td>Collaboration</td>
<td>Analyzer/Fact Seeker</td>
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<td>Self-Management</td>
<td>Innovator</td>
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<td></td>
<td>Conflict Manager</td>
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<td>Team Builder</td>
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<td>Goal Director</td>
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<td>Process Manager</td>
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<td></td>
<td>Consensus Builder</td>
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</table>
MANAGING A DESIGN PROCESS

The 3 S’s

- **Scope**: Sets the limits on what the team must accomplish for the project to succeed.

- **Schedule**: Determines when each project task must be completed for the project to be completed on time.

- **Spending**: Manages all the resources that can be spent on a project.
  - In commercial settings, often translated into dollars.
  - For students, time is the resource to be most closely managed.
MANAGING DESIGN ACTIVITIES

The 3 S’s

- **Scope tools:**
  - Team Charter: Agreement on project requirements, what constitutes success, and what limits on the project may apply.
  - Work breakdown structure (WBS): A hierarchical decomposition of all the tasks to be completed for a project to be done.

- **Schedule tools:**
  - Team calendar: mapping of deadlines to a calendar. Includes deadlines to client (or class deadlines) as well as individual task deadlines (defined by WBS). Should update at every team meeting.

- **Spending tool:**
  - Budget: A list of all items in the project that will incur an economic cost, organized into logical categories (e.g. labor and materials)
    - Your budget should reflect the cost of your design
Each task is credited with some percentage of total project effort (could be commensurate with time).

When task is begun, progress on that task is credited at 25%. Updated at each project meeting, up to 90%.

When team accepts task complete, 100% credited.

Total percent complete on the project is the sum of percentages completed on each task.

The PCM allows the project leader to track task completion and identify delays.

Particularly important when commencement of one task depends on completion of a different task.
TOOLS TO MANAGE DESIGN PROCESS

- Project definition:
  - Picking your project.
  - Determining what *client* wants for project.

- Project framework:
  - Determining specific tasks to be done.
  - Organizing a team.

- Project scheduling:
  Assigning tasks and reaching agreement on when they must be accomplished.

- Budget:
  Managing spending activities in a project.

- Project tracking, evaluation and control:
  Monitoring project to insure that deadlines are met, tasks accomplished, and resources used appropriately.
Your team is designing the next generation of a smartphone and can’t agree on the approach
- Some group members want a revolutionary new design
- Other group members want an incremental update

Each group member should pick a side: evolutionary or revolutionary:
- Each group needs at least one member on each side

How would you converge on the approach to your next-generation design?

What would you do if some group members were not happy with this outcome?
TODAY’S SPEAKER

JIM FRUCHTERMAN

BENETECH