How might we most effectively prepare students to be able to use design "methods"?

a. Teach design methods as part of their capstone design experience.

b. Teach design methods in conjunction with the discipline-specific analysis methods.

c. You can't teach design methods, they need to learn by doing design projects.

d. Designers don't use methods, design is intuitive.

d. All, none or some of the above

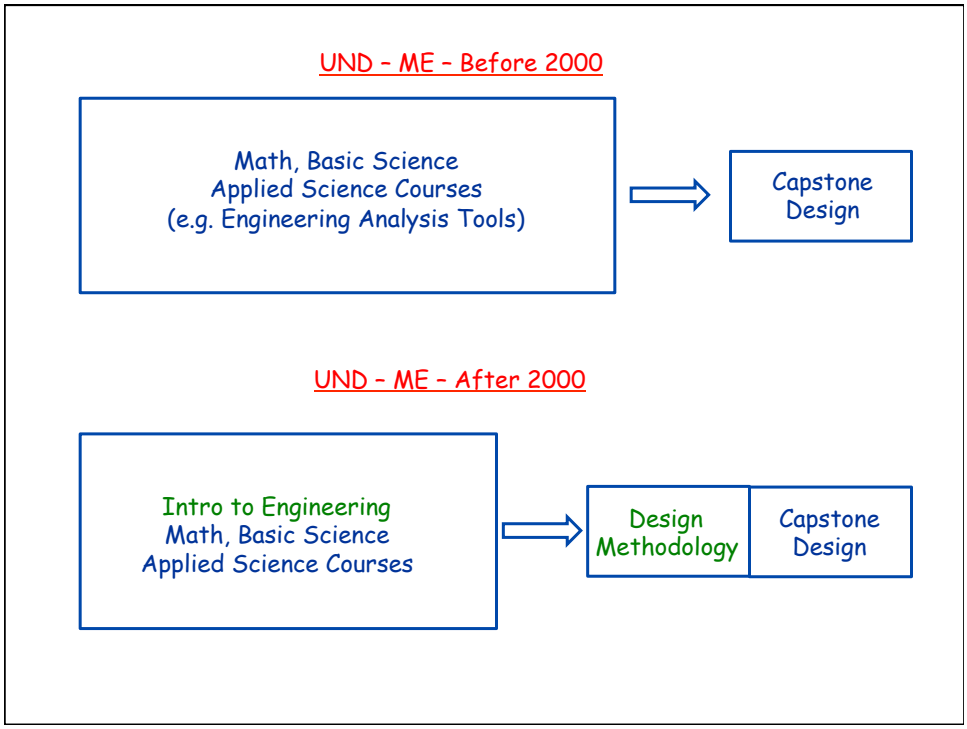
A personal journey:

70's – Government laboratory and research in automated design and optimization for aerospace systems

80's – Developed "design – build – fly" framework for aerospace design education - still in place today

90's – Began to explore more diverse products and systems. Adapted "design-build-fly" framework to ME program. Explored the role of uncertainty, risk and human decisions in design.

00's – Design methods vs. design automation, human-centered design vs. technology-driven design, IDEO, Technical University-Delft




# AME30362: Design Methodology

**Course Goals and Learning Outcomes:** This course provides the opportunity to learn and apply methods that assist mechanical engineers in the system and product design process. It involves both creative (right-brain) and analytic (left-brain) thinking and explores the role of each in design. It addresses topics related to the technical, business and human factors found in design. Emphasis is placed upon sustainable design and how it influences designers, design thinking and designing.

Upon completion of the course the student should be able to:

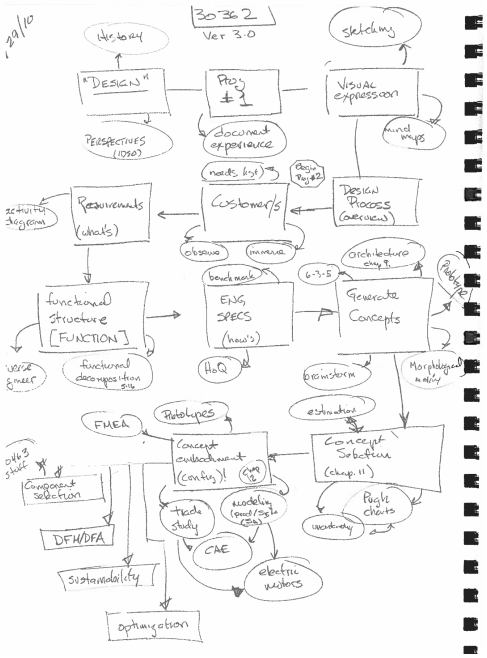
- Describe the various phases of the system and product design process.
- Apply various synthesis and analysis methods for concept generation, selection and evaluation.
- Use visual, written and oral means to communicate design concepts.
- Conduct an engineering parametric trade study.
- Solve basic engineering economics problems. (FE Exam)
- Describe engineering ethics guidelines. (FE Exam)

## How do you help them to…

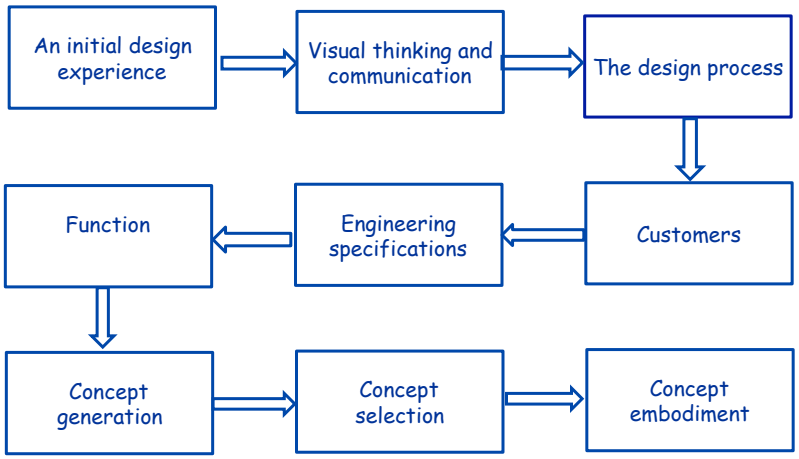
- Identity and comply with explicit written requirements
- Appreciate that design involves both synthesis and analysis and when to apply each
- Deal with the uncertainty associated with the co-evolution of the problem and the solution
- Be able and willing to provide constructive assessment and feedback on the work of others
- Cope with "effective / ineffective" versus "right /wrong"

## AME 30362 Fall 2010

How it evolved is a topic for another talk!



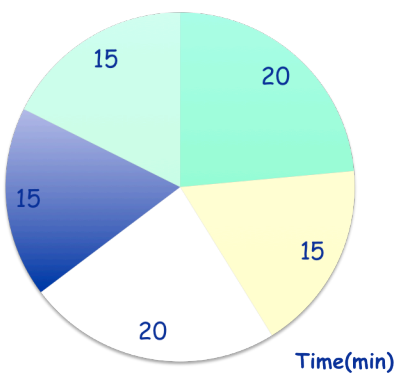
## The 30362 Process

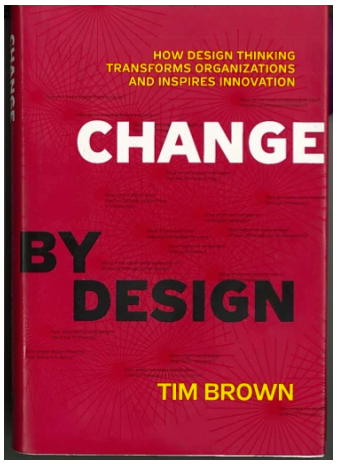



## Basic Ground Rules for AME30362:

- Limit of 20 min of lecture per class on new content
  - No more than 7-8 slides of basic content
  - Post all slides **after class** to archive content
- Discuss and post feedback on all HW, quizzes and projects
- An In Class Activity(ICA) each class – write and submit 'something'
- Homework will be peer reviewed prior to submission for grading
- Students re-work most assignments in response to peer and instructor assessment
- All graded assignments will have a performance expectation / grading rubrics (specifications)

## A "workshop" spread over 29 75-minute sessions with a lot of outside activities



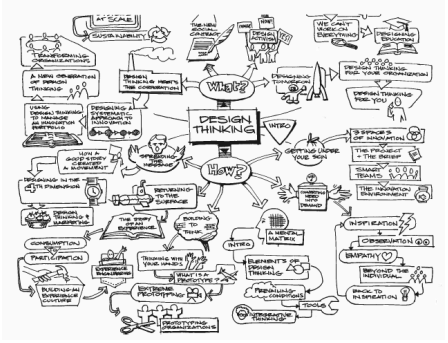




Change by Design
Tim Brown

ISBN-978-0-06-176608-4

Another IDEO contribution – this time from its head in 2009 so it highlights the evolution of design thinking from Kelley's earlier book.

Emphasizes how design influences more than just products.



# Example ICA: Solar Panel Array Design

You are designing a solar panel array and have the choice of two different panel types. The characteristics of the two available panel types are shown below. You're working to meet the following target design specifications for the assembled array:

- Power output >= 4500 W
- Weight <= 400 lb
- Surface area <= 150 $ft^2$

Determine if a combination of the two panel types can satisfy the requirements and determine the feasible combination that has the minimum cost.

http://en.wikipedia.org/wiki/Solar_panel

| | Panel 1 | Panel 2 |
|---|---|---|
| Area (ft2) | 8 | 3 |
| Weight (lb) | 25 | 8 |
| Output (W) | 250 | 100 |
| Cost ($) | 400 | 300 |



## PROJECTS:

Project 1: A design experience (Indiv.) 4-days
Up-cycle material from the waste-stream into a useful product

Project 2: Product Assessment and Redesign (Group) 8-weeks
For a selected product class, disassemble 2 products, assess the designs and propose the "next" generation concept

Project 3: Concept Design Study (Indiv.) 10-weeks
Using a sequence of 8 design methods (weekly homework), develop a design concept and prepare a portfolio for internal and external review

Project 4: Concept Assessment and Selection (Group) 3-weeks
Down-select from the concepts developed in Project 3

Project 5: Parametric Trade Study (Indiv.) 2-weeks
"What if" study for a multidisciplinary analysis of an electric vehicle

Project 6: Machine shop experience (Indiv.) 2, 1-hr sessions
Hands-on use or a mill or lathe to fabricate a simple part

# A typical "week"

| | Subject - Presentation | In-Class Activities | Student Presentations | Assign - discuss assignment | Due / Hand-in Collect | Pre-class reading or viewing due | Pre-class on-line submit |
|---|---|---|---|---|---|---|---|
| **Week 2** | | | | | | | |
| Session 3 8/28 | Intro to Visual thinking and expression using Mind maps (VUE) (15)<br><br>peer critiques (5) | Group disc of Proj. 1 (15) (assign groups of 4)<br><br>ICA - Mind map - human powered transportation (10) | Group pres of Proj #1 (10) (2-3 student groups)<br><br>Open discussion of Proj #1 experience (10) | (10)<br>Proj #3<br>Design study<br><br>Proj #6 (S-R)<br><br>CQ2<br>IDEO Deep Dive<br>Story of Stuff<br><br>HW #1 (mindmap) | Proj1 – 3-slides and log<br><br>ICA- human-powered transportation concept map | | |
| Session 4 8/30 | More visual thinking and expression, sketching, concept sketches (10)<br><br>e.g. flow charts | Peer assessment conversation for Proj. 1 - 1 on 1, (10)<br><br>ICA – flowchart (10) (proj 2 plan)<br><br>Group Wrk – Proj. 2 (20) | How might they have improved their product for Proj1 (10)<br><br>Comments on IDEO deep dive video and Story of Stuff (smb at IDEO?) (10) | (5)<br>for CQ3<br>GoD – E2 f<br>Rittel – Wicked problems<br><br>Session 5 HW1 | Proj1 peer critique<br><br>ICA – flowchart (proj 2 plan) | IDEO Deep Dive video | C-Quiz 2<br>Proj #1, Deep Dive, HF, TF, BF, convergent and divergent thinking, mind map experience |
| | | | | | | | |

# AME30362 Homework – Subjective Evaluations

- F – not submitted
- D – submitted but poor quality and key required elements missing
- C – submitted on time, complete and acceptable quality
- B – submitted on time, complete and good quality, suitable for a senior-level homework assignment at ND
- A – submitted on time, complete and of high quality, suitable for an entry-level professional portfolio


Design Portfolio
Mobile-Med