ME 4054W: SENIOR DESIGN PROJECTS
Professor: Jim Van de Ven

- Research: Machine Design Applied to Energy Conversion & Storage
Introductions

• Teaching Assistant:
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• Administrator:
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• Active Learning:

  “Tell me and I’ll forget;
  show me and I may remember;
  involve me and I’ll understand.” (Confucius)
Why Use Active Learning?

Research Shows it is Effective:

![Bar Chart]

Class Agenda

• Introductions
• Design Introduction
• Course Logistics
• Group Design Activity
• Basics of Design Process
• Course Goals
• Shop Safety Training
Peer Intros

- **Name Tag:**
  - Class
  - Where Grew Up
  - Adjective
  - Best Friend Describes You
  - Adjective
  - Mother Describes You

- **Meet Neighbor – Groups of 2**
  - Name
  - Where they are from
  - Something interesting about them

- **Introduce Neighbor to the Table**
Design Matters

"The Knowledge Economy as we know it is being eclipsed by something new -- call it the Creativity Economy"
Exercise

Originated with Bob McKim
   – Studied Design at Stanford

• Draw a Picture of Your Neighbor
   – 30 Seconds

• Reactions???
ME 4054W Course Objectives

To learn analysis driven engineering design by experiencing a complex, open-ended engineering design problem.

Students will:

- Work in teams
- Plan the project
- Apply engineering analysis
- Communicate progress through technical reports
- Experience life as a working engineer
ME 4054W Structure

- The course web site is at:  
  http://me.umn.edu/education/courses/me4054/

- The class meets as a whole for the lectures shown on the schedule. You are expected to attend each class meeting.

- The bulk of the course work, however, is concerned with your design project and the rest of the time on the schedule, plus time outside class, is spent working on your project.
Project Teams

• Most of the work in this course will be done as part of a team assigned to a specific project. Teams are typically four to six students and one or two advisors.

• There are 14 total projects and descriptions are posted on the class web site.

• You express your ranked project preferences on an online form.

• Students are assigned to teams by the course staff based on preference. You will generally get one of your choices, but even if not, you will land on a good project.
Schedule
Grading

- **Group**
  - Final Report/Design 25%
  - Design Documentation (drafts) 20%
  - Oral Presentations 10%
  - Project Plan 10%

- **Individual**
  - Midterm (design process) 10%
  - Notebook and contributions to website 10%
  - Technical Reports 10%
  - Peer Evaluations 5%
Course Layout Questions?
DESIGN PROCESS
OVERVIEW
As practiced in ME4054

(Ref: Chaps 1-2, Ulrich & Eppinger text)
Classic Failures

• Optimistic sales ramp up (< 3 yrs)
• Too far out there (Segway)
• Focus on features v. benefits
Habits of Effective Design Teams

• Study the customer
• Creativity
• Quick and dirty prototyping
• Objective evaluation
• Latest technology
• Established Design process
• Manage risk, abandon if necessary
Group Assignment (today)

Customer Based Design

Problem: Design a “widget” that would prevent slipping on ice when you are walking

Teams: divide into teams of 4 or 5 at your table
   2 team members must be customers (and only customers)

Presentation: up to 3 slides (ppt or paper), 5 minutes
   1. Widget design, with features
   2. Describe role of the customer
   3. Present one equation or physical principal used to develop the design

E-mail design with team names to vandeven@umn.edu
Design process...ideal

1. IDENTIFY OPPORTUNITY
2. GATHER INFORMATION
3. DEFINE PROBLEM
4. GENERATE CONCEPTS
5. SCREEN CONCEPTS
6. IMPLEMENT
7. HANDOFF

University of Minnesota
Driven to Discover
Design process...real

- Identify Opportunity
- Gather Information
- Define Problem
- Generate Concepts
- Screen Concepts
- Implement
- Handoff
Identify opportunity

- What’s the business opportunity
- Vision, corporate strategy
- Market trends
- Technology capability
- Emerging technologies
- Unmet needs

DELIVERABLE(S):
1. Project description
2. Mission statement
Understand the Customer

- Voice of the Customer (VOC)
- Who?
  - Market segmentation
  - Personas
- How
  - Observation
  - Interviews
  - Survey
  - Focus Group
Idea Generation

• External
  – Patents
  – Reverse engineering
  – Trade magazines, trade shows, stores
  – Experts
  – Users

• Internal
  – Brainstorming (many methods)
  – Solo storming
Concept Screening

- Define the metrics
- Include all stakeholders
  - Internal screen
  - Customer screen
- Be objective
- Step back and reflect

Ulrich and Eppinger, Product Design and Development, Exhibit 7-4
Engineering Design

• Analysis-based design
  – Use equations to ball park
  – Use computer simulations to fine-tune
  – Show that you know physics and engineering

• Get in the ball park with the prototype
  – But don't obsess over the details
Build Prototypes

• Quick and Dirty is good
  – Fast
  – Cheap

• Learn from the prototypes
  – Internal communication
    • Solo/Team
  – External communication
    • Customer
    • Boss

*If you have many prototypes, you will impress your client!*
Implementing the Design

• Analysis-driven design
• Simulation-aided design
• Prototyping
• Design for X (DfX)
  – Environment
  – Reliability
  – Assembly
  – Safety
Evaluating the Design

• Experimental validation of hardware
  – Design of Experiments

• Validation through simulation
Common ME4054 Errors

• Did not understand the problem
  – Background research
  – Knowledge of prior art

• Did not specify outcomes
  – Key part of project planning

• Did not use analysis
  – Key part of engineering design
  – Key metric in ME4054

• Did not document
  – Essential to all modern projects

• Team meltdown
  – Team management needed

• Under-delivered
  – Effective scheduling and task allocation
Design Show in 14 Weeks

Lots of people
Trade Show Booths
Prototypes
Judges
No Stress
ME4054W Opportunities

- Gain real-world design experience
  - Return value to client
- Design to customer needs
- Great job experience
  - Put on your resume
  - Networking
- Apply engineering science course analysis
- Learn to work in a team
- Learn to communicate as an engineer
Project Kick-Off on Thursday

• Read about the clients
• Read about the projects
  – Prior art?
Assignment (after class)

• Go to course website and use the online form to select your preferred project by noon on Wednesday (Sept 7, 2012)

• Bring 6 copies of your resume on Thursday for Team Meeting
Shop Safety Training

• Training video shown immediately after class
• Not necessary if you have completed training in last 12 months
• Sign attendance form after training
Feedback – 2 minute writing

• ½ Sheet of Paper
• No Names

• What are your goals for this course?
IP is Critical

• Value of company is in its intellectual property and the ability of staff to generate IP, not in the products
• VCs look at people more than at concept
• IP, utility patents
  – Provisional Patent
  – Patent Application
  – Issued Patent
## Companies Receiving Most U.S. Patents

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<th>2005 Rank</th>
<th># Patents</th>
<th>Company</th>
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<td>Canon</td>
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<td>Hewlett-Packard</td>
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Source: USPTO.gov